European Commission

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SIXTH NATIONAL COMMUNICATION AND FIRST BIENNIAL REPORT FROM THE EUROPEAN UNION UNDER THE UN FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC)

(required under the United Nations Framework Convention on Climate Change and the Kyoto Protocol)

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Accompanying Staff Working Documents:

Part 1: EU's 6th National Communication, SWD(2014)2, and Part 2: EU's first Biennial Report, SWD(2014)1

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I. EXECUTIVE SUMMARY

i. INTRODUCTION

The European Union (EU) and its 28 Member States, both individually and jointly, have been implementing domestic and international actions against climate change now for a considerable number of years, which resulted in significant emission reductions.

The Staff Working Documents accompanying this Communication constitute the 6th National Communication and the 1st Biennial Report of the EU, as required under Article 12 of the United Nations Framework Convention on Climate Change (UNFCCC) and Article 7 of the Kyoto Protocol, and under Decision 2/CP.17 of the Conference of the Parties under the UNFCCC, respectively. This Communication is an executive summary of these documents.

ii. NATIONAL CIRCUMSTANCES

The EU comprises 28 Member States with a population of 508 million. Croatia joined the EU as the 28th Member State on 1st July 2013. After the economic downturn due to the global financial and economic crisis in 2009, the EU saw economic growth in 2010 and 2011.

Energy policy since 1990 has resulted in a significant shift to less carbon-intensive energy use. Since the last National Communication, energy use per capita has continued to decrease even more strongly, with a short interruption in 2010. In addition, energy intensity has decreased steadily since 2006, except in 2010.

iii. GREENHOUSE GAS INVENTORY: THE EU ON TRACK TO OVERACHIEVE THE KYOTO TARGET FOR THE 2008-2012 PERIOD

In 2011, total EU-28 greenhouse gas (GHG) emissions without emissions and removals from land use, land-use change and forestry (LULUCF) and excluding emissions from international aviation, were 18.3 % lower compared to 1990 levels. Emissions per capita in the EU dropped by 24% between 1990 and 2011, from 11.8 t/capita, to 9 t/capita. Between 2010 and 2011, emissions decreased by 3.3 % in the EU-28, largely due to a strong emission decrease in households and services.

Emissions in the EU-28 have been decreasing while the economy has grown; the decoupling of economic growth from GHG emissions has been progressing steadily since 1990. Gross Domestic Product (GDP) growth for the 1990-2011 period was approximatively 44 % for the EU-15 and 45 % for the EU-28. Between 2010 and 2011 the EU-28 GDP increased by 1.4%, while GHG emissions fell by 3.3 %.

Under the Kyoto Protocol, the EU-15 has agreed to reduce its GHG emissions by 8 % compared to base year levels, during the first commitment period (2008–2012). Based on the latest available inventory data for 2011, total GHG emissions in the EU-15 were on an annual average 14.9 % below base year levels (without LULUCF). The EU-15 is therefore not only on track to achieve its Kyoto target, but will overachieve it. This is confirmed by the approximate data for 2012.[1] Furthermore, all the eleven Member States which acceded to the

[1] European Commission's Report on the Progress towards achieving the Kyoto and EU-2020 Objectives: http://ec.europa.eu/clima/policies/g-gas/docs/com_2013_698_en.pdf and EEA's Trends and Projections report: http://www.eea.europa.eu/media/newsreleases/climate-and-energy-targets-2013

EU as from 2004 and which have an individual Kyoto target, are expected to meet or over-achieve their commitments.

iv. POLICIES AND MEASURES

The EU sets its climate change mitigation objectives within the international commitment to limit the average global temperature increase to less than 2°C compared to pre-industrial levels.

At the 18th session of the Conference of the Parties (COP 18) in Doha in December 2012, the EU decided to take a 2nd commitment period of the Kyoto Protocol which will run from 2013 until 2020. As of 1st January 2013, all EU Member States implement the subsequent obligations. The EU's Climate and Energy package[2], adopted in 2009, provides an integrated package of policies and measures to implement these obligations and to tackle climate change up to 2020 and beyond.

The EU is continuously developing additional policies and measures to further reduce its emissions and to meet its emission reduction target to reduce its GHG emissions by at least 20 % compared to 1990 by 2020, with a conditional offer to move to a 30% reduction, provided that other developed countries commit themselves to comparable emission reductions and developing countries contribute adequately according to their responsibilities and respective capabilities.

Since the last National Communication, the main policies and measures at EU level include the full implementation of the Climate and Energy package, a new adopted Monitoring Mechanism Regulation, a new Energy Efficiency Directive, new 2020 targets for the CO_2 emissions of light commercial vehicles, a similar proposal for cars and a proposal to phase down hydrofluorocarbons (HFCs) sold.

Cross-cutting

The Climate and Energy package constitutes the backbone of the EU policies and measures to reduce GHG emissions. It includes the following 2020 headline targets:

- to reduce EU greenhouse gas emissions by at least 20 % compared to 1990 by 2020;.
- to supply 20 % of energy from renewable sources by 2020 (as a share of total EU gross final energy consumption), supplemented by a target to achieve a minimum of 10 % renewable energy in transport; and
- to reduce by 20 % the total primary energy consumption by 2020, compared to a business as usual baseline.

Many existing EU-level policies and measures are being strengthened to meet these targets. This includes in particular the following cross-cutting legislative developments:

- The EU Emissions Trading System (ETS) has been revised and strengthened based on lessons learned. The third phase (2013-2020) has successfully started. The changes include a single, EU-wide emissions cap, auctioning of new allocations as default allocation method, harmonised allocation rules based on EU-wide

[2] http://ec.europa.eu/clima/policies/package/index_en.htm; The six corresponding legislative acts were published in the Official Journal of the European Union in June 2009 (5.06.2009 L40) and are already in force.

performance benchmarks for free allocation, additional sectors and gases included. The EU ETS covered on average 41 % of total EU-28 GHG emissions during the period 2008-2012. Due to the financial crisis and the significant use of emission reduction credits from abroad, a surplus in allowances has accumulated in recent years leading to a drop in the price. The Commission has made a proposal on how to address this issue in the short term, and explores structural reform measures.

- In the context of the EU Effort Sharing Decision, EU Member States have taken on binding annual targets (for each year from 2013 to 2020), reducing their GHG emissions from the sectors not covered by the EU ETS, such as housing, agriculture, waste and transport (excluding aviation), and a thorough annual compliance system has been established.
- The revised and strengthened Monitoring Mechanism Regulation entered into force in 2013. It enhances current reporting rules on GHG emissions to implement the Climate and Energy package and to meet requirements arising from current and future international climate agreements.

With regard to the EU's future climate strategy, the Commission adopted policy documents to promote the discussion on the long-term framework of climate and energy policies in Europe. It includes a roadmap on moving towards a competitive low carbon economy in 2050, a White Paper on competitive and efficient transport systems, a roadmap on energy and a bioeconomy strategy. Furthermore, the Commission adopted a Green Paper to launch a public debate on the preparation of the EU climate and energy framework for 2030.

Energy

Significant progress has been made to meet the 20% renewables target by 2020 laid down in the Climate and Energy Package. The share of gross final consumption of energy met by renewables has increased substantially over the last ten years to around 13 % in 2011. A substantial increase can be seen from renewable heat production, wind power generation and photovoltaics whereas hydro power production has been relatively constant. At national level, EU Member States prepared National Renewable Energy Action Plans and most Member States experienced significant growth in renewable energy, and are on track to meet their national binding targets. At present, many Member States are reviewing their national support schemes to improve the overall cost efficiency of policies on renewables. The Strategic Energy Technology Plan is guiding Member States since 2007 in prioritising the development of innovative solutions which will respond to the needs of the European energy system by 2020, 2030 and beyond.

A wide range of policies and measures were also introduced to promote energy efficiency, most recently the Energy Efficiency Directive. This Directive aims at keeping the EU's energy efficiency target on track and explicitly sets goals for primary and final energy consumption by 2020.

Overall, a de-carbonisation of the energy sector has been experienced, as highlighted by the following data: the consumption of carbon-intensive coal and lignite decreased by 37 % by 2011, compared to 1990, while gas consumption increased by more than 30 %. Renewables have seen the most marked increase with consumption increasing by over 120 % in 2011 from 1990 levels.

Transport

CO_2 emissions of new light duty vehicles are targeted by recent regulations which aim at reducing emissions of the new passenger cars by 40 % and emissions of new light commercial vehicles by 28 % by 2020, compared to the average of new light duty vehicles in 2007. These efforts are supplemented by environmental performance requirements such as tyre pressure monitoring systems and gear shift indicators.

In order to reduce fossil fuel consumption, the Fuel Quality Directive also introduced a binding target for fuel suppliers to reduce life-cycle GHG emissions per unit of energy by up to 6 % by 2020, compared to 2010. In addition, in 2013 the Commission adopted the Clean Power for Transport Package which supports the broad deployment of alternative fuels vehicles and vessels and the relevant infrastructures in Europe.

As a result of the regulations, significant progress has been made to reduce the average CO_2 emissions of the new passenger car fleet and meet the binding targets set at 130 g CO_2/km by 2015 and 95 g CO_2/km by 2020. Average emissions decreased to 132.2 g CO_2/km in 2012, compared with the 2007 fleet average of 158.7 g CO_2/km.

Transport activity has steadily increased in the EU since 1990 up until the economic crisis in 2008. Freight transport growth was largely in line with real GDP growth until the economic crisis, followed by a strong decline in 2008 and 2009 and a recovery in 2010. Passenger transport has grown slower than real GDP since 1995. Overall, GHG emissions from transport have grown until 2007, albeit at a slower pace than real GDP, and are decreasing since, showing the decoupling of transport emissions from GDP.

Industry

Emissions from industrial processes have significantly decreased by 27.5% since 1990 and have continued to decrease since the last National Communication. Most GHG emissions from industry are covered under the EU ETS.

Furthermore, emissions from Fluorinated gases are regulated, leading to a cumulative reduction of 2,861 kt CO_2 eq by 2010, since the corresponding legislation was adopted in 2006. Furthermore, a proposal to strengthen this legislation is under consideration by the European Parliament and the Council. It aims at limiting the use of F-gases in new equipment and introducing a phase-down measure of HFCs combined with some bans on use.

The new Industrial Emissions Directive (IED) also aims at achieving significant benefits to the environment and human health by reducing polluting emissions to the atmosphere, water and soil, as well as waste from industrial and agricultural installations, in particular through better application of Best Available Techniques (BAT).

Agriculture

Total GHG emissions from the agricultural sector decreased by 23.1% between 1990 and 2011.

In recent years, environmental considerations including climate change mitigation have gradually been integrated into the EU's Common Agricultural Policy (CAP). The new CAP (covering the period 2014-2020) will further enhance the existing policy framework for sustainable management of natural resources, contributing to both climate change mitigation and enhancing the resilience of farming to the threats posed by climate change and variability.

Furthermore, legislation (the Nitrates Directive) is in place, to contribute to decreasing CH_4 and N_2O emissions from agricultural activities. The European Soil Thematic Strategy also aims at preventing soil degradation and preserving soil as an important carbon pool.

Forestry

The new EU Forest Strategy provides a framework that coordinates and ensures coherence of forest-related policies and allows synergies with other sectors that influence forest management. Member States are asked to consider the principles and goals of this strategy when setting up and implementing their action plans and national forest programmes. The new EU legislation on GHG accounting rules for LULUCF activities (going beyond forestry) lays down rules for the robust accounting in this sector. It will support the mitigation potential of this sector by improving the visibility and tracking progress of mitigation efforts.

Waste

Since the last National Communication, focus has been put on the full and timely implementation of the EU waste legislation, which contributes directly or indirectly to a reduction of GHG emissions.

v. PROJECTIONS: THE EU ON TRACK TO MEET THE KYOTO TARGET FOR 2020

The latest available GHG projections by Member States (which take into account the implementation of the Climate and Energy Package) show that the EU-28 will collectively overachieve its 2020 target.

- Under the "With Existing Measures" (WEM) scenario, total GHG emissions (excluding international aviation) are projected to be 22 % lower in 2020 than in 1990 and 24% lower in 2030 compared to 1990.
- Under the "With Additional Measures" (WAM) scenario, as reported by Member States, the projected GHG emissions compared to 1990 would decrease by 26% in 2020, and 30% in 2030.

The WEM sensitivity analysis confirms the projected 2020 target achievement. The 2030 results are more uncertain and more dependent on the assumptions made. However, the sensitivity analysis confirms for 2030 the order of magnitude indicated by the WAM scenario results.

The most significant sectoral contribution in absolute GHG emission reductions in the EU-28 WEM scenario from 1990 to 2020 is projected to stem from the energy sector (1051 Mt CO_2eq), followed by agriculture, industry and the waste sector. GHG emissions in the transport sector are projected to increase by 18 % compared to 1990 levels. If additional measures are also considered (WAM scenario), the pattern of sectoral shares in emission reductions remains the same, while the emissions growth in the transport sector in EU-28 is less prominent (12 % increase by 2020 compared to 1990 levels).

Reductions in CO_2 emissions are expected to contribute most to overall emission reductions in the EU-28. Under the WEM scenario, CO_2 contributes to 70% of the aggregate GHG emission reductions in 2020 compared to 1990, followed by CH_4, and N_2O.

vi. IMPACTS, VULNERABILITY AND ADAPTATION

While reducing GHG emissions is of paramount importance to avoid dangerous climate change, the EU also recognises that some climate change impacts are unavoidable because of past emissions. The EU has therefore undertaken research and taken action to understand these impacts, develop adaptation responses and assist developing countries in strengthening their capacity to cope with climate change. Since the 5th National Communication, progress has been made on assessing the impacts of climate change and developing adaptation policies across Europe. Comprehensive information on past and projected climate change and related impacts has been published for Europe, in particular as part of the European climate adaptation platform (Climate-ADAPT).

Action has been strengthened since the 5th National Communication in particular through the EU Strategy on adaptation to climate change, which was adopted in 2013. The strategy aims at contributing to a more climate-resilient Europe, by encouraging and supporting actions by Member States, promoting adaptation in key vulnerable sectors at EU level, and ensuring better-informed decision-making.

vii. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

The information reported refers in principle to financial resources and transfer of technology by the EU alone. Information on financial resources and transfer of technology by the EU's Member States can be found in their respective National Communications.

Improved access to funding will be a critical factor in building a climate-resilient Europe. As a result, all EU institutions have agreed that at least 20% of the overall EU budget for the period 2014-2020 should be climate related. This represents nearly a tripling of the current climate related share of the EU budget.

The EU is strongly committed to continue assisting developing countries in the fight against poverty and the achievement of the UN Millennium Development Goals. Combating climate change forms an integral part of this agenda. In recent years specific cooperation on climate change has been strengthened significantly across a range of different frameworks.

Providing more than half of the world's total Official Development Assistance (ODA) and with the fight against poverty at the core of the EU's external and development cooperation policies, the EU attaches an increasing importance to climate finance in its ODA. The EU has increased the amount of financial support to mitigation and adaptation action in developing countries.

EU multilateral and bilateral financial contributions related to climate change have steadily increased over the last few years, peaking at € 734 million in 2012. Between 2008 and 2012, the EU commitments to support climate relevant activities in developing countries amounted to € 3.0 billion.

The EU and its Member States also committed € 7.3 billion for "Fast-Start Finance" over the period 2010-2012, thus exceeding its goal adopted at the Conference of the Parties in 2009 (COP15) of € 7.2 billion.

The EU has also increased its focus in supporting the poorest and most vulnerable countries, especially by the implementation of initiatives such as the Global Climate Change Alliance (GCCA) and increased financial support to adaptation.

In 2007, the EU pioneered the establishment of the GCCA. The GCCA is now a well-established mechanism and a reference for future actions. Back in 2008, the GCCA was working with four countries. By the end of 2012, over 45 GCCA programmes are either up and running or in preparation in more than 35 countries within an envelope of € 290 million.

Support to adaptation action has seen increased importance during the reporting period. Most of the climate change support provided by the EU is channelled through projects in which climate change is not the principal policy objective, thus demonstrating the success of the climate change mainstreaming efforts.

Furthermore, a number of climate change activities involving technology transfer are funded through the EU budget, most notably in the area of research.

Capacity development is also at the heart of the EU development assistance. In line with this policy, the EU supports a wide range of climate-related capacity development actions in third countries, including strengthening local institutional capacity for adaptation, mitigation, climate financing, integration (mainstreaming) of climate change into national policies, as well as support to the participation in the international climate change negotiation process.

As part of the EU budget for 2014-2020, new external financial programmes have been set up to support developing countries, with climate change as a key objective. This concerns in particular key instruments such as the Development Cooperation Instrument and the Partnership Instrument, where the already mentioned objective of climate action objectives representing at least 20% of EU spending in the period 2014-2020 equally applies.

viii. RESEARCH AND SYSTEMATIC OBSERVATION

Research is a shared competence of the EU and its Member States. Only actions coordinated at EU level are reported in the EU National Communication.

The EU contributes to Research and Systematic Observation (RSO) through the involvement of multiple actors and through a suite of instruments, tools and programmes and across multiple sectorial policies including:

- EU Framework Programmes (FPs) for Research and Technological Development
- LIFE+ (EU's funding instrument for the environment)
- Competitiveness and Innovation Framework Programme
- International Development Cooperation
- Contribution to and/or financial support for major international institutions, research initiatives and programmes such as the UNFCCC, the Intergovernmental Panel on Climate Change (IPCC) and the Global Climate Observing System (GCOS), among others.

A suite of instruments, tools and programmes such as the Seventh Framework Programme for Research and Technological Development (FP7) – to be continued from 2014 with the Framework Programme for Research and Innovation (Horizon 2020), the Strategic Energy Technology (SET) plan, and NER300, provide funds for research and technology development across multiple sectorial policies in the EU.

FP7 has been the most important EU financial mechanism to support research on climate change and the development of energy technologies, including cooperation with non-EU countries. While some calls are still open and a final figure cannot yet be given, a rough estimation indicates that from 2007 to 2013 in FP7 over € 800 million were spent on supporting climate change research. The majority of the funding was provided for collaborative research projects within the 'Cooperation[3]' programme, complemented by other funding for research infrastructures for climate observations and modelling and for investigator-driven 'frontier' research awarded by the European Research Council (ERC)[4]."

A new EU research and development programme (Horizon 2020) has been set up for the period 2014-2020. It contains the objective of reaching 35% climate related expenditures.

ix. EDUCATION, TRAINING AND PUBLIC AWARENESS

The EU has been investing a significant amount of effort and resources to increase the awareness of the Europeans to the challenges posed by the impacts of climate change and to the opportunities arising from, in particular, climate change mitigation. In that respect, actions in the field of education and training, in addition to EU-wide awareness raising campaigns, have played a major role. Of such activities, the communication campaign – A World you like with a Climate you like - can be highlighted.

x. CONCLUSION

The domestic and international actions implemented by the EU and its Member States against climate change through the climate and energy package, resulted in significant emission reductions, and the GHG reduction trends continue, with a clear decoupling of economic growth from GHG emissions. Enhanced action has also been taken to assess the impacts and to adapt to climate change, in particular through the new EU strategy on adaptation to climate change. Furthermore, by strengthening the support and assistance provided to developing countries, the EU has helped enhanced action globally.

3 http://cordis.europa.eu/fp7/cooperation/home_en.html

4 http://erc.europa.eu/

SIXTH NATIONAL COMMUNICATION FROM THE EUROPEAN UNION UNDER THE UN FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC)

1. INTRODUCTION

This document represents the European Union's (EU) 6th National Communication (NC) required under the United Nations Framework Convention on Climate Change (UNFCCC), as reaffirmed by UNFCCC decision 9/CP.16 and UNFCCC decision 2/CP.17. It provides a comprehensive overview of climate change-related activity at the EU level.

As defined in the UNFCCC reporting guidelines for National Communications[5], the information is structured into:

- National circumstances relevant to greenhouse gas emissions and removals (section 2),
- Greenhouse gas inventory information (section 3),
- Policies and measures (section 4),
- Projections and the total effects of policies and measures (section 5),
- Vulnerability assessment, climate change impacts and adaptation measures (section 6),
- Financial resources and transfer of technology (section 7),
- Research and systemic observation (section 8) and
- Education, training and public awareness (section 9)

UNFCCC decision 2/CP.17 also requires the EU to submit its 1st Biennial Report (BR) by 1st January 2014. The UNFCCC reporting guidelines for National Communications content-wise overlap with the UNFCCC biennial reporting guidelines for developed country Parties (Annex I of decision 2/CP.17).

As endorsed in UNFCCC decision 2/CP.17, the EU has opted to submit its 1st Biennial Report as Annex 1 to this 6th National Communication. The tables as defined in the common tabular format (CTF) for the UNFCCC biennial reporting guidelines for developed country Parties (UNFCCC decision 19/CP.18) are enclosed as Appendix: CTF for EU 1st Biennial Report of Annex 1: EU 1st Biennial Report. For the CTF submission to the UNFCCC, the electronic reporting facility provided by the UNFCCC secretariat has been used as required by UNFCCC decision 19/CP.18.

In order to avoid unnecessary duplication of information, overlapping contents were concentrated in the 1st Biennial Report: Those sections of the 6th National Communication's main body which content-wise would be identical to sections of the 1st Biennial report, do thus solely contain a reference to the corresponding section of Annex 1 (1st Biennial Report) and/or the CTF Appendix to Annex 1. To facilitate user-friendliness, whenever a reference is made to chapters in the Biennial Report text, these are clearly marked with [BR1] before the relevant chapter number in the Biennial Report.

5 FCCC/CP/1999/7 part II, in combination with UNFCCC decision 15/CMP.1

The 28 Member States of the European Union submit separate NCs to the UNFCCC. However, in the EU's submission the chapters on greenhouse gas inventory information (see section 3) and projections (see section 5) reflect the sum of information compiled across the Member States.

A summary table outlining the location of supplementary information required under Article 7, paragraph 2, of the Kyoto Protocol within this National Communication is provided in the appendix to this document.

2. NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

Key developments

Population

- Croatia joined the European Union as 28th Member State on 1 July 2013. The EU-28 population has continued to grow, at around 0.3 % per annum, a similar trend to the NC5.

Economy

- EU-28 real GDP was 45 % higher in 2011 compared to 1990 although growth rates declined significantly in 2008-2011. Economic growth was mainly driven by growth in the service sector and in international trade. In 2009 the EU-28 faced a severe economic crisis in the aftermath of the financial crisis in 2008.
- The economic crisis was characterised by declines in international trade, industrial production, gross inland energy consumption, transport volumes and GHG emissions, to name but a few indicators. However, after the economic downturn in 2009, the European Union saw economic growth in 2010 and 2011 and many of these indicators increased again (although at a lower pace).

Energy

- Total gross inland and final energy consumption grew over the period from 1990-2006 (around 0.5 % per annum), and declined thereafter. In 2011 gross inland energy consumption was 3 % above the value of 1990.
- The economic trend in recent years is mirrored in the strong decline of energy consumption in 2009 and an increase in 2010; the decrease of energy consumption in 2011 is mainly due to milder winter conditions in that year.
- The trend reported in the NC5 of a shift in the primary fuel mix from coal to gas has slowed down in recent years. However, since 2000 a shift from oil to renewables can be observed.
- The rate of growth in renewables (driven largely by wind and biomass) has increased from 2002 onwards. The share of renewables in gross inland energy consumption increased from 6 % in 1990 to 13 % in 2011.

Transport

- Both freight and passenger transport grew strongly since 1995 up until the economic crisis in 2008. Freight transport showed a strong decline in 2008 and 2009, followed by a slow recovery in 2010, whereas passenger transport remained relatively stable.

Agriculture and forestry

- In 2009, agricultural use and forestry use accounted for 43 % and 30 % respectively of the land used in the EU.

- Overall the area of land under agricultural use decreased by approximately 3 % since 2000 whereas the forested area increased by 3 %.

2.1. Introduction

This chapter documents the national circumstances of the European Union. It illustrates a number of key characteristics that relate directly or indirectly to the greenhouse gas emissions and include energy, transport, land use, climatic conditions and trade patterns. The chapter analyses how these various factors have influenced greenhouse gas emissions to-date and how the historic trends observed might influence emissions going forward.

Data is reported as the aggregate of the Member States which comprise the European Union (EU), both the EU-15 and EU-28 (where data is available), as the former has a collective emissions reduction target under the Kyoto Protocol. Information is also reported at the Member State level where appropriate. In some cases, data was not available for Croatia, and EU-27 figures were considered instead.

The 5th National Communication focused primarily on the period from 1990 to 2007. This communication extends the analysis to the most recent years for which data is available (generally 2008 to 2011); changes in trends since 2007 are highlighted, where relevant.

This chapter includes the following improvements compared to the NC5:

- more detail on legislative arrangements and administrative procedures;
- a new map showing the population density in the EU-28;
- improved presentation of the distribution of land cover and land use types;
- more information on climatic conditions including annual precipitation and mean daily temperature;
- a comparison of purchasing power standards (PPS) per capita of all Member States;
- more detail on the impact of the global economic downturn;
- production data of energy intensive industries such as iron and steel and cement production;
- a time series showing the development of waste generation and treatment;
- a breakdown of types of housing;
- different types of energy sources used for space heating;
- development of the unit consumption of energy in households;
- information on fertilizer consumption and livestock in the EU;
- a comparison of the total forested area in 2000 and 2010;
- the chapter “Liberalisation and privatisation of energy markets” is no longer included.

2.2. Government Structure

The European Union's institutional system is unique in the world. The Member States, currently 28, confer competences upon the Union to attain objectives they have in common. The competences conferred upon the Union are set out in the Treaties[6], which are international agreements serving as the founding core legal acts establishing the Union and regulating its relations with the Member States. Competences not conferred upon the Union in the Treaties remain with the Member States. The Treaties also create the Union's institutions, which are independent from Member State national authorities, and aim to promote the Union's values, advance its objectives, serve its interests, those of its citizens and those of the Member States, and ensure the consistency, effectiveness and continuity of its policies and actions. The Union institutions comprise:

- the European Parliament,
- the European Council,
- the Council,
- the European Commission,
- the Court of Justice of the European Union,
- the European Central Bank,
- the Court of Auditors.

The major policy-making bodies are the European Parliament, the Council and the Commission who drive the majority of policy initiatives, including on climate action.

The Members of the **European Parliament** are directly elected by citizens every five years. The European Parliament has four essential functions:

- It shares with the Council the power to legislate, i.e. to adopt European legislative acts (directives, regulations, decisions).
- It shares budgetary authority with the Council and can therefore influence EU spending.
- It has to be consulted, and in some specific instances it has to give its consent, before the conclusion of an international agreement with third countries or international organisations.
- It exercises democratic supervision over the European Commission. It elects the President of the Commission, approves the nomination of Commissioners and has the right to censure the European Commission.

The **Council of the European Union** consists of representatives of each national government at ministerial level. It is the main decision-making body and has a number of key responsibilities:

- It is the Union's legislative body in co-decision with the European Parliament.
- It co-ordinates the broad economic policies of the Member States.

6 The last revision of the Treaties was signed in Lisbon and entered into force on 1 December 2009. The consolidated versions of the current Treaties can be found at: http://eur-lex.europa.eu/JOHtml.do?uri=OJ:C:2012:326:SOM:EN:HTML.

- It concludes, on behalf of the EU, international agreements with one or more third states or international organisations.
- It shares budgetary authority with the Parliament.
- It takes the decisions necessary for framing and implementing the common foreign and security policy, on the basis of general guidelines laid down by the European Council.
- It co-ordinates the activities of the Member States and adopts measures in the fields of police and judicial co-operation in criminal matters.

The **European Council** is the formation of the Heads of State or Government of the Member States, together with its President and the President of the Commission. The High Representative of the Union for Foreign Affairs and Security Policy participates in the work of the European Council. The European Council defines the general political directions and priorities of the European Union, but has no legislative powers.

The **European Commission** embodies and upholds the general interest of the Union. The President, the High Representative of the Union for Foreign Affairs and Security Policy and the other Members of the European Commission are appointed by the European Council after they have been approved by the European Parliament. In carrying out its responsibilities, the Commission is completely independent, i.e. it can neither seek nor take instructions from any government or other institution, body, office or entity. The **Commission** has the following main functions:

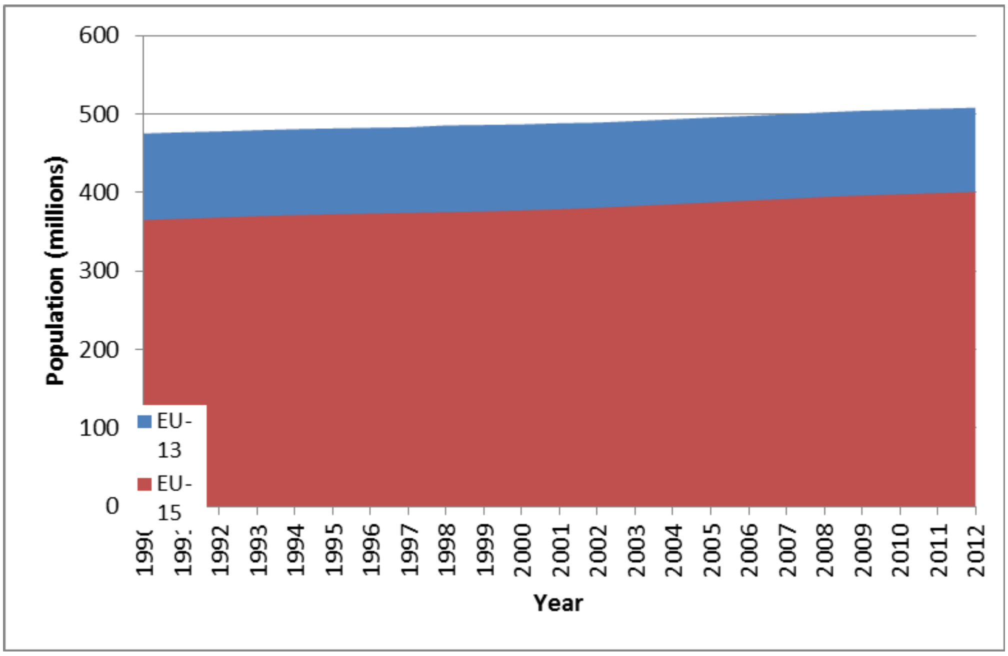
- It has the right to initiate draft legislation and present legislative proposals to the Parliament and the Council.
- As the Union’s executive body it is responsible for implementing the European legislation, budget and programmes.
- It acts as guardian of the Treaties and, under the control of the Court of Justice, ensures that Union law is applied properly.
- It represents the Union on the international stage and negotiates international agreements with third countries and international organisations.

The remaining institutions cover the judiciary (Court of Justice), the central monetary authority (European Central Bank) and the external audit authority, responsible for carrying out the audit of EU finances (European Court of Auditors).

2.3. Population profile

While population growth is generally considered a driver for greenhouse gas emissions and for increasing energy consumption, the population trends in the EU do not seem to have played a major role in emission trends since 1990. Over the last 22 years the EU-28's population has increased by an average of 0.3 % annually. The total population increase in 2012 compared to 1990 was 6.9 %. In 2012, the EU-28 population amounted to 508 million people. A similar trend is observed in the EU-15 countries, with an annual average increase of around 0.4 % over the same period. The trend has not changed significantly since the publication of NC5. Trends in per capita primary energy consumption are shown in section 2.7.

Figure 2-1 Aggregate EU - 28 population 1990-2012

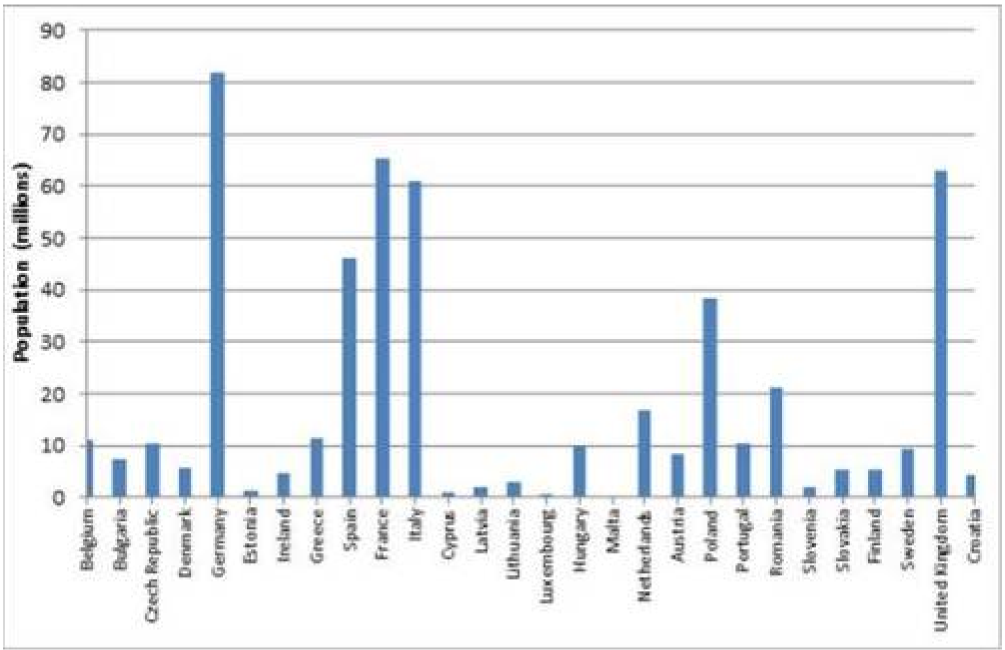


Source: Eurostat and INSEE

Note: Population on January 1st of each year. Data for population in French overseas territories in 1990 is based on data from the French statistical office INSEE.

The populations of Member States vary considerably, from 0.4 million for Malta to 81.1 million for Germany.

Figure 2-2 EU Member States populations, 2012



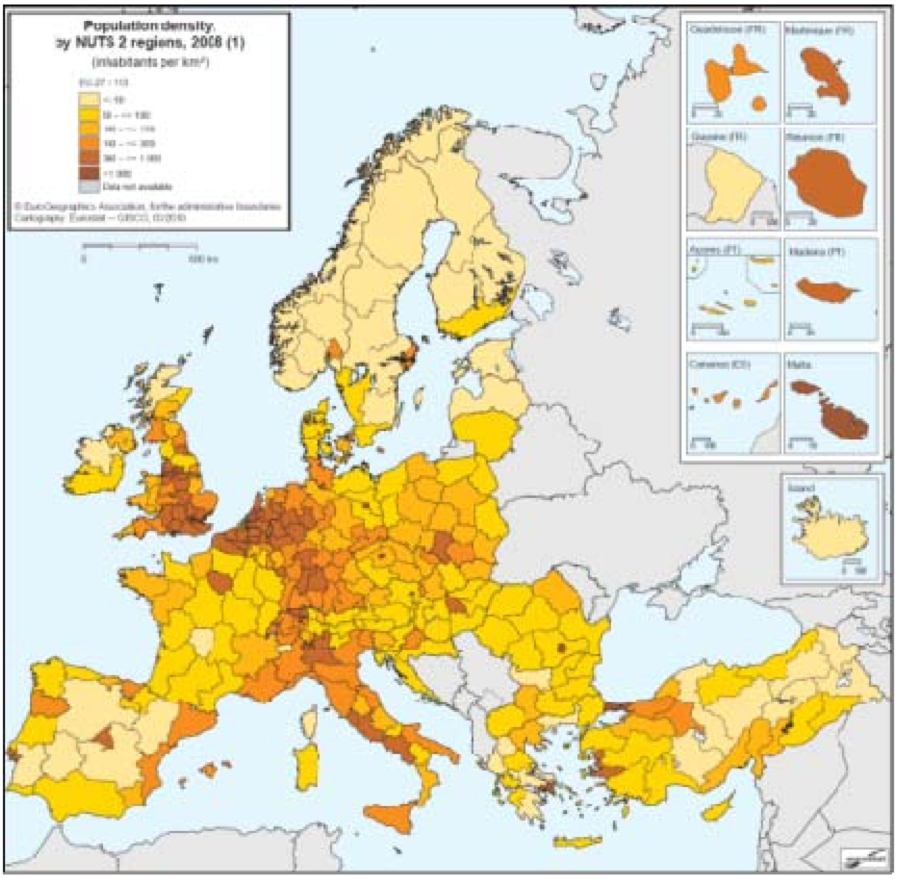
Source: Eurostat , INSEE

Note: Population on January 1st of each year. Data for population in French overseas territories in 1990 is based on data from the French statistical office INSEE.

In addition, population density varies between 17.7 inhabitants/km² in Finland and 1318.6 inhabitants/km² in Malta. The five states with the highest population density are Malta, the Netherlands, Belgium, the United Kingdom and Germany, with population densities of over 200 inhabitants/km².

Most EU Member States have relatively high population densities when compared to other Parties to the UN Convention. As higher population densities have implications on settlement and building patterns, this leads to changes in energy consumption and a tendency for shorter transport distances. However, shorter transport distances may facilitate economic integration among communities and regions, resulting in a tendency for higher transport intensity. In this respect, population density can have both a positive and negative impact on greenhouse gas emissions.

Figure 2-3 Population density of the EU-28 and selected neighbouring countries.



Source: Eurostat CISCO (2010)

Note: NUTS (Nomenclature of territorial units for statistics) regions on level 2 are basic regions for the application of regional policies, typically based on existing administrative divisions of Member States, with populations between 800 000 and 3 million people. Population density is based on the total area of the regions, including inland waters. Croatia and Scotland (UK), the density is based on land surface, excluding waters. The illustration also includes the non-EU countries Switzerland and Norway, FYR of Macedonia and Turkey.

2.4. Geographic profile

The European Union is situated primarily in Europe, with the exception of some French, Danish and British overseas territories. It spans a total area of 4 423 147 square kilometres, with a large coastline, which is 136 106 km long[7]. The EU topography is therefore diverse, including mountains, lakes, rivers, forests and plains. The EU is also highly urbanised, with 41 % of the population living in urban regions, 35 % in intermediate regions and 23 % in rural regions[8].

The distribution of land cover types varies widely across the EU. The most frequent land cover types in the EU are woodland, cropland and grassland. Forests cover 41.2% of the EU surface. The most forested country is Sweden with a forest area of 75.6 %,

7 Eurostat, “Key figures for coastal regions and sea areas”, Statistics in focus, 2009. http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-09-047/EN/KS-SF-09-047-EN.PDF. Accessed on: 24.07.2013.

8 Eurostat, “Urban-intermediate-rural regions”, News release, 30 March 2012, http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/1-30032012-BP/EN/1-30032012-BP-EN.PDF. Accessed on: 24.07.2013.

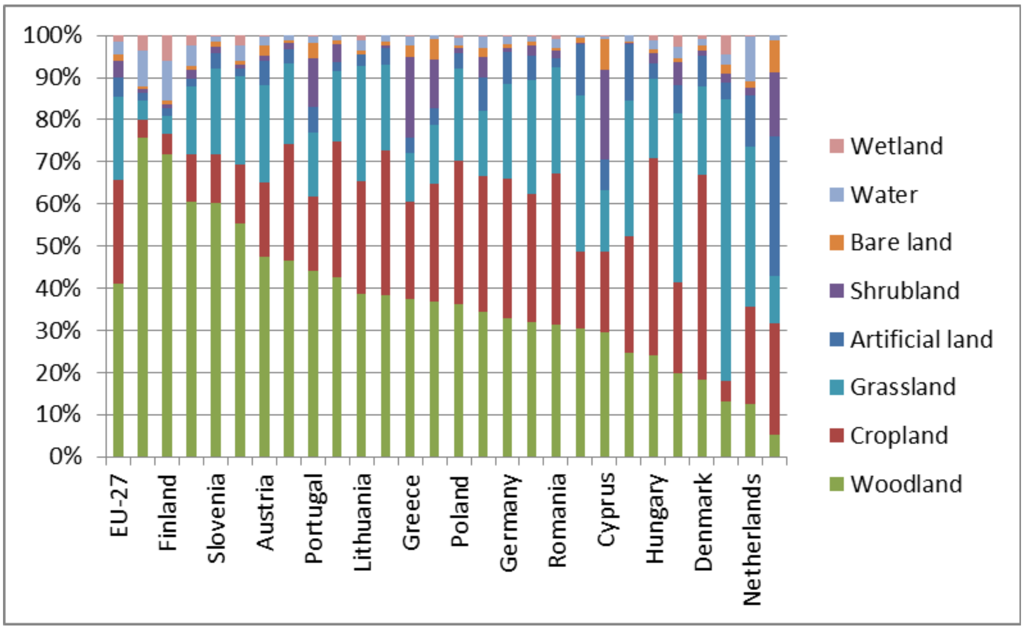
whilst the least forested country is Malta where forests represent only 5.1 % of the total area. In general, northern and alpine regions tend to have larger proportions of woodland.

Concerning cropland, 24.7 % of the total EU area is covered by arable land or permanent crops. In Denmark and Hungary, more than 45 % of the country area is covered by cropland. The lowest proportion of cropland cover was recorded in Finland, Ireland and Sweden (less than 5 %).

Grasslands (including natural and agricultural grasslands) are the dominant land cover in Ireland (67.1 %), the United Kingdom (40.1 %) and the Netherlands (38.0 %). The EU average of grasslands amounts to 19.5%. Other land use types are shrubland, artificial land, water, bare land and wetland which contribute to 15.2 % of the total EU land cover.[9]

9 LUCAS 2012, Land cover overview, http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lan_lcv_ovw&lang=en. Accessed on: 28.11.2013.

Figure 2-4 Main land cover by land cover type, 2012 (% of total area)



Source: Eurostat LUCAS

Note: No data available for Croatia.

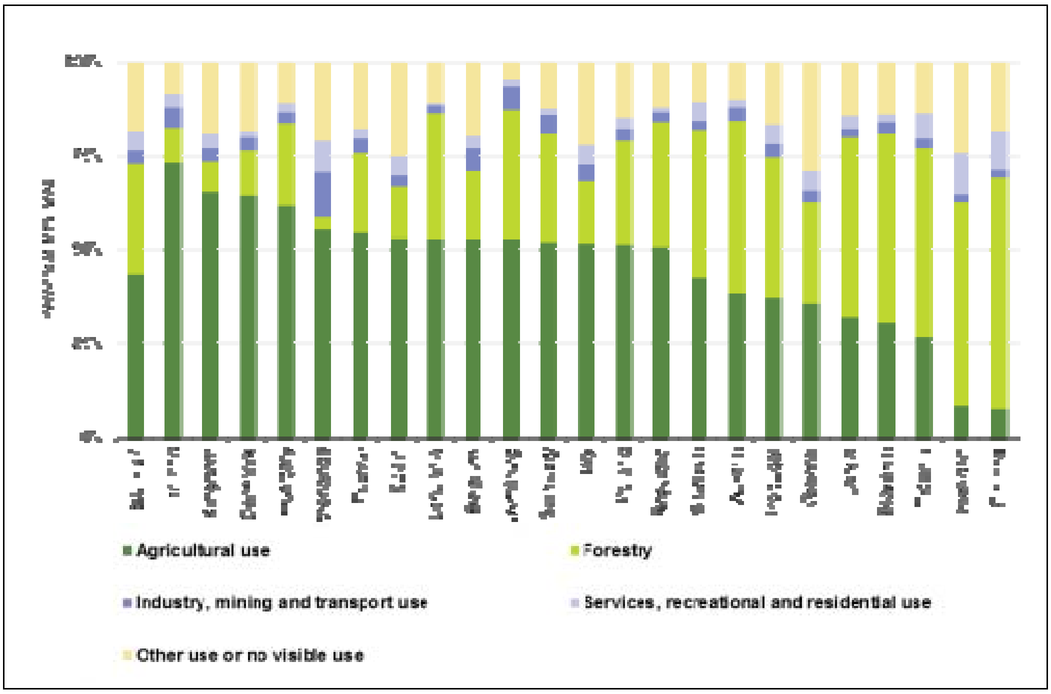
As a consequence, the highest proportion of agricultural land use was reported in Ireland, the United Kingdom, Denmark and Hungary (more than 60 % of total area). On the other hand, forestry is the predominant land use type in Finland, Sweden and Slovenia (more than 50 % of total area).

The EU-wide share of land use types is distributed as follows: 43 % agricultural use, 30 % forestry, 5 % services, recreational and residential use, 2.4 % industry, mining and transport use and 18.8 other or no visible use.[10]

Agriculture generates significant greenhouse gas emissions, this is discussed in more detail in section 2.12. Forest and other wooded areas however can be important carbon sinks (see section 2.13 for further details). Changes in land use will be driven to some extent via policy actions in the agricultural sector (see section 4.8), particularly the Common Agricultural Policy as well as those in the forestry sector (see section 4.9).

10 Eurostat, "Land cover, land use and landscape", Statistics Explained, data from September 2011, http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Land_cover,_land_use_and_landscape, accessed on: 08.07.2013

Figure 2-5 Primary land use by land use type, 2012 (% of total area)



Source: Eurostat LUCAS

Note: No data available for Bulgaria, Malta, Romania, Cyprus and Croatia.

2.5. Climate profile

The European Union covers climate zones ranging from dry summer sub-tropical in the Mediterranean over hemiboreal and boreal in the northeast to temperate maritime conditions along the Atlantic coast and the British Isles. High elevation patches of tundra climate can be found as well. The climate profile of a country can have strong impacts on its needs for heating during cold seasons or cooling during hot seasons, which triggers higher energy consumption and greenhouse gas emissions.

EU Member States close to the Atlantic Ocean or the North Sea generally experience relatively low temperature variations, both between summer and winter and between day and night. Figure 2-6 gives an overview of daily temperature variations. The northern Atlantic coast also experiences high rainfall (Figure 2-7). Scandinavian countries (i.e. Denmark, Finland and Sweden) tend to have mild summers and cold winters.

Figure 2-6 Mean of daily temperature range in the EU (1961-2010)

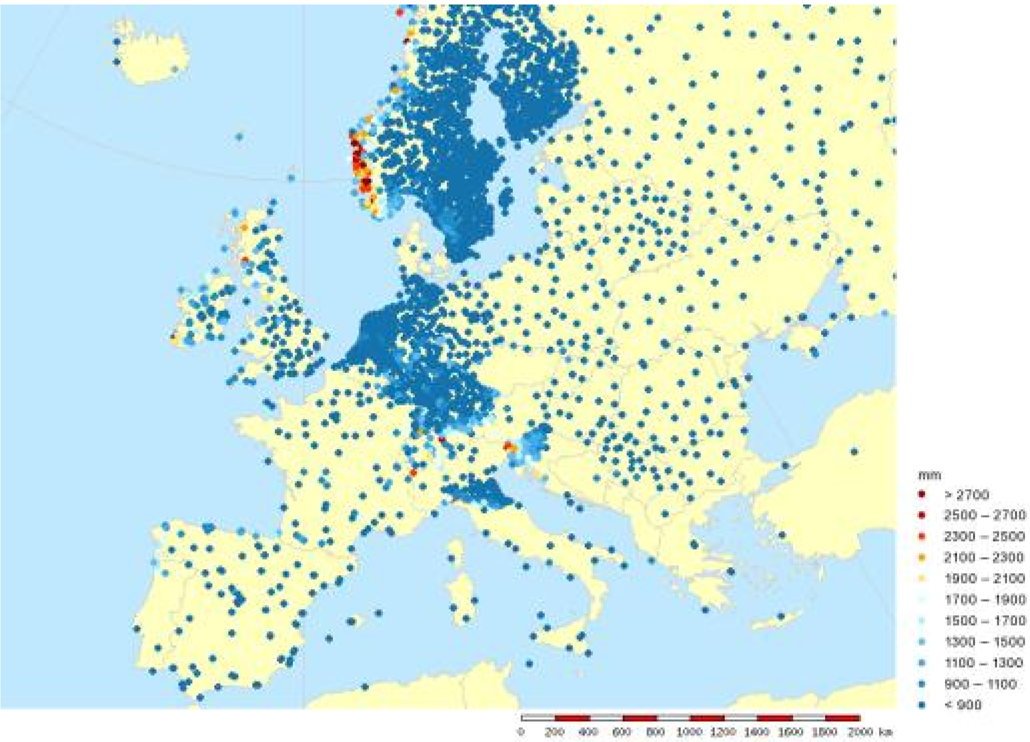
Source: E-OBS dataset from the EU-FP6 project ENSEMBLES[11] and the data providers in the European Climate Assessment and Dataset project[12].
Note: Each dot represents a measuring station.

The Mediterranean area tends to have higher temperature variations over the whole year. Generally this area has a hot, dry summer climate and mild, often rainy winters, although there are differences between regions. In the alpine region in central Europe annual precipitation is higher and temperatures are mild. The central European States have mild winters and mild summers, with more continental climatic conditions further east.

11 http://ensembles-eu.metoffice.com

12 http://www.ecad.eu

Figure 2-7 Annual precipitation sum in the EU (1961-2010)



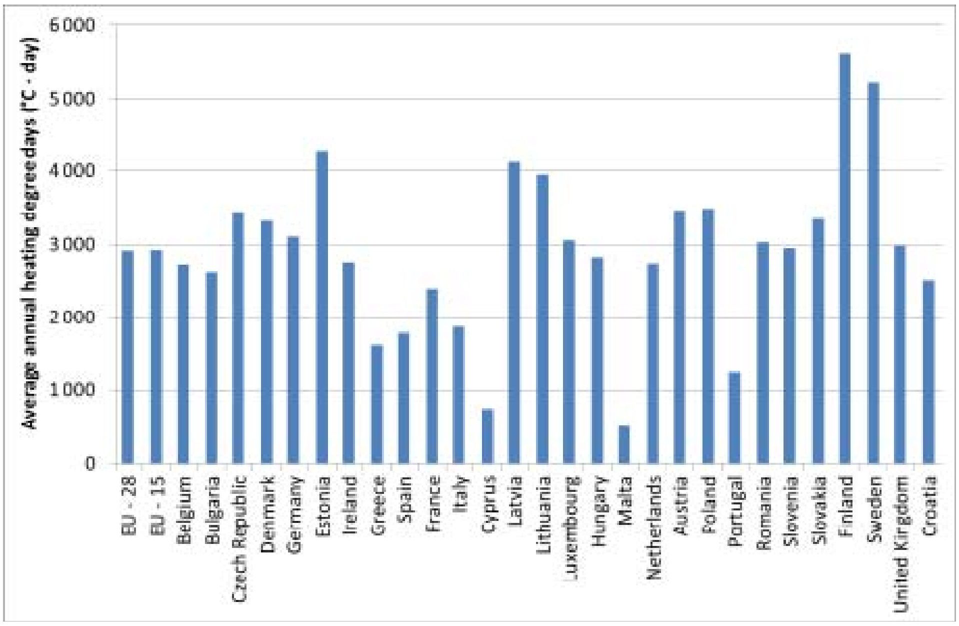
Source: E-OBS dataset from the EU-FP6 project ENSEMBLES[13] and the data providers in the European Climate Assessment and Dataset project[14].
Note: Each dot represents a measuring station.

The energy requirements and emissions in both winter months (for space heating) and summer months (for air conditioning) vary according to the temperature. The figure below shows the average annual number of heating degree days in each Member State. Requirements for space heating are particularly high in the northern and eastern Member States, whilst in summer months, southern and eastern countries will often experience average temperatures of more than 25 degrees Celsius. Tracking of cooling degree days will also become of increasing importance, particularly given the electricity demand for space cooling. In some countries, such as Greece, peak electricity demand tends to occur in summer months whereas for the majority of Member States it still occurs only during the winter period.

13 http://ensembles-eu.metoffice.com

14 http://www.ecad.eu

Figure 2-8 Energy demand for heating, expressed as average annual heating degree days by Member State (1990-2009).



Source: Eurostat

Note: Heating degree-days are a measure of the demand for energy needed to heat a building in a certain climate. Eurostat uses the following method for the calculation of heating degree days: (18 °C - Tm) · d if Tm is lower than or equal to 15 °C (heating threshold) and are nil if Tm is greater than 15 °C where Tm is the mean (Tmin + Tmax / 2) outdoor temperature over a period of d days.

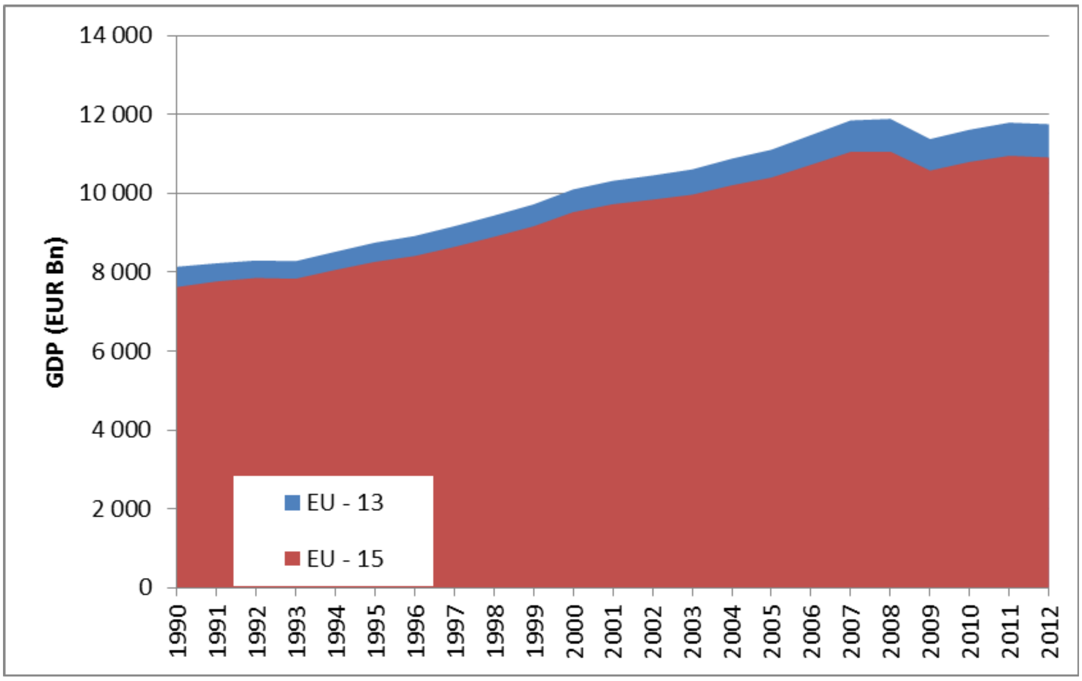
2.6. Economic profile

The economic profile of a country has a strong link to greenhouse gas emissions, with the overall level and types of economic activity strongly correlated to energy consumption. Greenhouse gas emissions also depend on factors such as energy efficiency and the structure of the economy. Trends in key economic factors are discussed below with the overall impact on energy intensity discussed in section 2.7.

2.6.1. Changes in overall Gross Domestic Product (GDP)

For the EU-28, GDP has increased by 44 % (in volume terms) from 1990 to 2012. When looking only at the EU-15 states, GDP has roughly followed the same pattern as the wider EU-28 with an overall increase in GDP of 43 %. The EU-15 countries account for around 92.7 % of all EU GDP.

Figure 2-9 Development of GDP 1995-2012



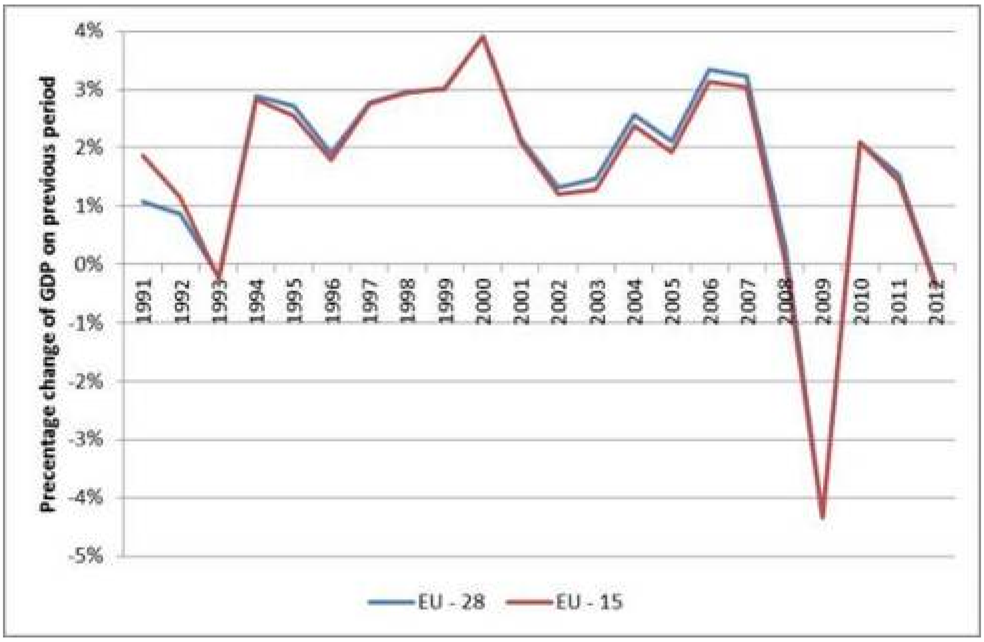
Source: Eurostat, European Commission, EEA

Note: GDP expressed as billions of euro, at 2005 market prices.

Economic growth in the EU slowed down in 2008 and declined in 2009 due to the global financial and economic crisis. Since 2010, the growth rate slowly increased and the GDP recovered. In 2012 positive growth rates were registered in 13 of the 28 EU Member States (average = -0.4 %), headed by Latvia (5.6 %), Estonia (3.9 %) and Lithuania (3.7 %). Nevertheless, in 2012 the Euro currency crisis in the Southern European countries contracted growth of the European economy again.[15]

15 Eurostat, National accounts – Real GDP, growth rate. ..http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tec00115&plugin=1 Accessed on:26.11.2013.

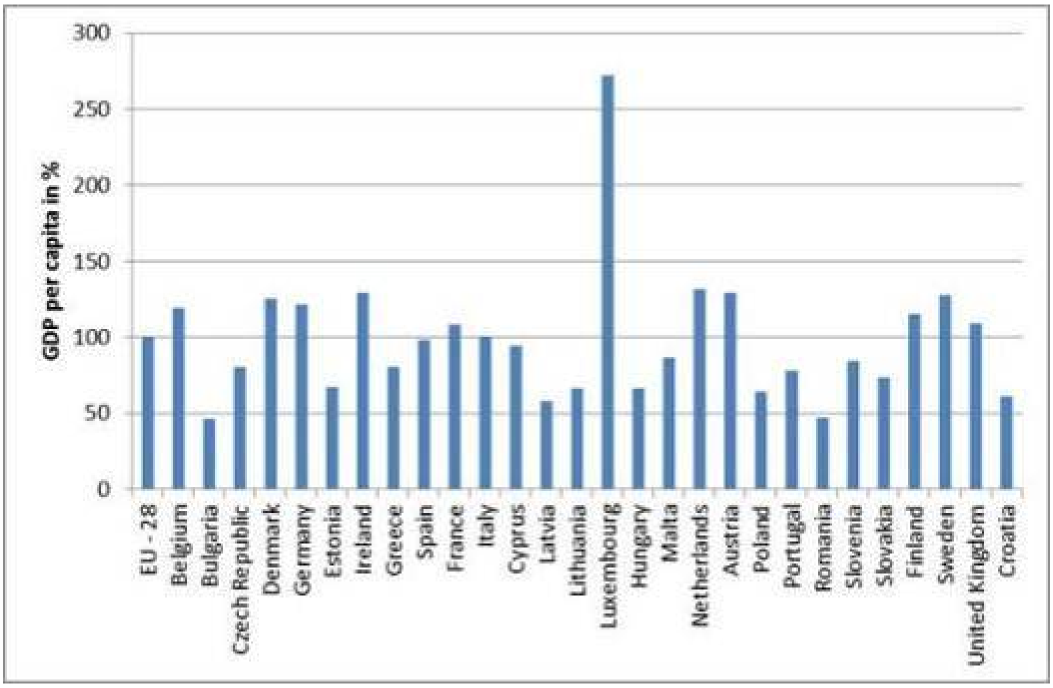
Figure 2-10 GDP change on previous period (in %) – 1991-2012



Source: Eurostat

Figure 2-11 shows GDP in purchasing power standards (PPS) per capita in 2011. This provides a better comparison of the potential for total consumption in each country (based on the purchasing power for a "representative" basket of goods and services). The countries' average GDP is compared relatively to the EU-28 average (set to 100). Among the EU Member States, Luxembourg is showing the highest relative value. For that country, GDP per capita in PPS is more than 2.7 times higher than the EU average which can partly be explained by the impact of cross-border workers from neighbouring countries. On the other end of the scale are Romania and Bulgaria whose GDP per capita accounts for less than 50 % of the EU average.

Figure 2-11 Percentage of GDP per capita in relation to EU-28 average (2011)



Source: Eurostat

Note: Percentage of EU-28 total (based on PPS per inhabitant), Figure for Romania dated from 2010.

2.6.2. Development of economic sectors

Between 1995 and 2010 the Gross Value Added (GVA) increased by 73.9 % in the EU-28. Table 2-1 shows the GVA of main economic sectors, where 73.6 % of the GVA is generated in the services sector. Services are of high importance in Malta, Cyprus, France, Greece, Belgium, Denmark and the United Kingdom where they contribute more than 75 % of the GVA.

At the same time, the share of the industry sector decreased from 23.8 % in 1995 to 18.7 % in 2010. Especially during the financial and economic crisis the industrial sector recorded heavy losses: - 13.8 % between 2007 and 2009. Construction also experienced substantial contraction; the output fell by 10.4 % between 2007 and 2010.

The breakdown of economic sectors shows that the largest contribution to the GVA originates from financial intermediation/real estate followed by public administration/community services/households. Both sectors experienced a growth of their share in overall GVA. Agriculture/fishing and construction are the smallest sectors regarding their GVA.

Table 2-1 Gross-value added (at basic prices) of main economic sectors (NACE rev 1.1)

Unit = € billion	EU-15				EU-28			
Branch	1995	%	2010	%	1995	%	2010	%
Total - all NACE activities	6 064	100%	10 129	100%	6 324	100%	11 000	100%
Agriculture; fishing	159	2.6%	154	1.5%	181	2.9%	187	1.7%
Industry (except construction)	1 428	23.5%	1 839	18.2%	1 502	23.8%	2 062	18.7%
Construction	359	5.9%	595	5.9%	376	5.9%	658	6.0%
Wholesale and retail trade; hotels and restaurants; transport	1 263	20.8%	2 073	20.5%	1 323	20.9%	2 293	20.8%
Financial intermediation; real estate	1 501	24.7%	3 019	29.8%	1 543	24.4%	3 191	29.0%
Public administration and community services; activities of households	1 354	22.3%	2 448	24.2%	1 399	22.1%	2 611	23.7%

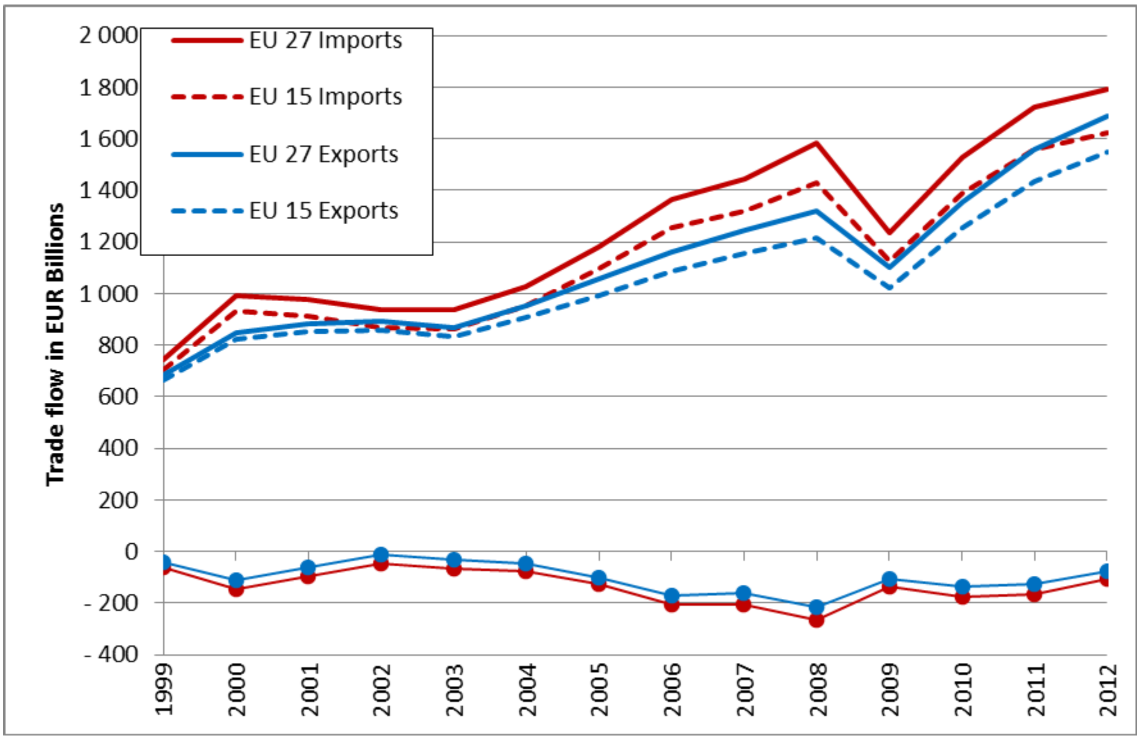
Source: Eurostat

Note: GVA expressed in billions of euro (from 1.1.1999)/Billions of ECU (up to 31.12.1998).

2.6.3. Trade patterns

Since the late 1990s, the EU has experienced a negative trade balance although the trend reversed slightly in the early part of the 2000s. The trade balance has ameliorated, compared to the 2006 – 2009 period but imports still exceed exports even though to a lower extent.

Figure 2-12 Development of extra-EU-27 trade.

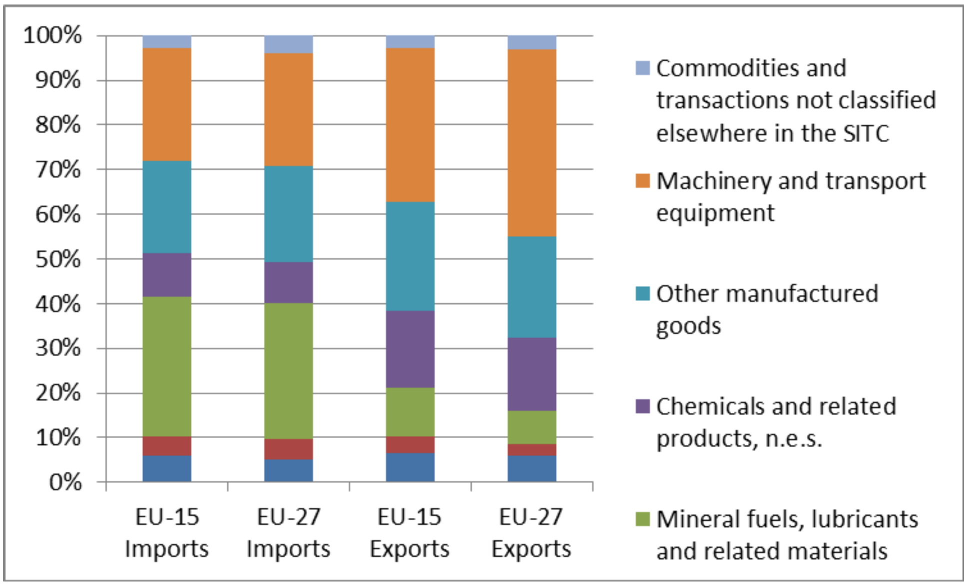


Source: Eurostat

Note: Croatia not included.

Figure 2-13 shows the percentage (as a proportion of total trade value) of extra- EU-27 trade by SITC (Standard International Trade Classification) category, for imports and separately for exports, in 2012. In comparison to the 5th National Communication, manufactured products such as machinery and transport equipment still present the largest share of EU exports but they no longer make up the highest proportion of EU imports. The leading imported product category currently is mineral fuels, lubricants and related materials.

Figure 2-13 Composition of extra-EU trade by value in 2012



Source: Eurostat

Note: Croatia not included.

With regard to GHG emissions, machinery and transport equipment as well as chemicals and related products tend to have lower emissions intensity, given the much higher value added of the products compared to energy use, mineral fuels and others, lubricants and related materials and other raw materials.

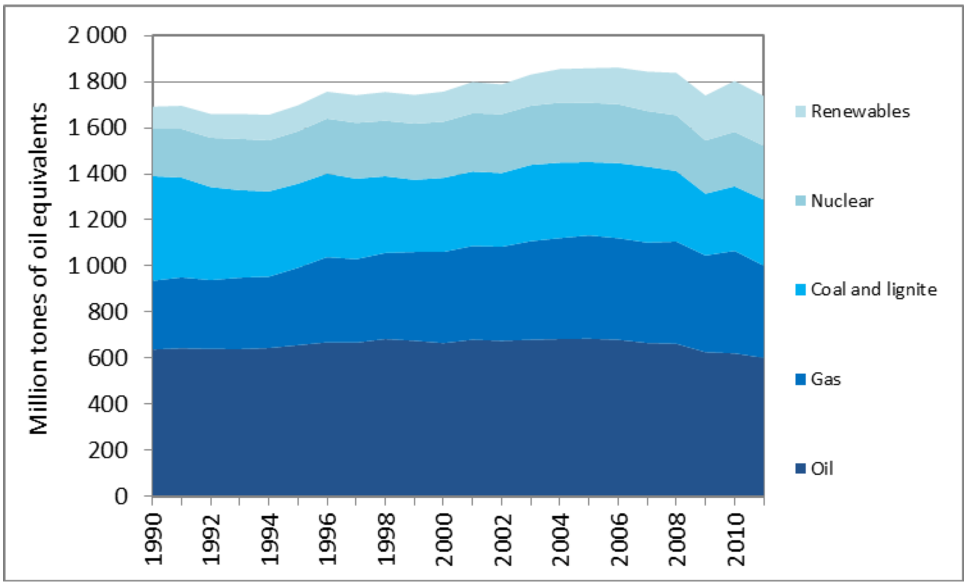
2.7. Energy profile

Energy use is the largest source of GHG emissions. The following sections provide a high-level overview of the most relevant factors concerning energy use in the European Union. The Eurostat Pocketbook "Energy, Transport and Environment Indicators – 2012 Edition"[16] provides more detail on the key drivers, environmental pressures and impacts from the production and consumption of energy. Climate policy drivers have had some impact on changes in the EU energy system to date (e.g. leading to improvements in energy efficiency or increases in the share of renewables), although to a large extent these have been driven by other factors (e.g. previous shift to gas as a result of price differentials). Historic trends in GHG emissions from energy-related activities are shown in section 3.2.3.

The impacts of climate policy in the energy sector (see section 4.5 for further details) are expected to be far more significant in future years than what statistics show up to now, particularly as a result of the new climate and energy package. It is expected to lead to more sizeable shifts in energy use towards renewables (and also gas) as well as an overall impact on primary and final energy consumption due to improvements in energy efficiency; these effects should become more noticeable within these indicators in coming years.

16 Eurostat Pocketbook: Energy, transport and environment indicators — 2012 edition http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-DK-12-001/EN/KS-DK-12-001-EN.PDF.. Accessed on 09.09.2013

Figure 2-14 Gross inland energy consumption[17] by fuel for the EU-28



Source: Eurostat

Gross inland energy consumption (see section 2.7.2 for details of final energy consumption) in the EU-28 increased over the period from 1990 until 2006 despite continued efforts to improve energy efficiency; since 2006 it was decreasing. This trend was interrupted by a large increase in 2010 caused by the recovery from the economic crisis which itself had led to a significant drop of primary energy supply in 2009.

Trends in the consumption of different energy carriers within the total have changed significantly since 1990 and the trends reported in the 5th National Communication have broadly continued. Since 1990 there has been a decrease of 37 % in the consumption of carbon-intensive coal and lignite. Meanwhile there has been an increase of over 30 % in gas consumption which, in comparison to other fossil fuels, produces less greenhouse gas emissions. The consumption of oil decreased slightly by 6 % between 1990 and 2011. Consumption of energy generated from nuclear power has also increased by 14 % on 1990 levels. Renewables have seen the most marked increase with consumption increasing by over 120 % from 1990 levels.

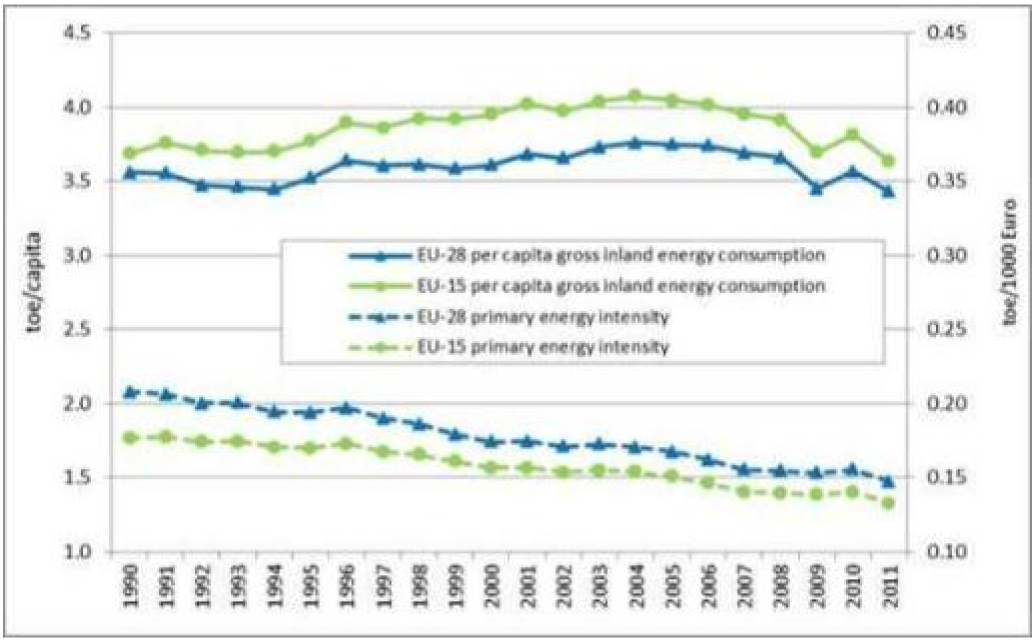
These increases have had a positive effect on the EU's GHG emissions as shown in section 3.2.3. Nevertheless, fossil fuels continue to dominate total energy consumption, making up 74 % of total primary energy consumption in total. The share of renewable energy sources remains small despite the increase in use (13 % gross final energy consumption).

Figure 2-15 below shows primary energy intensity (toe/unit GDP) and per capita primary energy consumption for both the EU-15 and EU-28 Member States from 1990-2011. Since NC5, per capita energy use has continued to decrease even more strongly with a short interruption in 2010, which again demonstrates the recovery from the global economic crisis. In addition, energy intensity has decreased steadily since 2006 for both the EU-28 and EU-15, except for 2010 (see the reason mentioned above). Both

17 Gross inland energy consumption is the total energy demand of a country or region. It represents the quantity of energy necessary to satisfy inland consumption of the geographical entity under consideration.

these trends are having a positive impact in reducing GHG emissions. More information on the GHG emission intensity of the EU economy can be found in section 3.2.5.

Figure 2-15 Per capita gross inland energy consumption and primary energy intensity (ratio between gross inland energy consumption and gross domestic product).

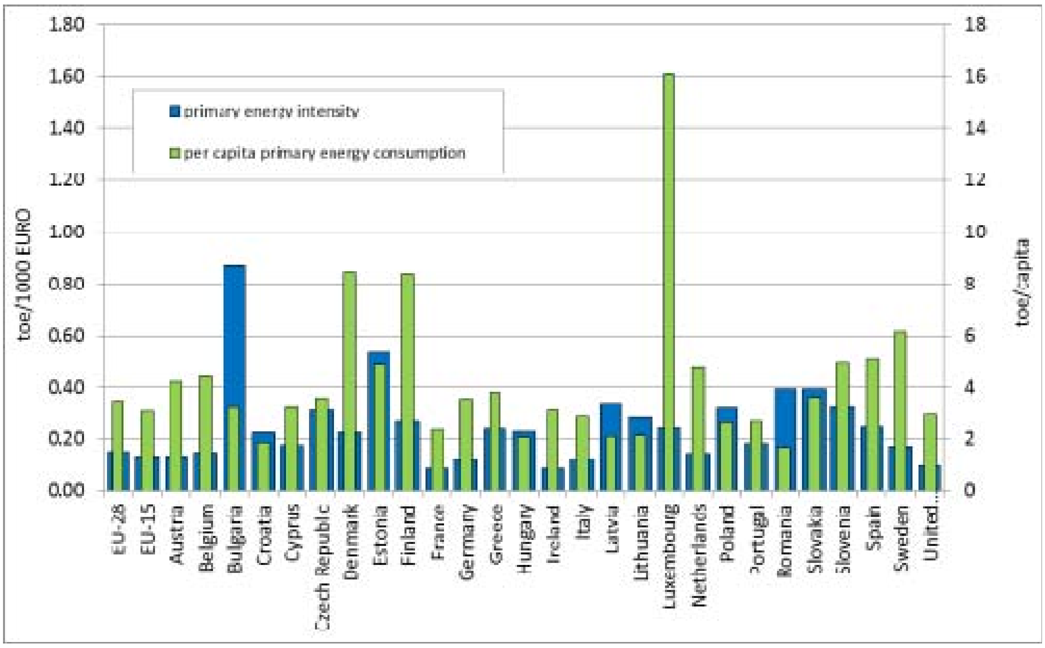


Source: Eurostat, European Commission, EEA

Note: Estimate of GDP as billions of Euro at 2005 market prices

Figure *2-16* shows primary energy intensity (toe/unit GDP at purchasing power standards) for each Member State and for the EU-15 and EU-28 in 2011.

Figure *2-16* Primary energy intensity and per capita consumption by Member State in 2011



Source: Eurostat

Note: Data for Malta not available

The final energy needs of the EU economy represent less than two thirds of the EU's primary energy consumption. There are very significant energy losses linked to the transformation and distribution of useful energy (e.g. as heat and electricity) to the end-users. Energy losses broadly depend on the average efficiency of conventional thermal power stations and combined heat and power (CHP) plants, the use of nuclear power for electricity production, and the penetration of non-thermal renewables.

Countries with lower energy intensity may also have an economy structured less around heavy industry and more around the service industries. In addition or alternatively, they may have a higher degree of energy efficiency (both in energy generation and end-use) throughout the economy.

New Member States generally have higher energy intensities (e.g. Bulgaria, Estonia, Slovakia). However, five new Member States (namely Croatia, Hungary, Latvia, Lithuania, and Romania) have particularly low per capita energy consumption – less than 2.5 toe/capita – compared with the EU-28 average of 4.3 toe/capita. In the EU-15, France has the lowest per capita energy consumption (2.4 toe/capita), while it is particularly high in Luxembourg (16.1 toe/capita) due to road fuel exports.[18]

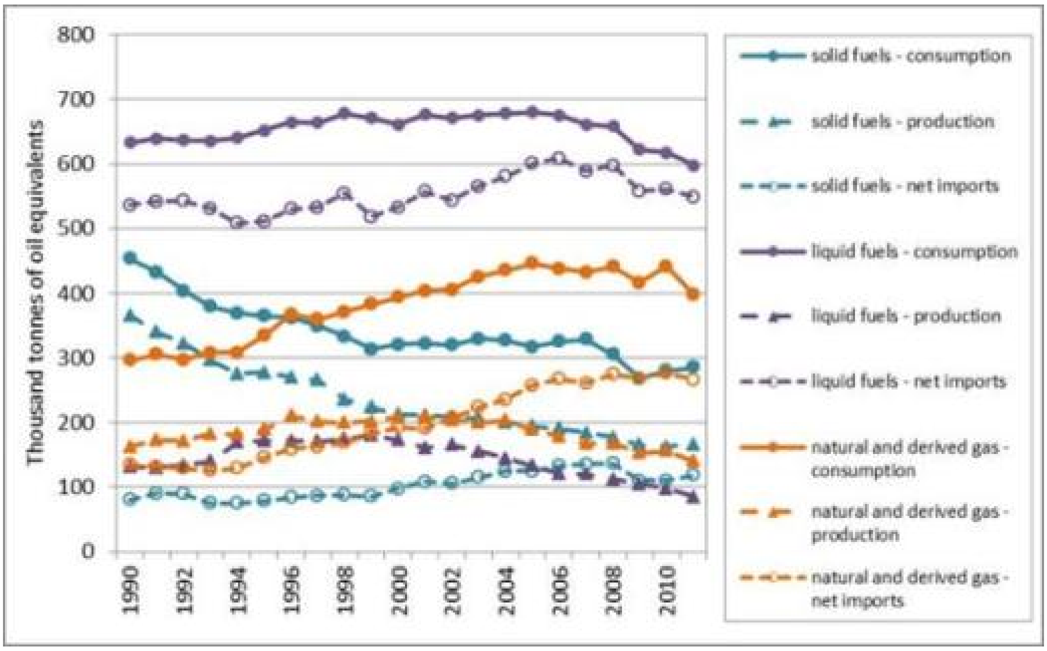
2.7.1. Energy Supply

Figure 2-17 shows primary production, gross inland consumption and net imports of solid fuels, oil and gas in the EU-28 as a whole from 1990 to 2011. The vast majority of oil consumed is from imports and the trend had been an upward one until 2006; since then it has been declining. Overall oil consumption has stayed relatively constant over this period, declining more significantly after 2006. In the meantime there has also been

18 Purchase of road transport fuels by non-residents, which are allocated to Luxembourg's energy consumption, but consumed in other Member States.

a decline in production at an average rate of 1.9% annually. The same applies to gas consumption, with imports exceeding production for the first time in 2002. Imports now make up approximately two thirds of EU gas consumption. In the case of solid fuels, overall consumption is decreasing. Although imports have risen in recent years, with a short decline in 2009, production volumes still exceed imports. If current trends continue, however, it is likely that imports will exceed production volumes in the next few years.

Figure 2-17 Supply of fossil fuels, EU-27

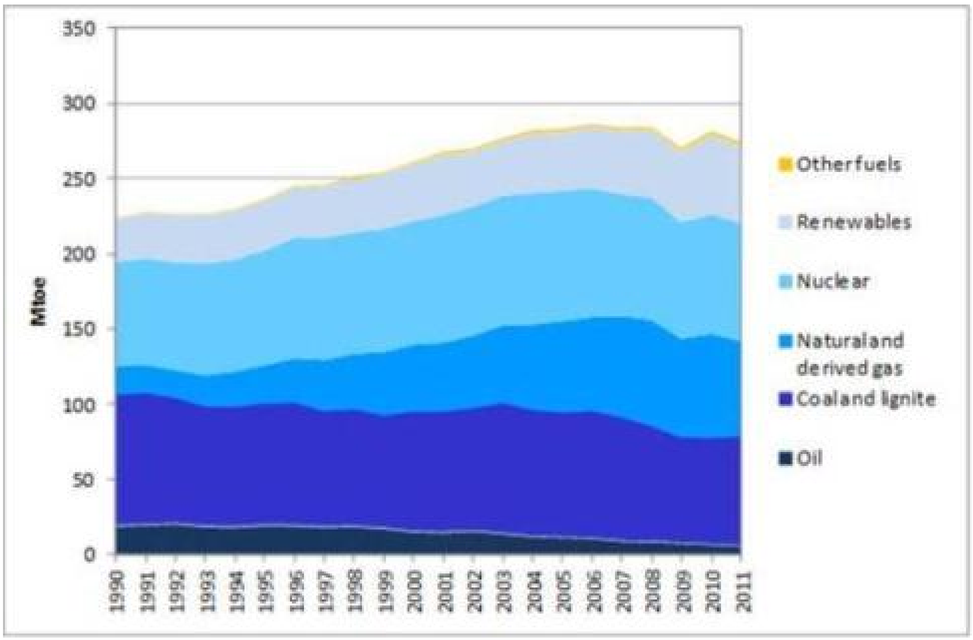


Source: Eurostat

Note: Data for Croatia not available.

In general, since the NC5, the EU-28 has seen a more rapid increase in its dependence on all imported fossil fuels (around 47 % of primary energy), which has led to growing concerns over security of supply. As in the 5th National Communication, oil still accounts for the largest share (47 %) of the EU's fossil fuel consumption. The next largest share is gas (31 %) and then solid fuels (22 % of the fossil fuels consumed in the EU).

Figure *2-18* Gross electricity production by fuel for EU-28

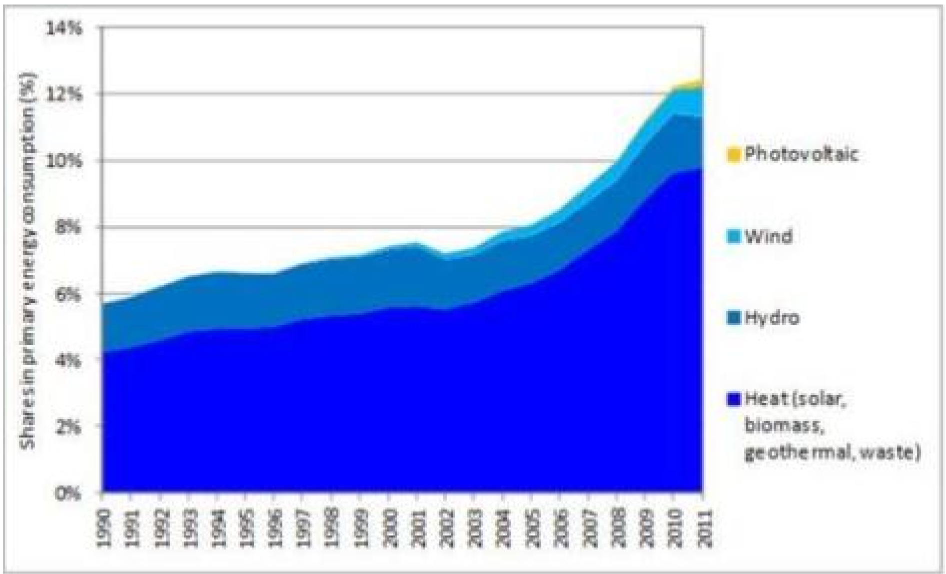


Source: Eurostat

Although the absolute amount of electricity production from renewables has increased by over 80 % since 1990, renewable electricity still makes only a 19 % contribution to total generation. The proportion produced by nuclear has remained fairly constant and in 2011 it was approximately 28 % of total electricity production. There have been large decreases in both oil and coal and lignite production; together they accounted for 29 % of total production in 2011 (down from 48 % in 1990).

Production from gas has increased from 9 % of the overall mix in 1990 to 23 % in 2011. Overall, the generation mix of electricity in the EU-28 has become less carbon intensive since the beginning of the 1990s, with the trends seen in NC4 and NC5 broadly continuing. However, the lower carbon intensity has been somewhat counterbalanced by the overall rise in total electricity production – an increase of 23 % from 1990 to 2011.

Figure *2-19* Share of renewable energy in gross inland energy consumption, EU-28.

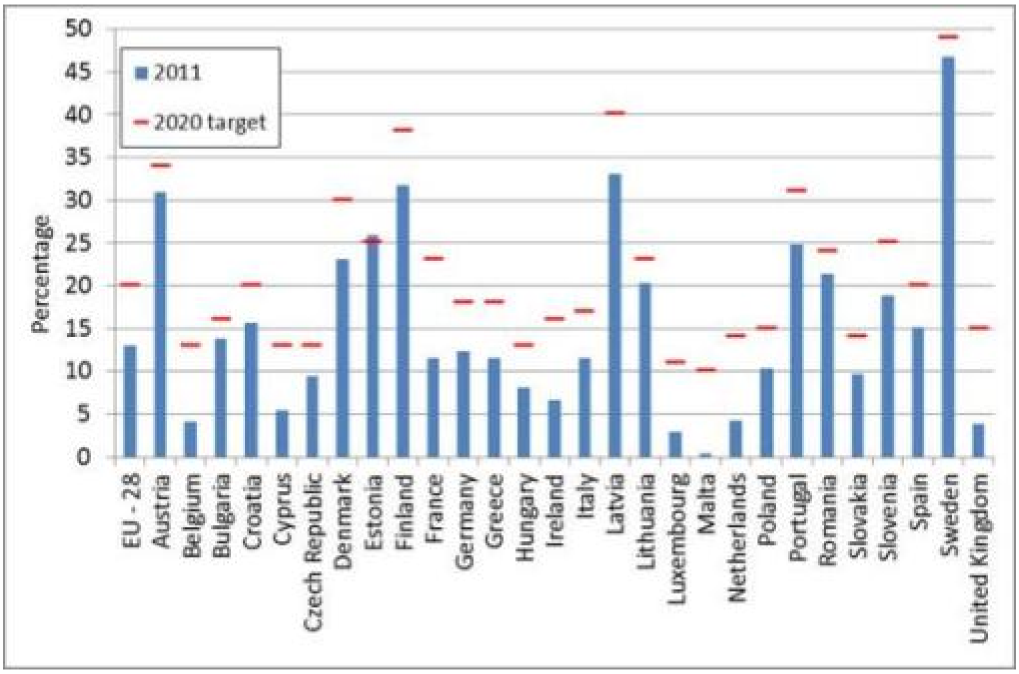


Source: Eurostat

The share of gross final energy consumption met by renewables has increased substantially over the last ten years to around 13 % in 2011. A substantial increase can be seen from renewable heat production, wind power generation and photovoltaics whereas hydro power production is relatively constant.

The bulk of renewable energy consumed, over two thirds, comes from heat (solar, biomass, geothermal and waste). Hydropower is the second biggest contributor, providing about 12 % of total renewable energy in 2011; however hydropower's relative contribution to overall renewables has decreased significantly (from about 26 % in 1990). Wind power has seen the largest increase - from less than 0.1 % in 1990 to contributing around 7 % of total renewable energy in 2011. During the last years, renewable energy from photovoltaic recorded the largest relative increase, of over 1000 %, from 324 toe in 2007 to 3 867 toe in 2011.

Figure *2-20* Share of renewable energy in gross final energy consumption in 2011



Source: Eurostat

Note: Gross final energy consumption is defined in Directive 2009/28/EC on the promotion of the use of energy from renewable sources as "the energy commodities delivered for energy purposes to industry, transport, households, services including public services, agriculture, forestry and fisheries, including the consumption of electricity and heat by the energy branch for electricity and heat production and including losses of electricity and heat in distribution and transmission".

Based on 2011 figures all EU countries with the exception of Estonia still need to take additional actions to fulfil the new Renewable Energy Sources (RES) targets for 2020 (see section [BR1] 4.3.3 in Annex 1: EU 1st Biennial Report). The RES targets include all sources of electricity, heat and transport fuel, aiming at a 20% of RES to gross final energy consumption for the EU as a whole by 2020 (see also section 2.7 on the EU energy policy). The country with the highest target is also one of the closest to meeting it; in 2011 46.8 % of Sweden's final energy consumption was from renewable sources close to its 2020 target of 49 %. Denmark, Portugal, Austria, Finland and Latvia also have renewable energy targets of at least 30 %, with Austria being closest in 2011 to meeting this target.

Conversely, the United Kingdom, the Netherlands and Belgium have 2020 targets of 15 %, 14 % and 13 % respectively but in 2011 were sourcing 4.3 % or less of final energy from renewable sources. In absolute terms France needs to make the biggest increase followed by the United Kingdom – a further 11.5 % and 11.2 % respectively must come from renewable sources to meet their RES targets.

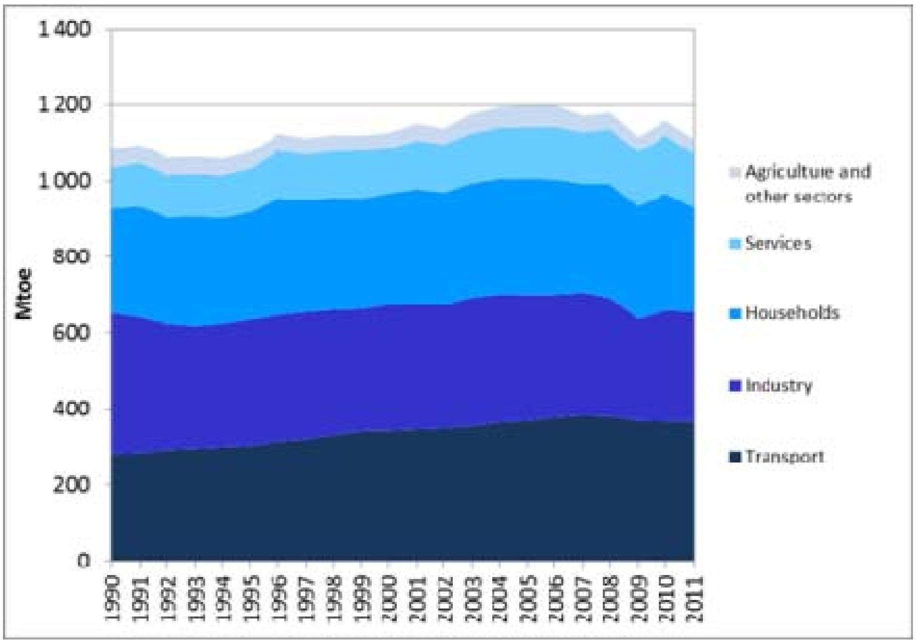
The most recent progress report (2013)[19] from the Commission states that there still exist barriers preventing the planned expansion of renewable sources, namely with regard to administrative simplification and permitting procedures for infrastructure

19 Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Renewable Energy Progress Report COM(2013) 175 final.

development and operation, but also because of the consequences of the economic crisis.

2.7.2. Energy consumption in different sectors

Figure 2-21 Final energy consumption by sector in the EU-28



Source: Eurostat

Final energy consumption in the EU-28 increased by approx. 2 % between 1990 and 2011. The services sector and the transport sector have both seen the largest increase in overall energy consumption since 1990 – by over 31 % and 29 % respectively. This is further explored in section 2.7. The relatively small proportion of low carbon transport in the EU is having a significant impact on GHG emissions (see section 3.2.3). The increase in energy consumption in the services sector correlates with an increasing share of GVA coming from this sector. Households are also one of the largest consumers of final energy in the EU. Space heating and cooling are the most significant components of household energy demand, and can vary substantially from year to year depending on climatic conditions. In 2011 household energy consumption equalled the 1990 level. Final energy consumption in industry has fallen by over 20 % since 1990, largely as a result of a shift towards less energy-intensive manufacturing industries, as well as the continuing transition to a more service-oriented economy.

2.7.3. Liberalisation and privatisation of energy markets

The creation of a genuine internal market for energy is one of the EU's priority objectives. The existence of a competitive internal energy market is a strategic instrument both in terms of giving European consumers a choice between different companies supplying gas and electricity at reasonable prices, and of making the market accessible for all suppliers. To this end, the Commission put forward the Third Energy Package[20] in 2007. The Third Energy Package includes two Directives (distinguishing

20 http://ec.europa.eu/energy/gas_electricity/legislation/third_legislative_package_en.htm

electricity market and gas market) and three Regulations. More details on these changes are described in section 4.5.

2.7.4. Energy prices

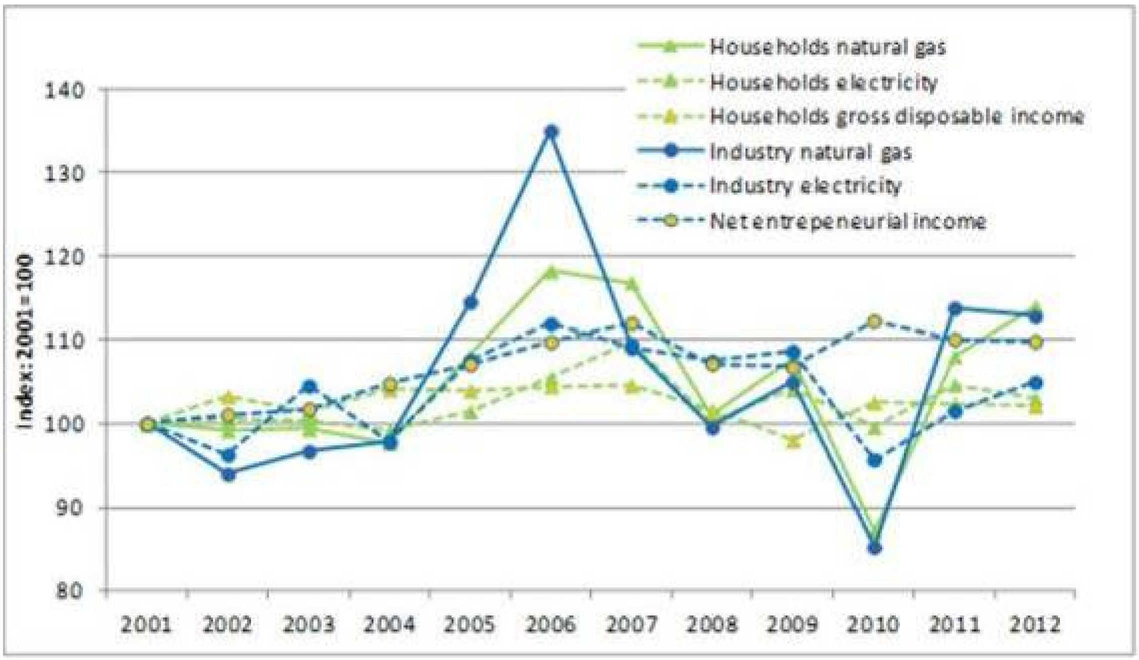
Figure 2-22 illustrates how the average end-user prices of both electricity and gas have varied since 2001 for industry and households in the EU. In addition, it illustrates how disposable income has varied over this period, as this provides a very broad indication of how expenditure on energy varies as a share of income.

The price of natural gas has generally increased over the period with large fluctuations in 2006 and 2010. The peak and troughs are more pronounced in the case of industry compared to households.

The price of electricity shows a small increase of the period with smaller fluctuations than the gas price. The fluctuations follow to some degree the fluctuations of the gas price illustrating that gas is an important fuel for the electricity production.

Increasing gas and electricity prices should have a positive impact on the EU's GHG emissions as both industry and households make efforts to conserve energy and improve their level of energy efficiency. This should be the case for households as the disposable income of households hardly increased between 2001 and 2012. On the other hand, substitution effects may play a negative role, whereby consumers opt for cheaper fuels such as coal, which is more carbon-intensive.

Figure 2-22 Change in average end-user energy prices in the EU, 2001-2012



Source: Eurostat

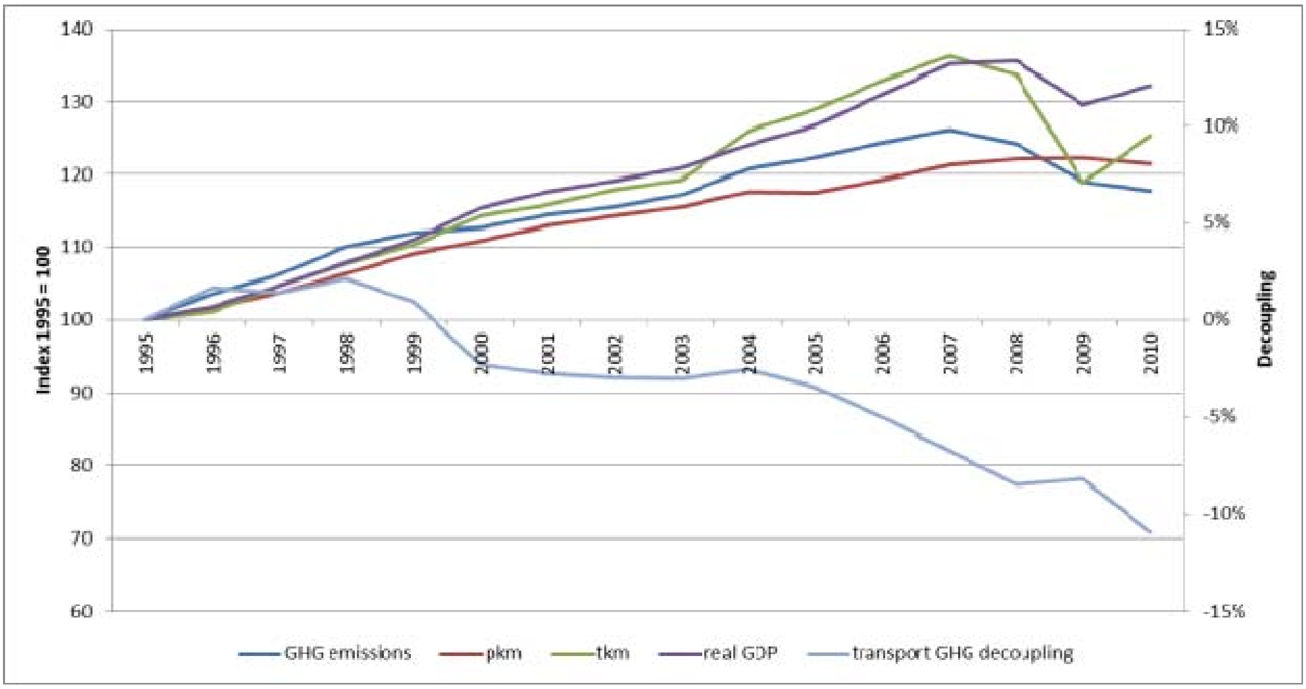
Note: Data until 2005 only included EU-15, from 2006 onwards prices for EU-27 were considered

2.8. Transport profile

The following sections provide a high-level overview of the most relevant factors related to transport.

As reported in the 5th National Communication, both freight and passenger transport have continued to grow strongly since 1995 up until the economic crisis in 2008. Freight transport growth was largely in line with real GDP growth until the economic crisis, followed by a strong decline in 2008 and 2009 and a recovery in 2010. Passenger transport has grown slower than real GDP since 1995. As a result, the GHG emissions and energy use of transport have grown until 2007, making it the sector with the largest energy consumption within the EU-27.

Figure 2-23 Growth in transport volumes and emissions and GDP in EU-27



Source: European Commission, DG Mobility and Transport and Eurostat

Note: Estimate of GDP as billions of Euro at 2005 market prices. Freight transport data from DG Mobility and Transport: Air and sea: only domestic and intra-EU-27 transport; provisional estimates. Road: national and international haulage by vehicles registered in the EU-27. Passenger transport (pkm = passenger kilometres) includes passenger cars, powered two-wheelers, buses & coaches, tram & metro, railways, intra-EU air, intra-EU sea. Decoupling is calculated as the percentage change in GHG intensity (ton CO2 per unit of GDP) compared to the 1995 baseline.

2.8.1. Freight transport

The table below shows the modal split for freight transport in 1995 and 2010. The major part of freight is transported via road (45.8 %), followed by sea transport (36,9%). Overall freight transport volume has increased by 25.2%, with volume increases along all individual modes as well. Overall the modal split did not change significantly between 1995 and 2010. Road transport is still the dominant mode, and has shown the largest relative and absolute increases. As a result the modal shares of most other transport modes (particular rail and oil pipelines) have decreased from 1995 to 2010. The increase in the modal share of road transport has to be noted as it is more carbon-intensive than most alternative modes.

Table 2-2 Modal split of freight transport in EU - 27

Modal split	Tkm		Share of the sector (%)		Transport increase (%)
	1995	2010	1995	2010	1995 – 2010
Road	1 288.7	1 755.6	42.1	45.8	36.2
Sea	1 146.0	1 414.8	37.5	36.9	23.5
Rail	386.1	389.9	12.6	10.2	1.0
Inland Waterway	122.1	147.4	4.0	3.8	20.8
Oil Pipeline	114.9	120.6	3.8	3.1	4.9
Air	2.0	2.5	0.1	0.1	27.4
Total	3 059.8	3 830.9	100.0	100.0	25.2

Source: DG Mobility and Transport

Note: Air and Sea: only domestic and intra-EU-27 transport; provisional estimates. Road: national and international haulage by vehicles registered in the EU-27.

2.8.2. Passenger transport

Between 1995 and 2007, passenger transport in the EU has increased at a relatively lower rate than GDP. The effect of the financial and economic crisis is less distinct than for freight transport.

A reduction in absolute carbon emissions in the passenger transport sector will need to come primarily via improved vehicle efficiency, shift from individual to collective transport or soft modes, the shift to less carbon-intensive transport fuels (e.g. sustainably produced biofuels or low carbon electricity) and a reduction in congestion.

The table below shows the total distance travelled by passengers– comparing 1995 with 2010. Overall passenger transport has increased by 21 %, largely as a consequence of the 22 % increase in car transport. Regarding the modal split the importance of passenger cars becomes clearly visible: 73.3 % of the total passenger kilometres are travelled by car. Air travel, which comes second in the modal split, accounts for only 8.2%. However, it has shown the largest increase and has grown by 51.5 % since 1995. This is important as growth in air transport has exceeded the improvements in efficiency, leading to significant increases in emissions. In general, the modal split does not differ substantially from the NC5.

Table 2-3 Modal split of passenger transport in EU - 27

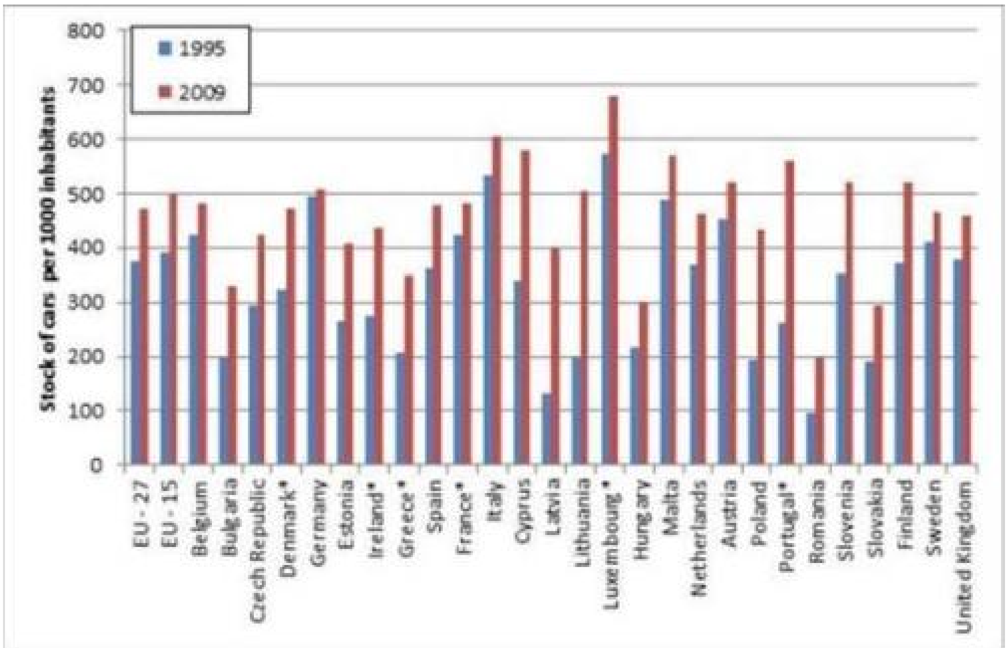
Modal split	**Pkm**		**Share of the sector (%)**		**Transport change (%)**
	1995	**2010**	**1995**	**2010**	**1995-2010**
Passenger cars	3 879.2	4 737.6	73.0	73.7	22.1
Powered 2-wheelers	122.2	120.0	2.3	1.9	-1.8
Buses & coaches	497.4	510.1	9.4	7.9	2.6
Railways	350.5	403.8	6.6	6.3	15.2
Tram & metro	71.0	90.1	1.3	1.4	26.9
Air	346.0	524.2	6.5	8.2	51.5
Sea	44.4	38.1	0.8	0.6	-14.2
Total	**5 310.7**	**6 423.9**	**100.0**	**100.0**	**21.0**

Source: Eurostat, DG MOVE

Note: Air and Sea: only domestic and intra-EU-27 transport; provisional estimates. Road: national and international haulage by vehicles registered in the EU-27.

The next graph shows that in each of the EU-27 Member States the level of car ownership has increased; overall ownership in the EU-27 increased by 26 % between 1995 and 2009. In Romania, Latvia and Lithuania car ownership levels have more than doubled, whereas Germany experienced the smallest increase at 2.6 %. Nevertheless, this still leaves Romania with the lowest level of ownership in the EU-27 (197 per 1 000 inhabitants). Luxembourg has the highest level of ownership with 678 per 1 000 inhabitants, followed by Italy with 606 cars.

Figure 2-24 Level of car ownership



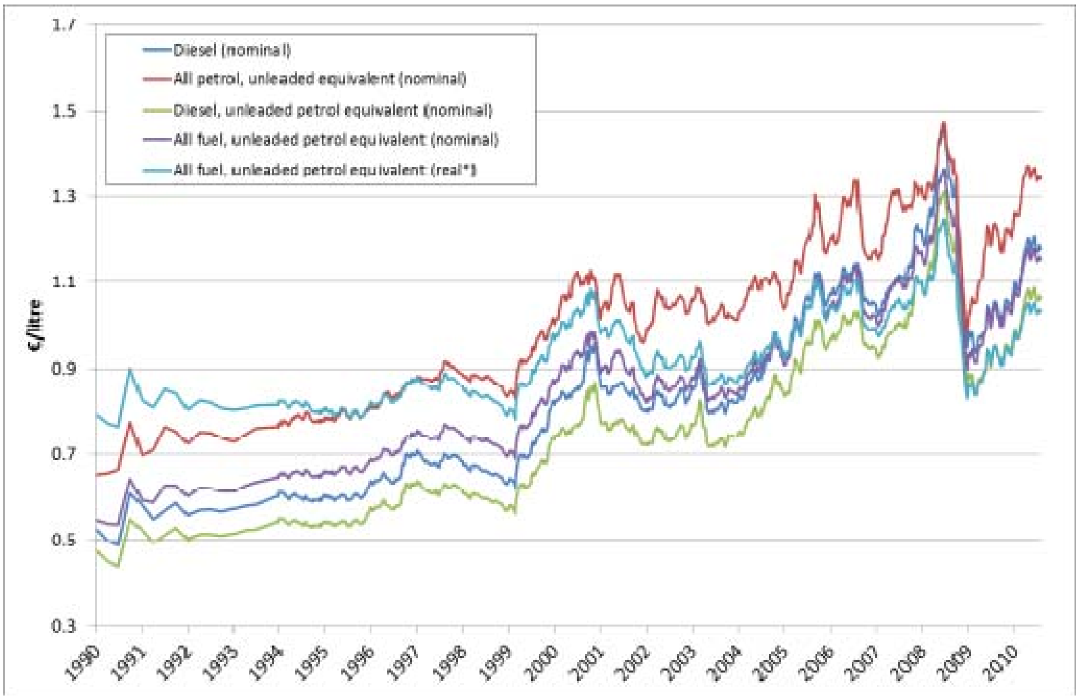
Source: Eurostat

Note: Croatia not included. Passenger car stock at end of year n divided by the population on 1st January of year n+1. Countries with * did not provide data for 2009, therefore latest figures reported were taken (Denmark: 2008, Ireland: 2007, Greece: 2003, France: 2007, Luxembourg: 2008, Portugal: 2002).

2.8.3. Prices of transport fuels

The line graph below shows how average diesel and petrol prices have evolved in the EU Member States since 1990. Overall, the prices for both fuels more than doubled between 1990 and 2011 due to substantial increases in oil prices; real prices (when adjusting for inflation) increased by around a third over the same period.

Figure 2-25 Average EU road transport fuel prices



Source: EEA

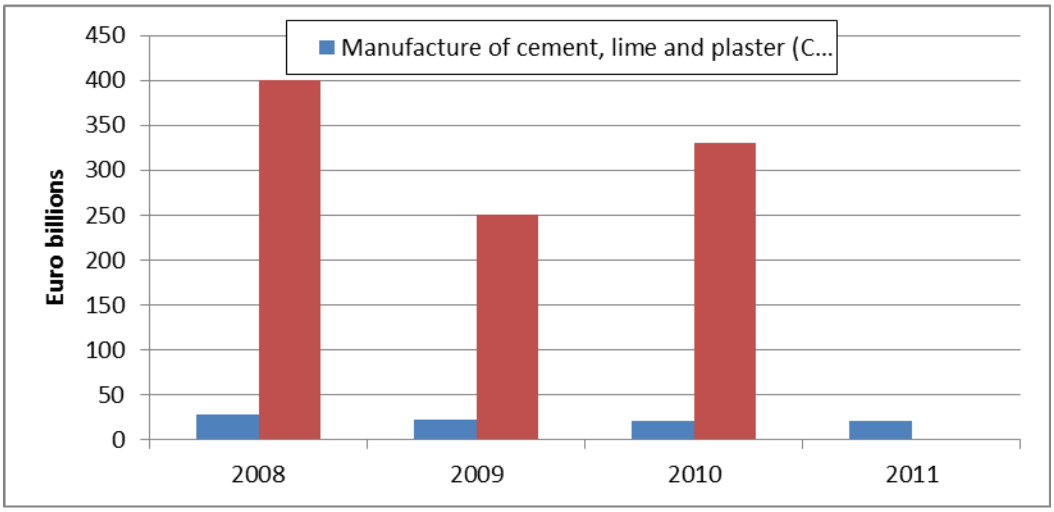
Note: * 'Real' is the price corrected for inflation, using 2005 as the baseline year.

2.9. Industry

The largest share of gross value added in the industry sector is contributed by subsectors electricity, gas, steam and air conditioning (11.0 %); food, beverages and tobacco products (10.4 %); and machinery and equipment (8.2 %).

The following illustration shows the production value of two very energy-intensive industry sectors in recent years. The decrease of production during the economic crisis in 2009 is clearly visible, in particular for iron and steel.

Figure 2-26 Production value of iron, steel and cement industry



Note: Production value measures the amount actually produced by the unit, based on sales, including changes in stocks and the resale of goods and services. The production value is defined as turnover, plus or minus the changes in stocks of finished products, work in progress and goods and services purchased for resale, minus the purchases of goods and services for resale, plus capitalised production, plus other operating income (excluding subsidies). Income and expenditure classified as financial or extraordinary in company accounts is excluded from production value. Annual average exchange rates vis-à-vis the euro in EUR millions (reference year 2005). Data for iron and steel not available for 2011.

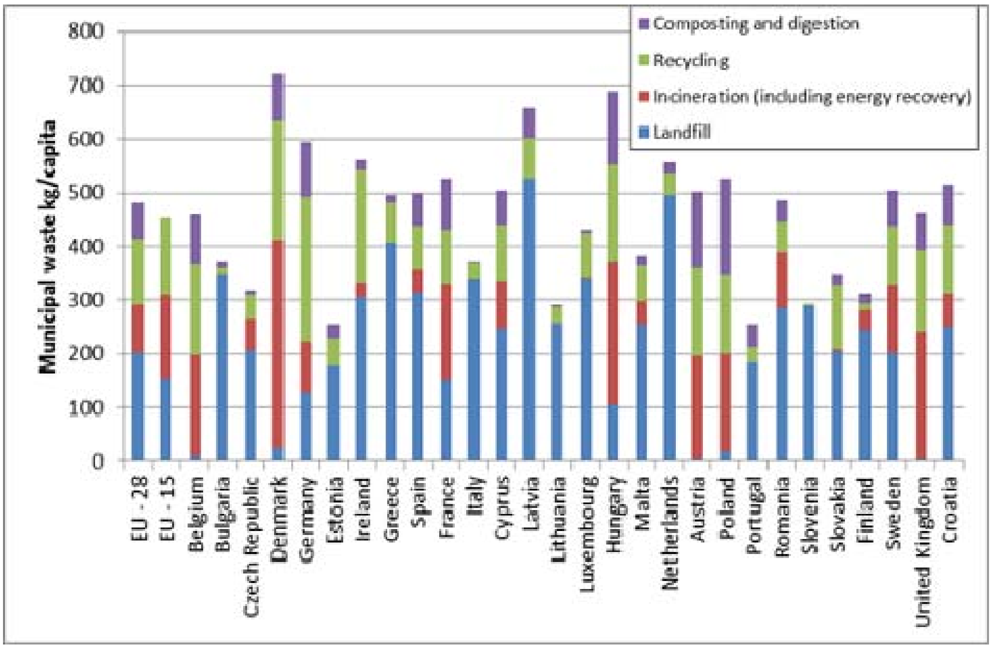
2.10. Waste

Greenhouse gas emissions from waste depend on the quantity of waste and how it is disposed of (including recycling, landfill and incineration). All types of waste treatment have an impact on emissions, including the consumption of energy in the collection, treatment and production of waste. The trends in emissions from waste can be seen in section 3.2.3. Waste to landfill produces large methane emissions if not managed correctly (e.g. via methane recovery and diversion of biodegradable municipal waste from landfill).

Recycling and incineration of waste with energy recovery generally result in lower greenhouse gas emissions than disposing of the waste to landfill, and these types of waste treatment are increasingly being used, in part as a result of the policy drivers discussed in section 4.10.

The figure below shows the amount of municipal waste generated for each Member State in 2011, broken down by type of treatment. For the EU-28 on average 42 % of waste per capita is recycled, 36 % is sent to landfill and 22 % is incinerated. The lowest recycling rates are in Bulgaria and Croatia – at less than 10 %, whereas the remaining 90 % are landfilled. In contrast, Germany, the Netherlands and Sweden do send only less than 1 % of the municipal waste to landfill. In Denmark, more than half of the municipal waste is incinerated. In terms of recycling, the Netherlands, Austria and Germany are the leaders with recycling rates of over 60 %.

Figure 2-27 Treatment of municipal waste per capita in 2011

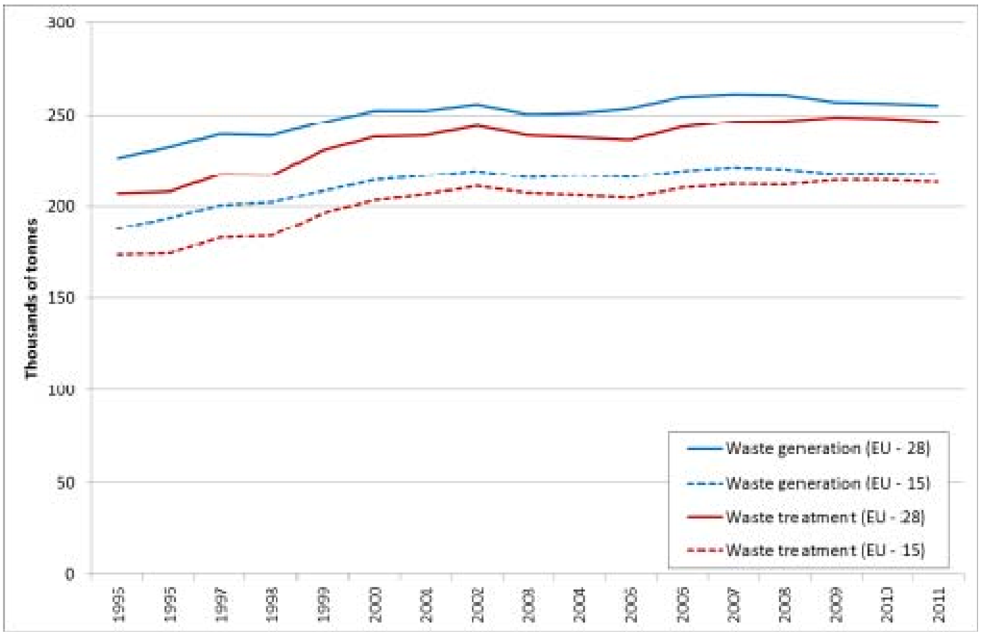


Source: Eurostat

Note: Composting and digestion aggregate not available for EU-15

As can be seen in the next figure, municipal waste generation increased markedly in the 1990s but showed a slight decrease during the financial and economic crisis in 2009. The amount of waste treated roughly follows the trend of waste generated. It can be seen that the gap between the two has been reduced in recent years.

Figure 2-28 Development of municipal waste generation and treatment since 1995.



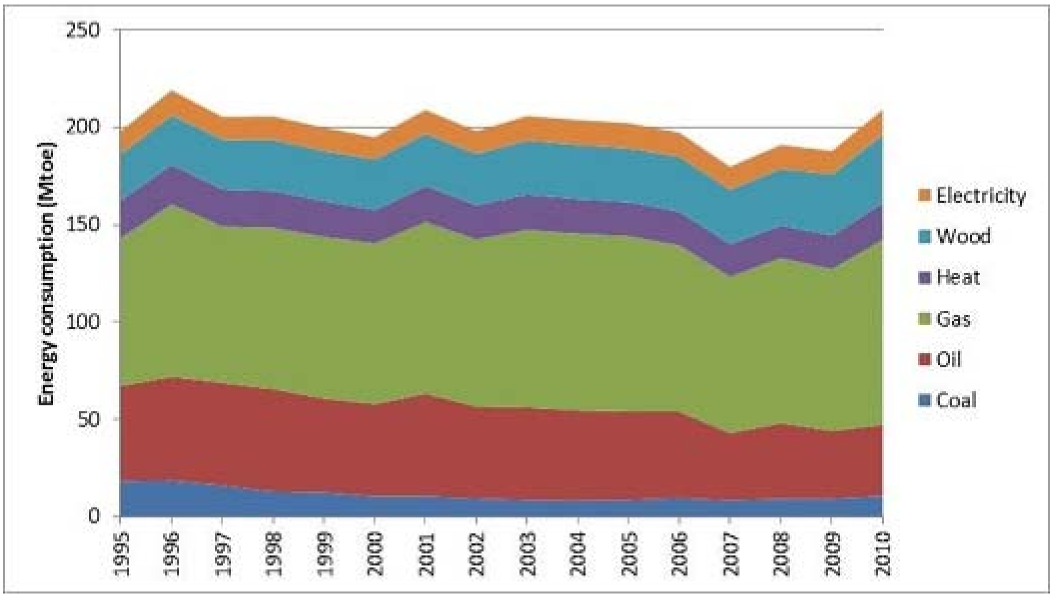
Source: Eurostat

Note: Data before 2006 not available for Croatia.

2.11. Building stock and urban structure

Energy consumption for space heating within buildings constitutes a significant component of all EU energy consumption. As a wide range of fuels is available for heating, the mix of these various fuels is crucial for the overall GHG emissions of this sector. The following figure shows the energy consumption of residential space heating in the EU, divided into fuel types.

Figure 2-29 Energy consumption of residential space heating in mega-tonnes of oil equivalents (Mtoe) in EU-28.



Source: Odyssee; Latvijas Statistica (for Latvia)

Note: data for Cyprus, Luxembourg, Malta, Portugal and Slovenia are not available for all years.

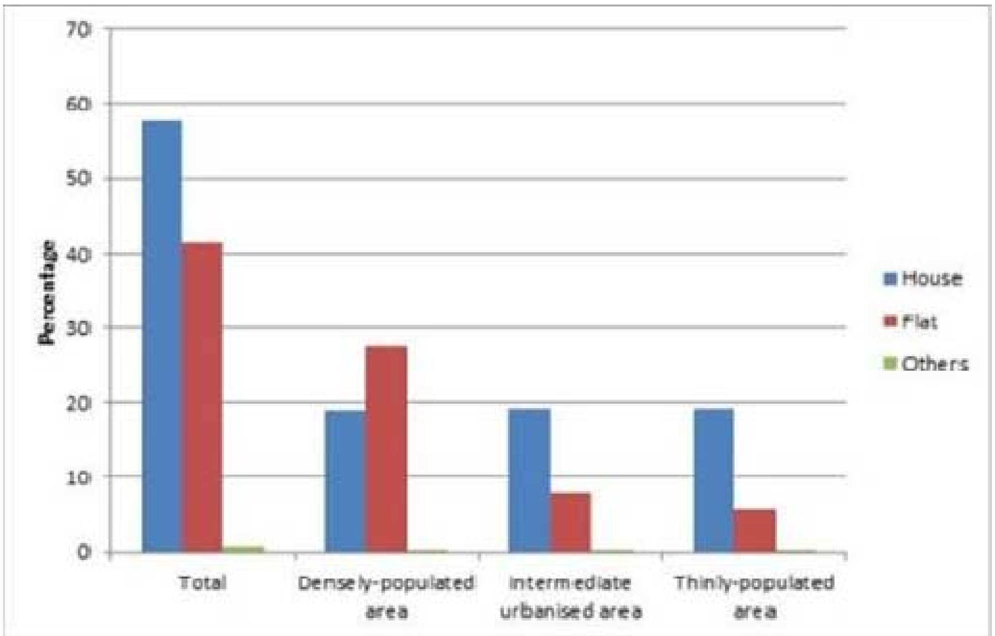
As can be seen in the figure above, coal consumption has decreased since 1996, but showed a slight increase in recent years. Its share in overall energy consumption currently amounts to 5 %, down from 9 % in 1995. Likewise, oil consumption has decreased from 25 % in 1995 to 17 % in 2010. At the same time, the share of gas consumption in residential space heating has increased from 37 % in 1995 to 46 % in 2010. This has important implications on overall GHG emissions from residential heating, as the CO_2 emission intensity is much lower for natural gas than for oil or coal.

Concerning the remaining categories of energy consumption, the past 15 years saw a slight decrease in (district) heat and an increase in wood and electricity used for residential heating.

The overall energy consumption of residential heating has not changed significantly over the past 15 years. Factors that affect overall energy consumption include increased energy efficiency, type of housing, residential area per capita and overall population. Annual fluctuations in the figure above can be explained by weather patterns such as a mild winter in 2007.

The type of housing is important because generally the ratio of residential area to outer wall area is more advantageous in flats compared to houses, resulting in lower energy consumption for heating. Densely populated areas with their high share of flats (see the following figure) are in many cases characterised by lower energy consumption per square meter.

Figure 2-30 Breakdown of types of housing in the EU-27 in 2011.

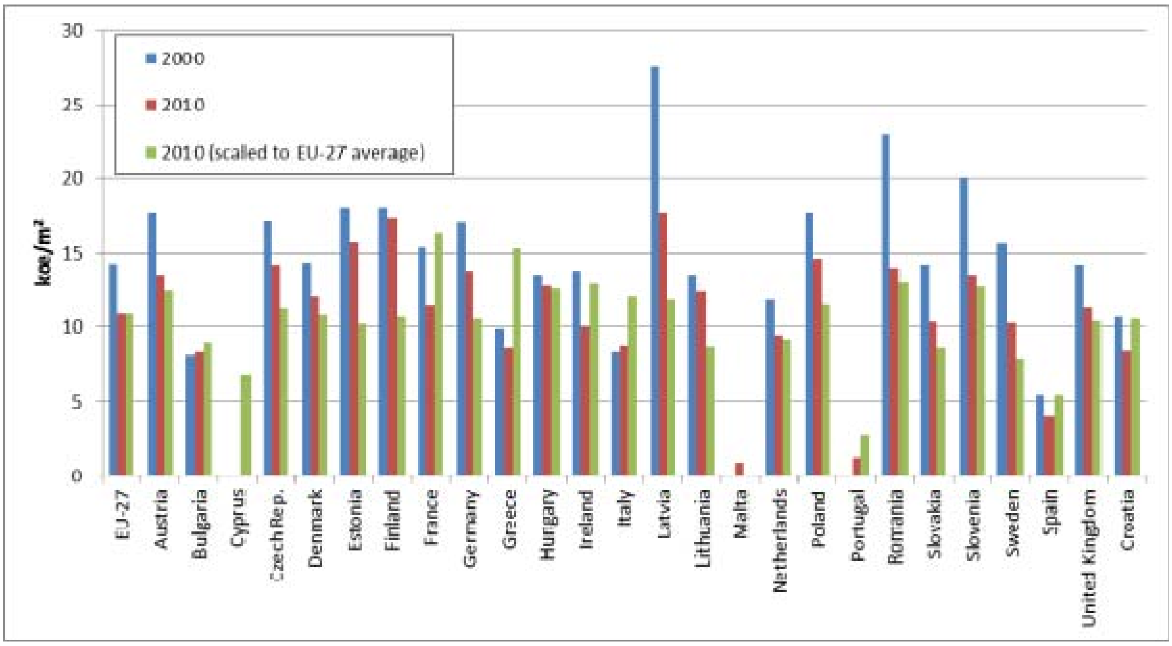


Source: Eurostat

Although overall energy consumption of residential heating has not changed significantly over the past decade, the energy consumption per unit area has decreased, as a result of higher energy efficiency. For example, the EU average energy consumption per square meter has decreased by 23 % from 14.3 to 11.0 kilogrammes of oil equivalents (see the following figure).

Climate-corrected energy consumption is also shown. It provides a good proxy for the thermal and heating system efficiency of households as it is corrected for the effect of size of building and average climate of the various Member States.

Figure 2-31 Household energy consumption for space heating in kilograms of oil equivalents per square meter (koe/m²), 2000 and 2010.

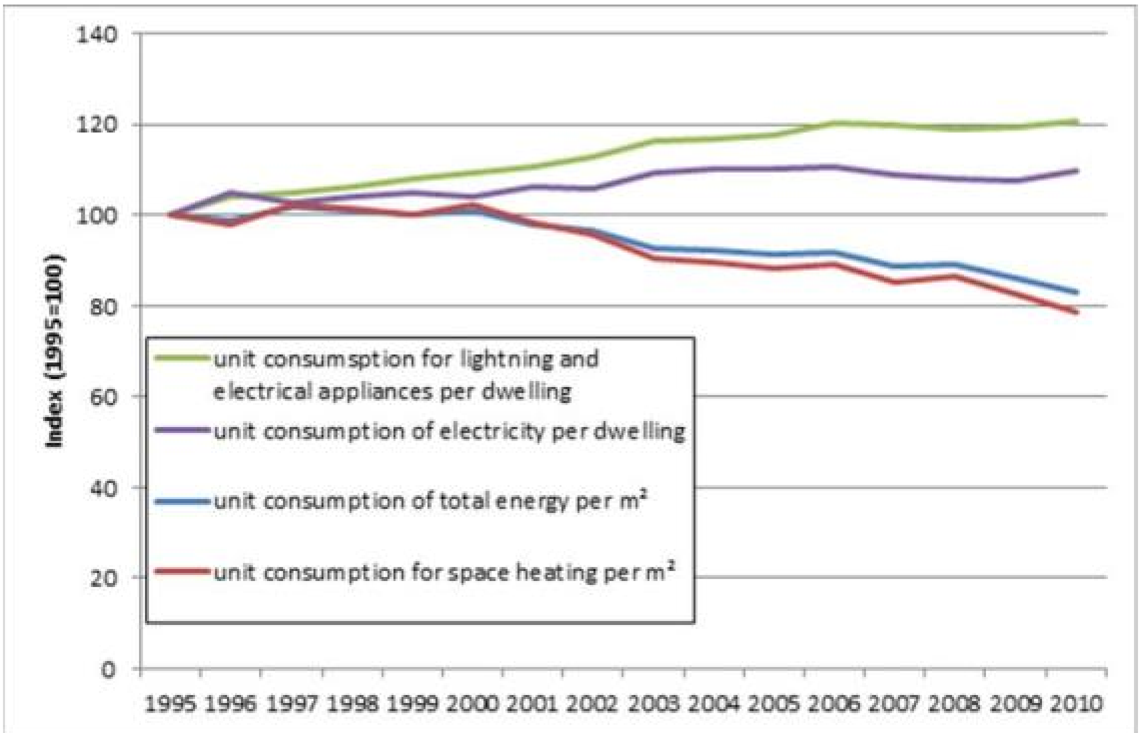


Source: Odyssee

Note: Data for 2000 and 2010 are climate corrected against each country's long-term average climate, whereas the last series is climate corrected and scale against the EU - 27 long-term average climate to account for temperature differences between countries. Data for Luxembourg, Belgium not available; for Malta, Netherlands and Portugal data is only partly available.

The buildings sector has one of the highest potentials for improved energy efficiency. Measures to reduce the space heating/cooling demand in buildings represent a significant part of this potential. Many of these measures (e.g. improved insulation) are highly cost-effective, but a number of barriers to their implementation exist, for example, high costs of initial investment. With regard to unit consumption of total energy and heating per square meter, it can be seen in the next figure that households reduced this energy consumption by almost 20 % since 1995. On the other hand, total electricity consumption per dwelling increased by 10 %, electricity consumption for lightning and appliances even increased by 20 % compared to 1995 levels, caused by the increasing stock of electrical appliances and larger homes.

Figure 2-32 Unit consumption of energy in households



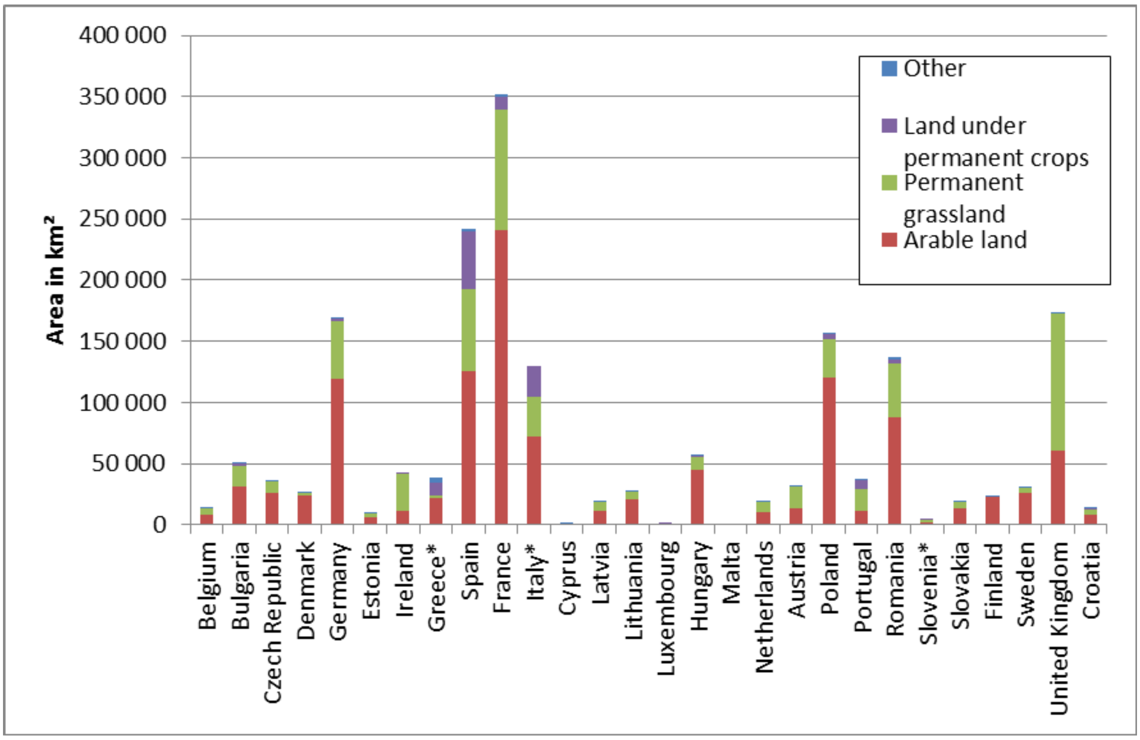
Source: Odyssee

2.12. Agriculture

In 2009 the total utilized agricultural area (UAA) in the EU amounts to 1.86 million km² which corresponds to 41.5 % of the total EU-28 area. On the overall EU-28 the area of land under agricultural use has been relatively stable revealing only a slight decrease of approximately 2.5 % between 2000 and 2009.The distribution of different land use types did not change either. Nevertheless, there are different trends among the Member States. In some Eastern countries of the EU (e.g. Slovakia, Latvia and Lithuania) a tendency of shrinking UAA can be observed. These countries face a deep restructuring process in their agricultural sectors. In other countries the UAA only slightly decreased (Austria, Portugal and Spain) and in some cases increased (France, United Kingdom, Malta, and Denmark).

Figure 2-34 shows the land use patterns of the Member States. France has the largest utilized agricultural area, followed by Spain, United Kingdom, Germany and Italy. Regarding the UAA categories, Spain, Greece and Italy are leading in terms of cropland (9 % of their total national surface area). Ireland has the largest share of permanent grasslands covering more than 40 % of its area.

Figure 2-33 Total utilized agricultural land and usage patterns in 2009 in the EU-28.



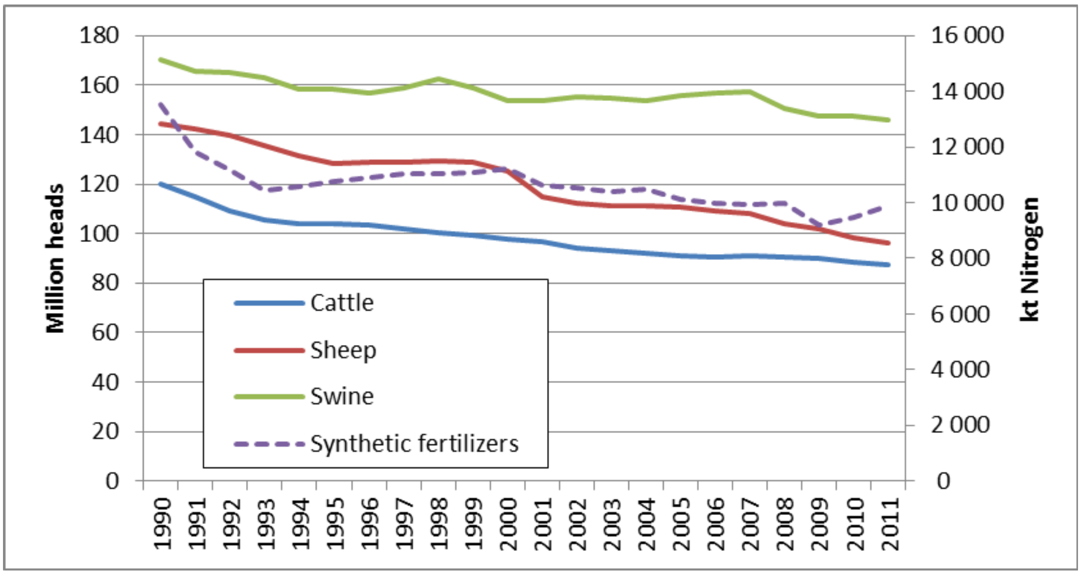
Source: Eurostat

Note: Incomplete data for Italy, Slovenia, and Greece. Missing figures were gap-filled with most recent data available.

Agriculture constitutes a significant source of GHG emissions, for example due to N_2O associated with fertilizer use and CH_4 emissions from livestock (as well as energy consumption in the sector itself). Related trends are highlighted in more detail in the figure below (trends in agriculture emissions are outlined in section3.2.3).

The use of nitrogenous fertilizers (in mineral and organic form) is an important factor driving agricultural emissions. The use of mineral nitrogenous fertilizer amounted to 9,.6 million tons in 2010, while was 30 % higher in 1990. The overall livestock in the EU-27 has substantially decreased since 1990, particularly ruminants which are emitters of enteric methane. The sheep herd amounts to around 95 million heads and the cattle herd counts approximately 87 million heads. Swine is the largest livestock sector with nearly 146 million heads.

Figure 2-34 EU-27 Fertilizer consumption and livestock.

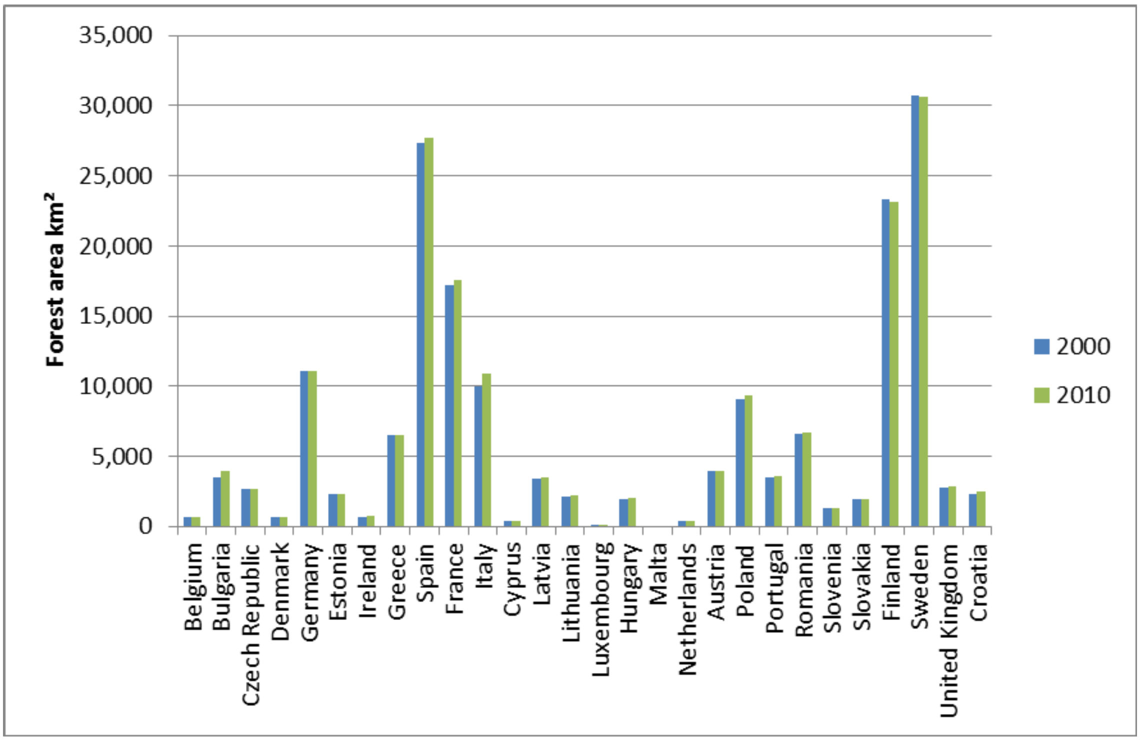


Source: Annual European Union greenhouse gas inventory 1990–2011

2.13. Forests

Overall, the total forested area across the EU-28 Member States increased by 3 % between 2000 and 2010. In 2010, the forested area amounted to approx. 1.8 million km² which is almost 40 % of the total EU-28 area. The forest area increased in all countries, with the exception of Sweden and Finland (showing a very slight decrease of -0.36 % and -0.71 % respectively between 2000 and 2010). Six countries make up two thirds of the total forested area: Sweden, Spain, Finland, France, Germany and Italy. The increase in forested and wooded areas throughout the EU is important for climate change mitigation, given their role as a carbon sink (trends in emissions related to Land-Use, Land-Use Change and Forestry are provided in section 3.2.3).

Figure 2-35 Forested area in 2000 and 2010



Source: Eurostat

Note: Total forested area including other wooded land.

3. GREENHOUSE GAS INVENTORY INFORMATION

Key developments

- Total GHG emissions in the EU-15 (without LULUCF) decreased by 14.7 % from 1990 to 2011. Over the same period, EU-28 GHG emissions decreased by 18.3 %. In both EU-15 and EU-28 the biggest relative change has been in the waste sector where the emissions of CH_4 from managed waste disposal on land decreased substantially.
- Averaged over the latest four years, EU-15 emissions (without LULUCF) were 11.2 % and EU-28 emissions (without LULUCF) were 15.6 %below the emission level of 1990.
- Emissions of total greenhouse gases decreased by 4.2 % in the EU-15 and 3.3 % in the EU-28 between 2010 and 2011. This was largely due to a strong emission decrease in households and services. Milder winter conditions and the lower demand for heating can partly explain lower emissions in 2011 compared to 2010.

3.1. Introduction

This chapter presents greenhouse gas emission trends of the European Union (EU) for the EU-15 and EU-28 for the period 1990-2011. The EU submits an inventory for EU-15 under the Kyoto Protocol and for EU-28 under the UNFCCC. The legal basis of the compilation of the EU inventory and the inventory methodology and data availability are also described briefly. The greenhouse gas data presented in this chapter are consistent with the 2013 submission of the EU to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat[21], except for the EU-28 aggregates, where the data for Croatia was added to the data for EU-27 to reflect the enlargement of the Union to 28 Member States as of 1 July 2013. Thus, as the 2013 EU inventory was submitted prior to this enlargement, it covers the EU-27 only. However, at the date of submission of this National Communication, the EU now covers the 28 Member States, as will the inventory submission in 2014. The aggregates for the EU-15 with a collective arrangement for fulfilment of the Kyoto target under the first commitment period are not affected. The data for Croatia was taken from Croatia's GHG inventory resubmission to the UNFCCC.

Summary tables of GHG emissions for the EU-15 and the EU-28 in the common tabular format are presented in CTF Tables 1 (a) and 1 (b) in the CTF Appendix. These data and the complete submissions of the Member States under Decision 280/2004/EC are available on the EEA website (http://www.eea.europa.eu/).

The EU inventory has been compiled from data delivered by the 27 Member States by 15 March 2013 under Decision 280/2004/EC, and subsequent updates to these data received by 15 May 2013. The data presented in NC6 takes into account the resubmission of the EU inventory to the UNFCCC of 18 November 2013. The data for Croatia, which was added to compile the EU-28 aggregates, was taken from its UNFCCC resubmission made on 15 November 2013.

21 European Environment Agency, Technical Report No 08/2013 Annual European Union greenhouse gas inventory 1990–2011 and inventory report 2013.

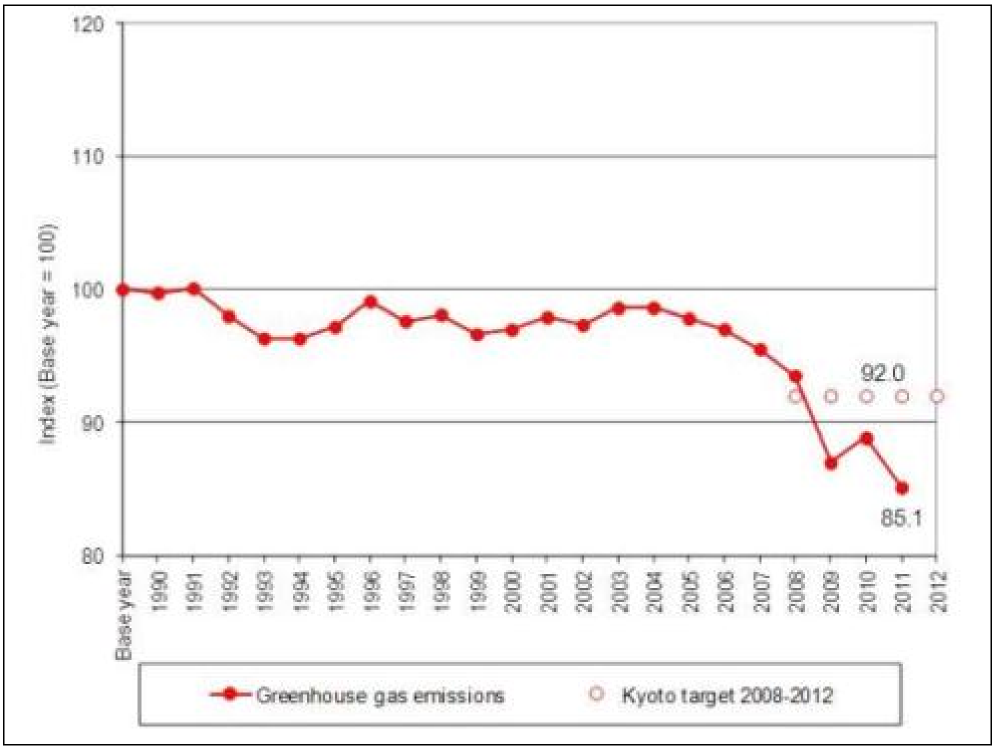
3.2. Descriptive Summary of GHG Emissions Trends

3.2.1. Overall greenhouse gas emissions trends

In 2011 total GHG emissions in the EU-15, without LULUCF, were 14.7 % (623 million tonnes CO_2 equivalents) below 1990, and 14.9 % (635 million tonnes CO_2 equivalents) below its Kyoto base year (Figure 3-1). Between 2010 and 2011 emissions decreased by 4.2 % (159.6 Mt of CO_2 equivalents).

Under the Kyoto Protocol, the EU-15 (the 15 Member States of the Union at the time) agreed to reduce their GHG emissions collectively by 8 % over the 2008-2012 period compared to the 'base year'[22]. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks and the use of Kyoto mechanisms. Since 2009 total GHG emissions have been below the EU-15 Kyoto target (CTF Tables 1 (a) in the CTF Appendix).

Figure 3-1 EU-15 GHG emissions 1990-2011 compared with Kyoto target for 2008-2012 (excluding LULUCF)

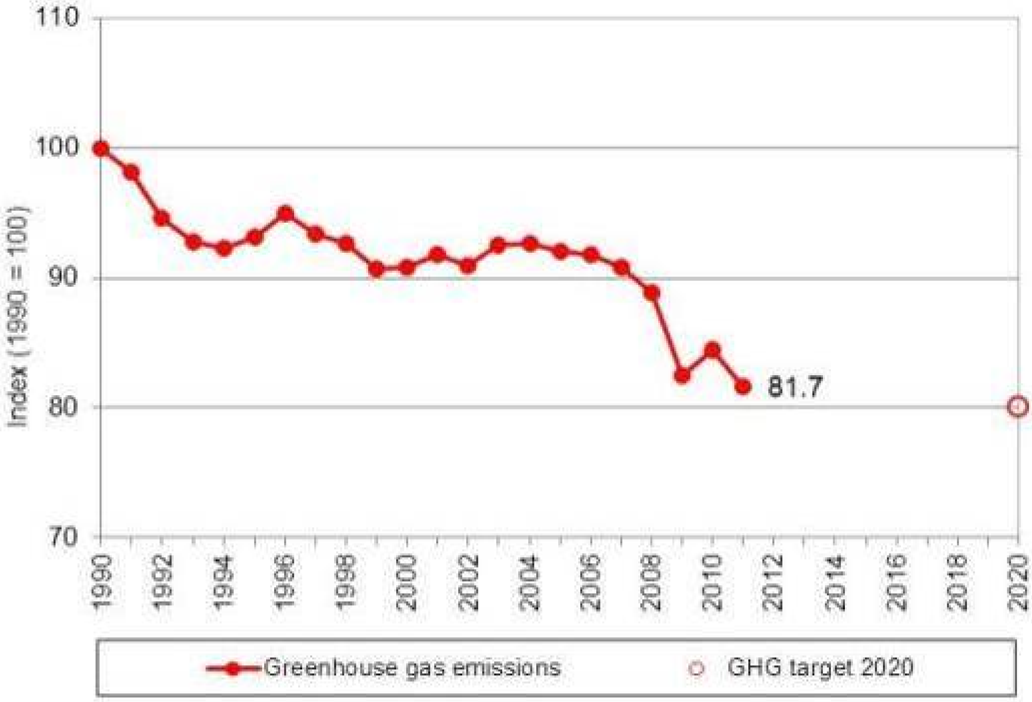


Source: EEA

Total GHG emissions, without LULUCF, in the EU-28 decreased by 18.3 % between 1990 and 2011 (-1028 Mt of CO_2 equivalent). Between 2010 and 2011, emissions decreased by 3.3 % (155.3 Mt CO_2 equivalent) (Figure 3-2).

22 Following the UNFCCC reviews of Member States' 'initial reports' during 2007 and 2008 and pursuant to Article 3, Paragraphs 7 and 8 of the Kyoto Protocol, the base-year emissions for the EU-15 have been fixed to 4 265.5 Mt CO2 equivalent.

Figure 3-2 EU-28 GHG emissions 1990-2011 (excluding LULUCF)



Source: EEA

3.2.2. Emission Trends by Gas

CTF Table 1 (a) in the CTF Appendix provides an overview on the main trends in the EU-15 GHG emissions and removals for 1990–2011. In the EU-15 the most important GHG is CO_2, accounting for 82.7 % of total EU-15 emissions in 2011. In 2011, EU-15 CO_2 emissions without LULUCF were 3 003 Tg, which was 10.8 % below 1990 levels. Compared to 2010, CO_2 emissions decreased by 4.8 %. CH_4 and N_2O emissions account for 8 % and 7 % of total GHG emissions respectively in 2011; both gases show falling trends. Fluorinated gases are increasing and account for the remaining 2 % of total GHG emissions.

CTF Table 1 (b) in the CTF Appendix provides an overview of the main trends in EU-28 GHG emissions and removals for 1990–2011. The most important GHG by far is CO_2, accounting for 82.2 % of total EU-28 emissions in 2011 excluding LULUCF. In 2011, EU-28 CO_2 emissions without LULUCF were 3 764 Tg, which was 15 % below 1990 levels. Compared to 2010, CO_2 emissions decreased by 3.8%. CH_4, N_2O and fluorinated gases account for 9 %, 7 % and 2 % of total GHG emissions respectively in 2011.

3.2.3. Emission Trends by Main Source Categories

CTF Table 1 (a) in the CTF Appendix provides an overview of EU-15 GHG emissions in the main source categories for 1990–2011. As emissions from international aviation and shipping are excluded from national totals they are not presented in the table.

The sector energy contributed 80 % to total GHG emissions being the largest source category in the EU-15. Total GHG emissions from this sector decreased by 11.7 % from 3 282 Tg in 1990 to 2 898 Tg in 2011. The main reasons for the falling emissions since

1990 are efficiency improvements and fuel shifts from coal to gas in electricity and heat production and in manufacturing industries. In addition, efficiency improvements, fuel shifts and better insulation of buidlings contributed to the falling trend.

The sector agriculture is the second largest source category in the EU-15 (10 % to total GHG emissions). Total GHG emissions from this sector decreased by 14.8 % from 434 Tg in 1990 to 370 Tg in 2011, reflecting falling cattle population and lower fertiliser and manure use on agricultural soils.

The sector industrial processes is the third largest source category (7 % to total EU-15 GHG emissions in 2011). Total GHG emissions from this sector decreased by 28.3 % from 353 Tg in 1990 to 253 Tg in 2011, mainly due to emission reduction measures in adipic acid production, nitric acid production and production of halocarbons.

The remaining emissions stem from the sectors waste and solvent and other product use with 2.8 % and 0.2 % of the EU-15 total emissions in 2011. In addition, the sector land use, land use change and forestry (LULUCF) was responsible for a net emission removal of 174 million tonnes of CO_2-equivalent in 2011, marking an increase of emission removals of 27.2 % since 1990. Overall, net emission removals from LULUCF accounted for 5 % of total GHG emissions in 2011. Forests are a significant net carbon sink, croplands are a source and grasslands are a small sink.

CTF Table 1 (b) in the CTF Appendix provides an overview of EU-28 GHG emissions in the main source categories for 1990–2011. The most important sector by far is Energy (i.e. combustion and fugitive emissions), accounting for 79.4 % of total EU-28 emissions in 2011. The second largest sector is Agriculture (10.1 %), followed by Industrial Processes (7.3 %). Waste and solvent and other product use accounted for 2.9 % and 0.2 % of the EU-28 total emissions, while LULUCF contributed over 297 million tonnes of net emission removals in 2011. Emissions from international aviation and shipping are excluded from the national totals and therefore not presented in the table.

International bunker emissions of the EU inventory are the sum of the aviation bunker and maritime bunker emissions of the Member States. These emissions are reported as memo items but excluded from national totals. Emissions of greenhouse gases from international aviation and shipping activities both increased constantly between 1992 and 2007. Between 2008 and 2010 international bunker emissions decreased in the EU-28, partly reflecting the economic recession, but have increased again in 2011. Total GHG emissions from international transport reached 299 million of CO_2 equivalents in 2011. Emissions from these two categories are equivalent to 3.8 % for international aviation (136 Mt) and 4.5 % for international navigation (163 Mt) of total EU-28 GHG emissions in 2011. In 2011, emissions from aviation bunkers and maritime bunkers are still 95 % and respectively 48 % above 1990 levels.

3.2.4. Change in Emissions from Key Categories for EU-15 and EU-28

Key categories are defined as the sources or removals of emissions that have a significant influence on the inventory as a whole, in terms of the absolute level of the emissions, the trend, or both.

Carbon dioxide

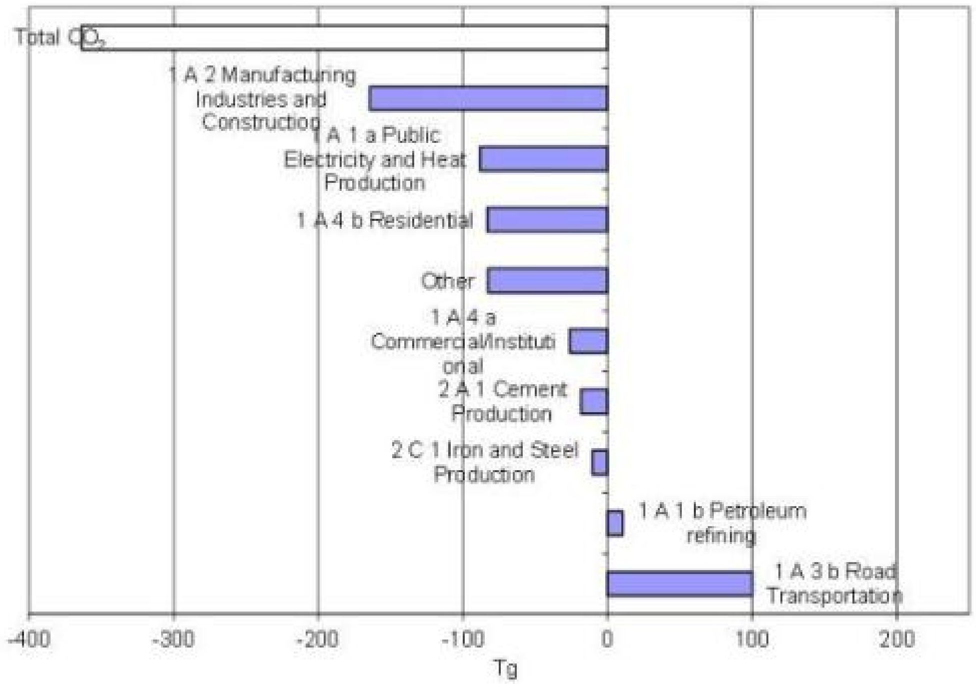
CO_2 emissions from ‘electricity and heat production’ are the largest key category in the EU-15, accounting for 24 % of total greenhouse gas emissions in 2011 and for 83 % of greenhouse gas emissions of the Energy Industries Sector. As can be seen in Figure 3-3, below, this category shows the second largest decrease between 1990 and 2011. Fuel used for ‘public electricity and heat production’ increased by 13 % in the EU-15 between 1990 and 2011, however, CO_2 emissions from ‘public electricity and heat production’ did not increase in line with fuel consumption. Between 1990 and 2011, CO_2 emissions from electricity and heat production decreased by 9 % in the EU-15. The main explanatory factors at EU-15 level have been improvements in energy efficiency and (fossil) fuel switching from coal to gas.

CO_2 emissions from ‘road transportation’ are the second largest key source of all categories in the EU-15 accounting for 20.4 % of total GHG emissions in 2011. Between 1990 and 2011, CO_2 emissions from road transportation increased by 16 % in the EU-15 due to an increase in fossil fuel consumption in this key category (Figure 3-3). Since 2007 the large increase in ‘road transportation’-related CO_2 emissions was offset by reductions in energy-related emissions from manufacturing industries and construction and ‘public electricity and heat production.

CO_2 emissions from ‘manufacturing industries and construction’ are the fourth largest key source in the EU-15, accounting for 13 % of total GHG emissions in 2011. Between 1990 and 2011, emissions from this category showed the largest decrease, as they declined by 26 % in the EU-15. The emissions from this key source are due to fossil fuel consumption in ‘manufacturing industries and construction’, which was 13 % below 1990 levels in 2011. A shift from solid and liquid fuels to mainly natural gas took place and an increase of biomass and other fuels has been recorded.

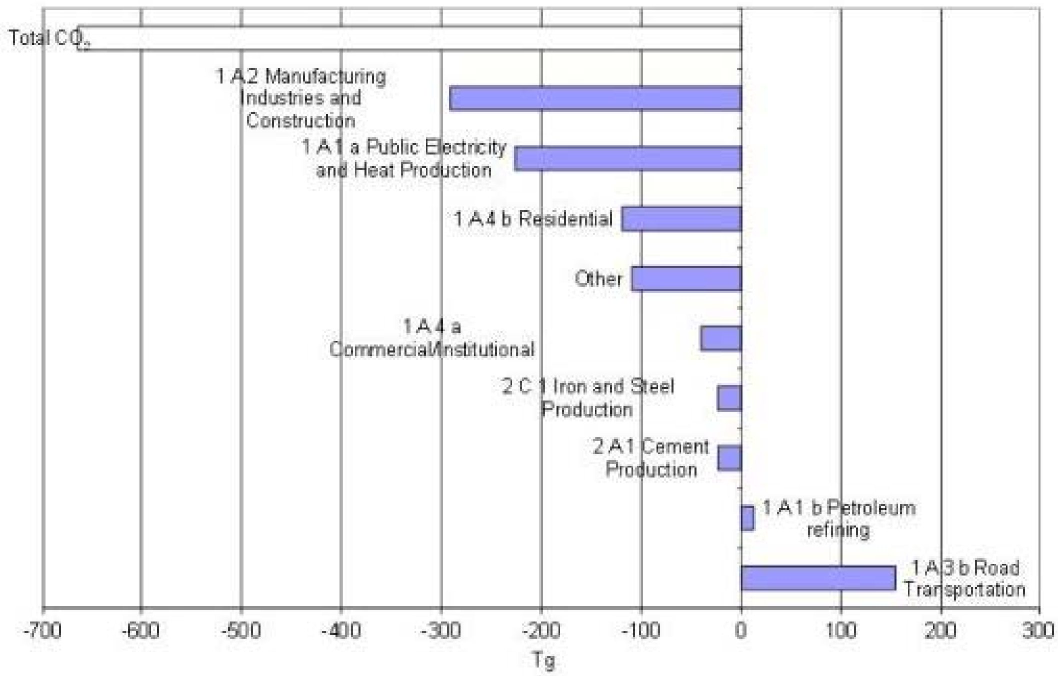
For EU-28 a similar trend in the change of CO_2 emissions from key categories can be observed (Figure 3-4).

Figure 3-3 Absolute change of CO2 emissions by large key categories 1990 to 2011 in CO2 equivalents (Tg) for EU-15



Source: EEA

Figure 3-4 Absolute change of CO2 emissions by large key categories 1990 to 2011 in CO2 equivalents (Tg) for EU-28

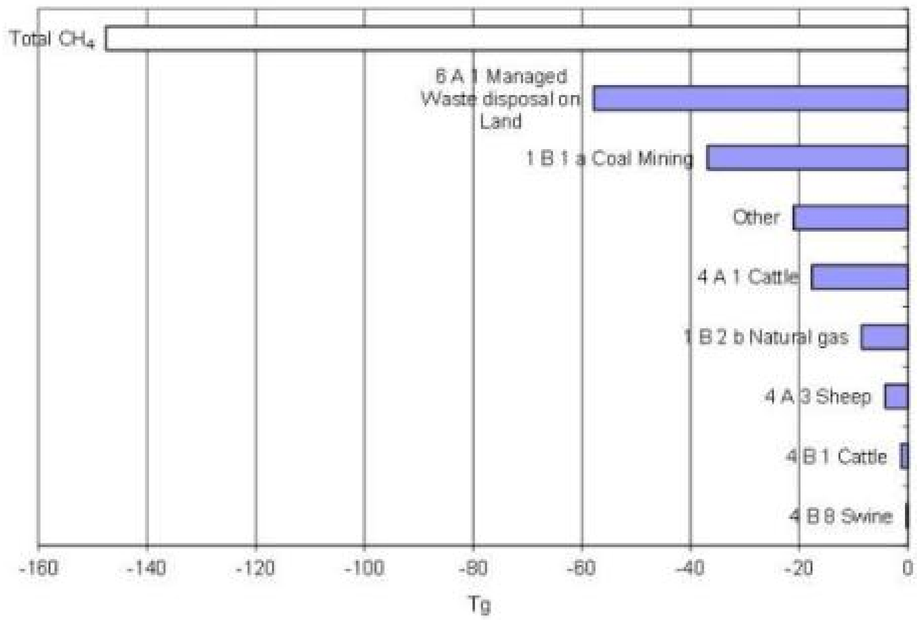


Source: EEA

Methane

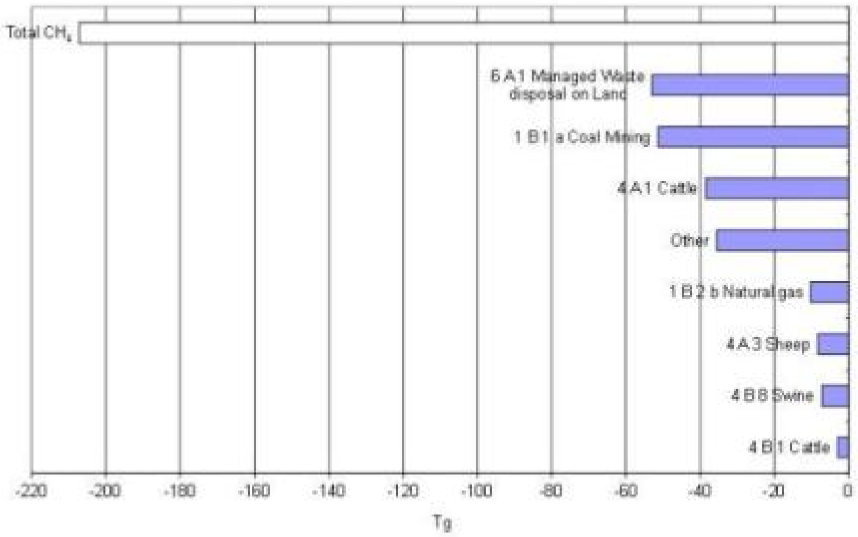
Methane emissions account for 8 % of total EU-15 GHG emissions in 2011 and decreased by 34 % since 1990 to 289 Tg CO_2 equivalents in 2011 (Figure 3-5). The two largest key sources (6 A 1 Managed Waste Disposal on Land at 23.1 % and 4 A 1 Cattle at 34.7 %) account for 57.8 % of CH_4 emissions in 2011. Figure 3-5 shows that the main reasons for declining CH_4 emissions were reductions in 'managed waste disposal on land' mainly caused by the increased use of recycling and incineration of waste with energy recovery and reductions in 'coal mining'. Figure 3-6 shows that the reduction of these two key categories were mostly due to developments in EU-15 while in EU-28 reductions in the CH_4 emissions from 'cattle' added significantly to the overall reduction of methane emissions.

Figure 3-5 Absolute change of CH4 emissions by large key categories 1990 to 2011 in CO2 equivalents (Tg) for EU-15



Source: EEA

Figure 3-6 Absolute change of CH4 emissions by large key categories 1990 to 2011 in CO2 equivalents (Tg) for EU-28

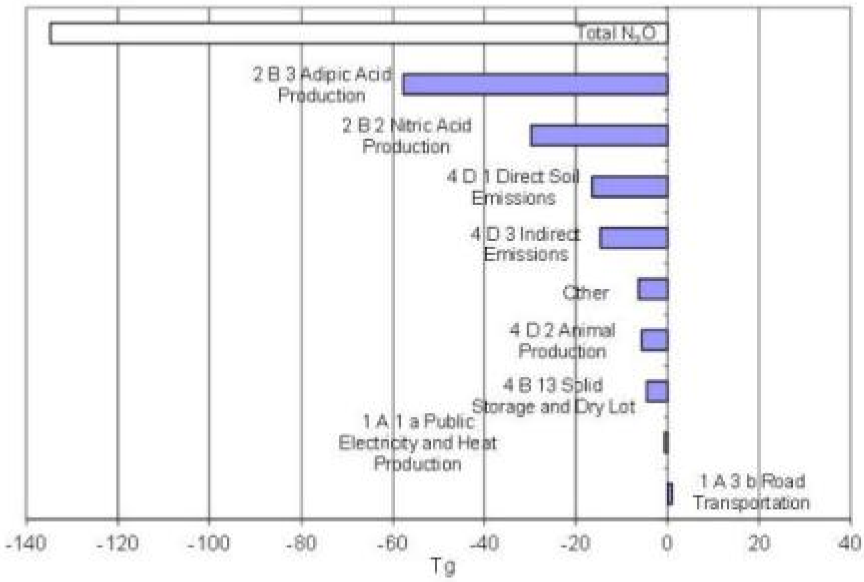


Source: EEA

Nitrous oxide

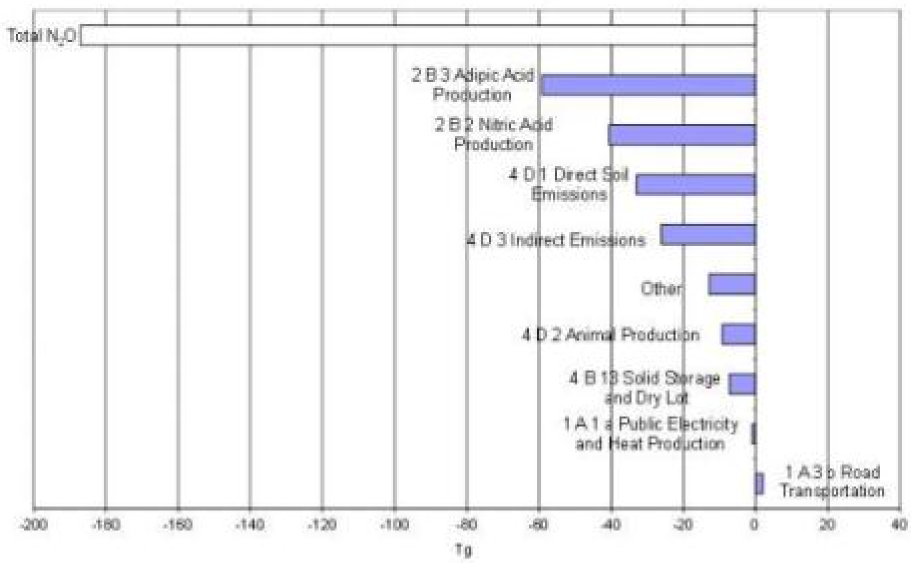
N_2O emissions are responsible for 7.3 % of total EU-15 GHG emissions and decreased by 34.1 % to 264 Tg CO_2 equivalents in 2011 (Figure 3-7). The two largest key sources causing this trend (4 D 1 Direct Soil Emissions at 36.6 % and 4 D 3 Indirect Emissions at 24.9 %) account for approx. 61.5 % of N_2O emissions in 2011. The main reason for large N_2O emission cuts were reduction measures in the ‘adipic acid production’. When also considering the new Member States, emission cuts in the key categories ‘direct soil emissions’ and ‘Indirect emissions’ mostly added to this overall trend in reducing N_2O emisions in the EU-28 (Figure 3-8).

Figure 3-7 Absolute change of N2O emissions by large key categories 1990 to 2011 in CO2 equivalents (Tg) for EU-15



Source: EEA

Figure 3-8 Absolute change of N2O emissions by large key categories 1990 to 2011 in CO2 equivalents (Tg) for EU-28



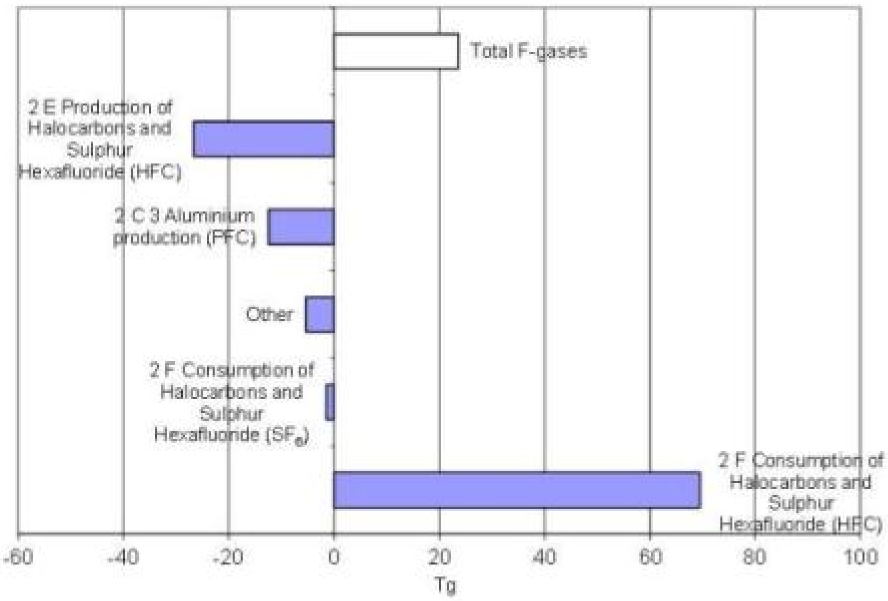
Source: EEA

Fluorinated gases

Fluorinated gas emissions account for 2.2 % of total EU-15 GHG emissions. In 2011, emissions were 80 Tg CO_2 equivalents, which was 42.9 % above 1990 levels (Figure 3-9). The two largest key categories (i.e. HFC from consumption of halocarbons and consumption of SF_6) account for 94 % of fluorinated gas emissions in 2011. HFC emissions from the ‘consumption of halocarbons’ showed large increases between 1990 and 2011. The main reason for this is the phase-out of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, foam production and as aerosol propellants). On the other hand, HFC emissions from the 'production of halocarbons' decreased substantially. The decrease started in 1998 and was strongest in 1999 and 2000. This is mostly the result of reducing HFC-23 by-production by destroying this substance as part of the process. From the remaining F-gases, both perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) showed overall decreases, both in the EU-15 and in the EU-28.

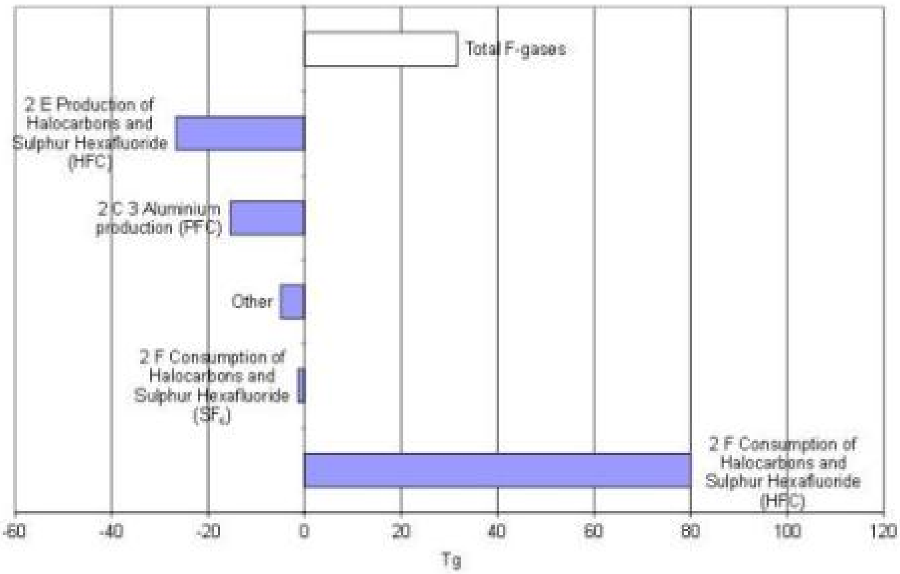
Figure 3-10 shows that the trend in F-gases in EU-28 is very similar to the trend in EU-15.

Figure 3-9 Absolute change of F-gas emissions by large key categories 1990 to 2011 in CO2 equivalents (Tg) for EU-15



Source: EEA

Figure 3-10 Absolute change of F-gas emissions by large key categories 1990 to 2011 in CO2 equivalents (Tg) for EU-28

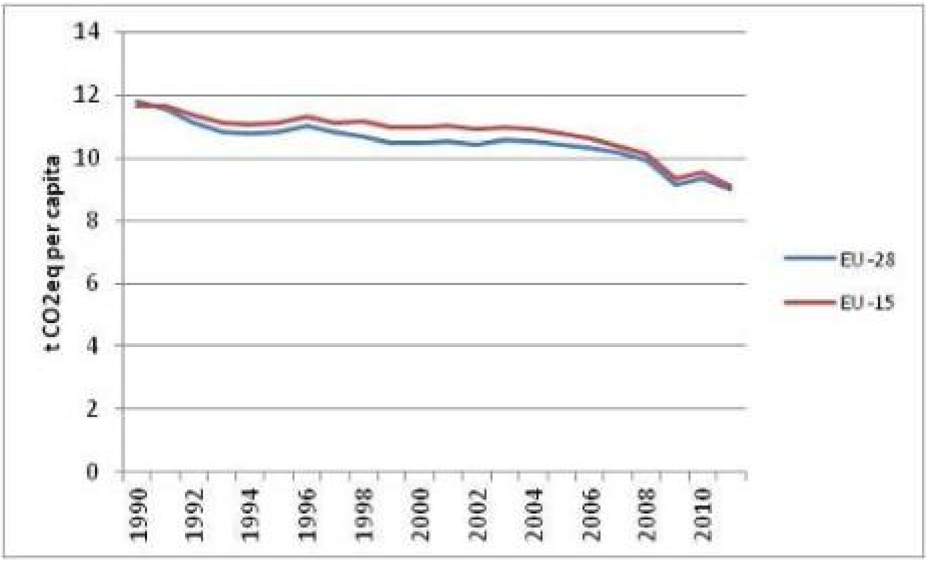


Source: EEA

3.2.5. *Key Drivers Affecting Emission Trends*

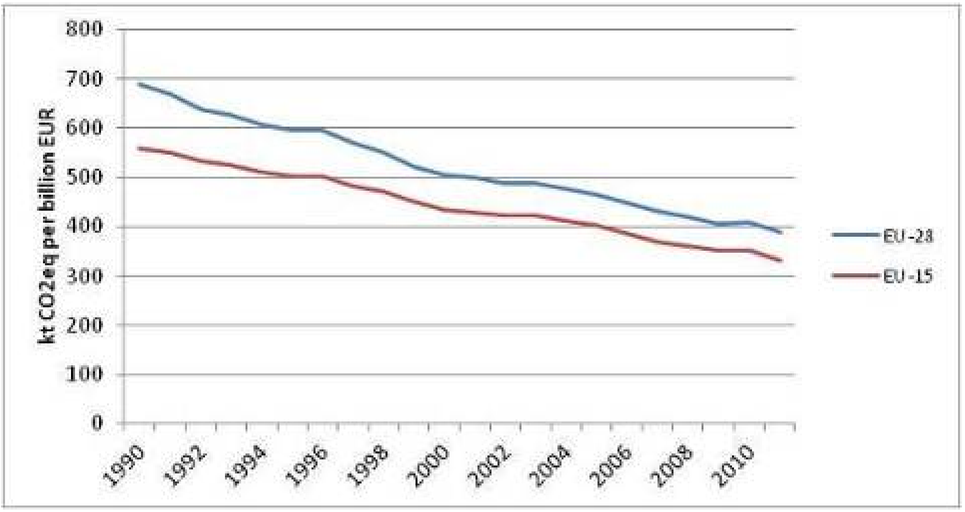
The main reasons for the changes during the period 1990-2011 are described in more detail in section 2 (National Circumstances). Two main drivers of greenhouse gas emissions are population and economic growth. As described in section 2, population grew by 9 % (EU-15) and 7 % (EU-28) and GDP increased by 44 % (EU-15) and 45 % (EU-28) between 1990 and 2011. As GHG emissions declined by 15 % (EU-15) and 18 % (EU-28) both GHG per capita and GHG emissions per GDP fell considerably.

Figure 3-11 GHG emissions per capita 1990 to 2011 for EU-15 and EU-28



Source: EEA, Eurostat

Figure 3-12 GHG emissions per GDP 1990 to 2011 for EU-15 and EU-28



Source: EEA, Eurostat

Since NC4 in 2007, emissions decreased in the EU-28, with a sharp drop in 2009, when the economic downturn caused substantial emission reductions in all Member States. In 2010, emissions increased again, partly driven by the economic recovery from the 2009 recession in many European countries. In particular emissions from iron and steel production and other manufacturing industries increased significantly in 2010.

The sections below summarise the main reasons for the changes in emissions in the EU during the period 2010-2011.

Main reasons for changes in EU-15 emissions, 2010–2011

The 2011 winter was warmer than in the previous year, leading to decreased demand for heating and lower emissions from the residential and commercial sectors.

The 159.6 million tonnes (CO_2 equivalents) decrease in GHG emissions between 2010 and 2011 was mainly due to the following factors:

- A strong emission decrease in households and services (-93.9 million tonnes, or -15.3 %) in almost all EU-15 Member States. Milder winter conditions and the lower demand for heating can partly explain lower emissions in 2011 compared to 2010.
- Decreasing emissions in electricity and heat production (-28.9 million tonnes, or -3.2 %) in particular in the UK and France. In both countries, reductions in demand for electricity was accompanied by greater use of nuclear power and lower use of gas (UK) and coal (France) for electricity generation.
- Decreasing emissions in road transportation (-8.6 million tonnes, or -1.2 %), following a decreasing trend for the fourth consecutive year, which was driven by reductions in both passenger and freight transportation.
- Reduced emissions in the category 'manufacturing industries excluding iron and steel industry' (-10.5 million tonnes, or -2.8 %) in particular in Greece, Italy, Portugal, Spain and the UK. The main reasons were a decline in

industrial production (Greece, Spain), a decline in cement production (Greece, Portugal, Spain, and Italy) and a fuel shift from oil to natural gas in the UK manufacturing industry.

- A slight decrease in emissions from iron and steel production (-4.4 million tonnes, or -3 %) following a substantial increase in emissions in 2010 (+29.6 million tonnes or +25.8 %) which was caused by a significant increase in crude steel production due to the recovery from the economic crisis.
- A substantial decrease in emissions from nitric acid production (-3.8 million tonnes, or -40 %) mainly driven by decreases in Belgium, France and the United Kingdom.

Main reasons for emission changes in the EU-28, 2010-2011

Between 2010 and 2011, emission decreases in the EU-28 were mainly due to:

- CO_2 from households and services (-104.5 million tonnes, or -14 %). This decrease was mainly caused by emission reductions in the EU-15. Among the new Member States Poland and the Czech Republic reported the highest decreases.
- CO_2 from public electricity and heat production (-19.5 million tonnes, or -1.6 %). This decrease was mainly caused by the EU-15, while Bulgaria, Romania and Poland had an opposing trend.
- CO_2 from manufacturing industries excl. iron and steel (-11.7 million tonnes, or -2. %). This decrease was mainly due to EU-15 Member States. Half of the new Member States also reported slightly decreasing emissions, while Poland's emission increased by 10 %.
- CO_2 emissions from road transport (-8.6 million tonnes, or -1 %). This decrease was mainly due to emission reductions in the EU-15. Most of the new Member States also contributed to this decreasing trend, while Estonia, Poland, Romania and Slovenia reported emission increases.
- Other major emission decreases occurred in nitric acid production, iron and steel production and solid waste disposal.

Substantial emission increases between 2010 and 2011 in the EU-28 were only reported for:

- N_2O from agricultural soils (+4.3 million tonnes, or +1.8 %).

3.2.6. Information on Indirect Greenhouse Gas Emissions for EU-15

Emissions of CO, NO_x, NMVOC and SO_2 have to be reported to the UNFCCC Secretariat because they influence climate change indirectly: CO, NO_x and NMVOC are precursor substances for ozone which itself is a greenhouse gas. Sulphur emissions produce microscopic particles (aerosols) that can reflect sunlight back out into space and also affect cloud formation. Table 3-1 shows the total indirect GHG and SO_2 emissions in the EU-15 between 1990 and 2011. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (-86 %), followed by CO (-67 %), NMVOC (-57 %) and NO_x (-49 %).

Table 3-1 Overview of EU-15 indirect GHG and SO_2 emissions for 1990–2011 (Gg)

INDIRECT GHG EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
	(Gg)									
NO_x	13 673	12 023	10 490	9 482	9 175	8 866	8 140	7 453	7 246	6 966
CO	53 825	42 345	31 937	23 992	22 568	22 087	20 478	18 419	19 239	17 844
NMVOC	15 270	12 596	10 237	8 385	8 239	7 621	7 178	6 824	6 751	6 549
SO_2	16 459	9 986	6 144	4 572	4 353	4 142	3 090	2 668	2 451	2 390

Source: EEA

3.2.7. Information on Indirect Greenhouse Gas Emissions for EU-28

Emissions of CO, NO_x, NMVOC and SO_2 have to be reported to the UNFCCC Secretariat because they influence climate change indirectly. (See 3.2.6 for further explanation). In the EU-28, SO_2 emissions decreased by 78 %, followed by CO (-64 %), NMVOC (-55 %) and NO_x (-48 %) (Table 3-2).

Table 3-2 Overview of EU-28 indirect GHG and SO_2 emissions for 1990–2011 (Gg)

INDIRECT GHG EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
	(Gg)									
NOx	17 090	14 741	12 748	11 646	11 365	11 015	10 200	9 352	9 209	8 882
CO	67 029	51 691	39 198	30 913	29 580	28 860	27 409	25 124	26 162	24 395
NMVOC	17 957	14 487	11 960	10 076	9 958	9 297	8 859	8 344	8 301	8 065
SO_2	25 378	16 815	10 462	8 307	8 134	7 810	6 432	5 675	5 476	5 654

Source: EEA

3.2.8. Accuracy/Uncertainty of the Data

Table 3-3 shows the main results of the uncertainty analysis for the EU-15. The lowest level uncertainty estimates are for fuel combustion activities (1.2 %) and the highest estimates are for agriculture (75.9 %). Overall level uncertainty estimates including LULUCF of all EU-15 GHG emissions is calculated at 8.3 % and excluding LULUCF slightly lower, at 7.9 %.

With regard to trend uncertainty estimates the lowest uncertainty estimates are for fuel combustion activities (+/- 0.4 percentage points) and the highest estimates are for LULUCF (25.2 percentage points). Overall trend uncertainty (including LULUCF) of all EU-15 GHG emissions is estimated to be 1.1 percentage points.

Table 3-3 Tier 1 uncertainty estimates of EU-15 GHG emissions for the main sectors

Source category	Gas	Emissions 1990	Emissions 2011	Emission trends 1990-2011	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A Fuel combustion activities	all	3 182 229	2 853 395	-10.3%	1.2%	0.4%
1.B Fugitive emissions	all	91 121	42 066	-53.8%	12.1%	7.1%
2. Industrial processes	all	347 030	250 674	-27.8%	9.0%	7.0%
3. Solvents and other product use	all	8 012	5 417	-32.4%	38.1%	5.5%
4. Agriculture	all	433 047	368 929	-14.8%	75.9%	7.4%
6. Waste	all	171 330	101 593	-40.7%	26.3%	12.7%
5. LULUCF	all	-128 679	-142 485	10.7%	31.7%	25.2%
Total (incl LULUCF)	**all**	**4 104 089**	**3 479 590**	**-15.2%**	**8.3%**	**1.4%**
Total (excl LULUCF)	**all**	**4 232 769**	**3 622 074**	**-14.4%**	**7.9%**	**1.1%**

Note: Emissions are in Gg CO_2 equivalents; they are slightly lower than the emissions included in CTF table 1 (a) because not all MS estimate uncertainties for all emissions and this table reflects the emissions for which uncertainty estimates are available.

Source: EEA

This is the second year in which an uncertainty analysis for Tier 2 (Monte-Carlo-Simulation) has been conducted for each sector. The analysis includes all uncertainty data which were reported for the Member States. In detail, these are nearly 1 500 individual data rows for all MS at subsector level and gas.

In all input and output parameters, uncertainty has been expressed as normal probability density function. Consistent with the IPCC requirements, the uncertainty range is presented as a range with 95% probability of a given value being within the boundaries. Thus the boundaries were given as the 2.5 and 97.5-percentiles from the mean value.

During the Monte-Carlo-Analysis the emissions and the combined uncertainty (uncertainty for emission factor and activity data) with normal distribution functions were simulated through 10 000 iterations. Therefore, for each individual level a standard derivation of emissions were generated. The results for this Tier 2 analysis can be found in the following tables (Table 3-4, Table 3-5).

Table 3-4 Tier 2 uncertainty estimates of EU-15 GHG emissions per main sector

Source category	Gas	**Base year emissions 1990** (average simulation value)	**Last Year 2011 emissions** (average simulation value)	**Level uncertainty estimates based on MS uncertainty estimates** medium (2.5 - 97.5 percentile)
1.A Fuel combustion activities	all	3 181 961	2 853 460	1% (0.99 - 0.99)
1.B Fugitive emissions	all	90 883	41 988	11.1% (10.8 – 11.4)
2. Industrial processes	all	346 737	250 547	4.8% (4.8 - 4.8)
3. Solvents and other product use	all	8 023	5 433	33.7% (32.8 – 34.6)
4. Agriculture	all	423 898	366 713	43.9% (43.01 - 44.8)
6. Waste	all	-129 034	-142 269	26.4% (25.996 – 26.9)
5. LULUCF	all	171 043	101 472	20.6% (20.6 - 20.6)

Note: Emissions are in Gg CO_2 equivalents and are mean values of the Monte-Carlo-Analysis

Source: EEA

Table 3-5 Tier 2 uncertainty estimates of EU-15 GHG emissions per gases

		CO_2	**CH_4**	**N_2O**	**PFC**	**HFC**	**SF_6**	**Total GHG**
1990	Mean value	3 232.35	427.85	381.80	30.00	10.02	11.50	4 093.51
	Standard deviation	32.17	17.65	97.09	1.46	0.39	0.37	104.84
	2s	2.0%	8.3%	50.9%	9.8%	7.8%	6.4%	**5.1%**
2011	Mean value	2 859.83	284.28	254.99	69.64	3.47	5.14	3 477.35
	Standard deviation	24.19	11.47	79.57	5.41	0.58	0.17	83.88
	2s	1.7%	8.1%	62.4%	15.5%	33.2%	6.5%	**4.8%**

Source: EEA

3.2.9. Changes since the 5th National Communication

Since the publication of the 5th National Communication, various updates and revisions to methodologies have been implemented in the EU GHG inventory, which have impacted on the time-series of emissions. Overall, recalculations for the EU-15 and EU-27[23] are insignificant (below 1 %). However, large recalculations in absolute terms were made in Germany, Spain and France (Table 3-6).

23 At the time of the 5th National Communication, Croatia was not yet part of the European Union, so the comparison here is based on the EU-27 aggregate.

Table 3-6 Major revisions to the EU GHG inventory since publication of the 5th National Communication

Country (Year of Change)	Change
Germany (2010)	Change of data source - from the evaluation tables which were used for the last submission - to the Energy Balance which is now available. Correction of error. New activity data and changed emission factor in the Nitric Acid Production.
Spain (2010)	Correction of errors and actualization of basic information from thermal power station. Actualization of basic information about the fuel balance of the year 2007.
Germany (2011)	Reallocation of CO_2 emissions from blast furnace gas combustion in coke ovens, industrial power plants, sinter plants and rolling mills from source category 2C1 to source category 1A1, 1A2a and 1A2f. New available data from national statistics. Estimation procedure has been corrected in accordance with IPCC (1996b) procedure for agricultural soils (N_2O). Correction of error in the estimation of TAN-immobilization in solid manure systems. Correction of emission factors (1996 GL instead of 2006 GL) in agricultural soils (N_2O). Revision of method that considers N-losses due to emissions from N-species in agricultural soils (N_2O).
France (2011)	Actualization of the compilation of the content of biogas as a result of the UNFCCC survey.
France (2013)	Modified livestock rates in the agriculture sector as a result of the agricultural census of 2010. Method changes for the estimation of solid waste disposal as a result of the UNFCCC survey in 2010. The estimate 2013 now integrates generation and burning of biogas.

At the time of the 5th National Communication, the trend of overall EU-15 GHG emissions excluding LULUCF between 1990 and 2007 was -4.3 %. In the 2013 submission this trend between 1990 and 2007 has decreased to -4.2 %. In the EU-27, the trend of GHG excluding LULUCF between 1990 and 2007 changed from -9.3 % in the 2007 submission to -9.2 % in the latest submission.

3.3. National System

3.3.1. Institutional Arrangements

In the EU, the legal basis for the compilation of the Union greenhouse gas inventory is Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC (hereafter referred to as the Monitoring Mechanism Regulation or MMR). More details of the Regulation are given in section [BR1] 4.9.1 in Annex 1: EU's 1st Biennial Report. The EU national inventory system as well as the

QA/QC programme is described in more detail in a Commission Staff Working Document[24].

The Directorate General for Climate Action of the European Commission is the overall body responsible for preparing the inventory of the European Union. Each Member State is responsible for the preparation of its own inventory and these inventories provide the necessary data for the inventory of the European Union, which is the sum of Member State inventories. As of 9 January 2013, all Member States of the EU are Annex I parties to the UNFCCC and have committed to preparing individual GHG inventories and submitting them to the UNFCCC Secretariat by 15 April each year.

The main institutions involved in the compilation of the EU GHG inventory are:

- Member States,
- European Commission Directorate General for Climate Action (DG Climate Action),
- European Environment Agency (EEA) and its European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM),
- Eurostat (also a Directorate General of the European Commission), and
- Joint Research Centre (JRC, also a Directorate General of the European Commission).

The roles and responsibilities of various agencies and entities in relation to the inventory development process, as well as the institutional, legal and procedural arrangements made to prepare the inventory are schematically shown in Figure 3-13 below. The entity with the overall responsibility for the Union inventory system is the European Commission, more specifically DG Climate Action.

DG Climate Action is assisted by the European Environment Agency (EEA), which is an agency of the European Union. Article 24 of the Monitoring Mechanism Regulation provides the legal basis for the cooperation between the European Commission and the EEA. The EEA's main task in the inventory process is the compilation of the Union inventory (CRF tables) and preparation of the Union inventory report. The EEA is assisted in its work by a European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM), which is an international consortium working with the EEA under a framework partnership agreement. The Commission's DGs Eurostat and JRC are also involved in the process of inventory preparation, with their respective roles related to energy statistics for Eurostat and LULUCF and agriculture for JRC[25].

While the Union GHG inventory is the sum of the sectoral emissions data from the Member States, the only case where this is different is with regard to the CO_2 emissions for the Reference Approach based on Eurostat energy data. The Reference Approach is a top-down approach, using high-level energy supply data to calculate the CO_2 emissions from the combustion of mainly fossil fuels.

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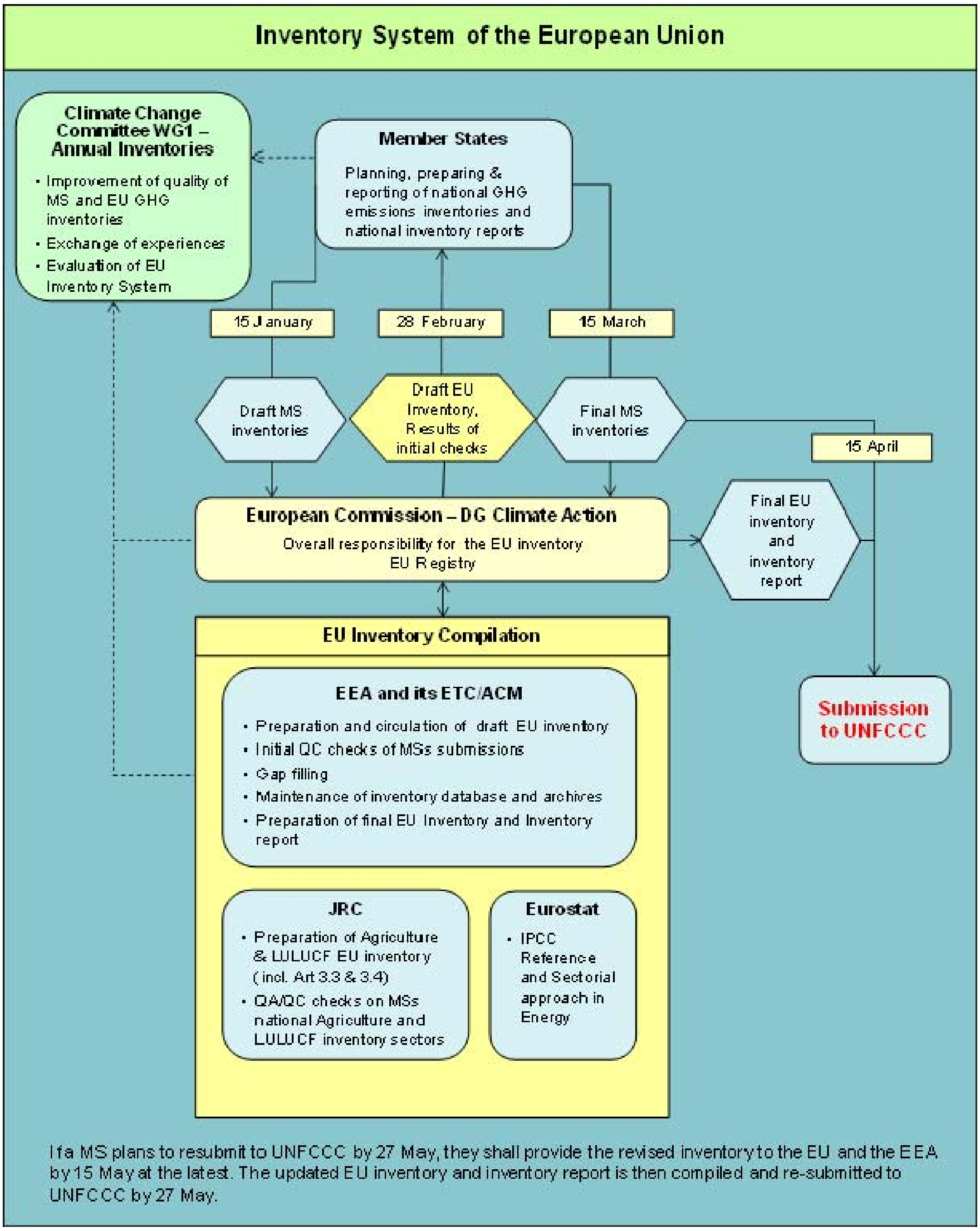
24 Commission Staff Working Document SWD(2013)308 final on Elements of the Union greenhouse gas inventory system and the Quality Assurance and Control (QA/QC) programme.

25 The Statistical Office of the European Communities (Eurostat) and the Joint Research Centre (JRC) are DGs of the European Commission. For simplicity reasons, these institutions are referred to as 'Eurostat' and the 'JRC' in this report.

The Union inventory for the complete time series, including the base year and all other inventory years, is established on the basis of the inventories supplied by Member States. The total estimates in the Union GHG inventory should accurately reflect the sum of Member States' national GHG inventories. The quality of the Union inventory therefore depends on the quality of Member States' inventories. Member States are responsible for the quality of activity data, emission factors and other parameters used for their national inventories as well as the correct application of methodologies provided in the IPCC Guidelines, IPCC Good Practice Guidance and IPCC Good Practice Guidance for LULUCF. Member States are also responsible for establishing QA/QC programmes for their inventories. The QA/QC activities of each Member State are described in the respective national inventory reports and summarised in the Union inventory report. The detailed QA/QC activities of the Union inventory system are described in the EU national inventory report and also summarised in section 3.3.2, below.

The Monitoring Mechanism Regulation sets out the annual cycle of preparation of the EU inventory, as shown schematically by Figure 3-13, below. By 15 January each year, Member States submit draft national inventories to the European Commission. The EEA, assisted by it ETC/ACM, Eurostat and JRC, carries out quality checks and prepares a draft EU inventory by 28 February. Member States submit final inventories (CRF tables and national inventory reports) to the Commission by 15 March, which contain the same information as the submission on 15 April to the UNFCCC Secretariat. The EEA, assisted by the ETC/ACM, Eurostat and JRC, together with DG Climate Action then prepare the final EU inventory (CRF tables and EU national inventory report). Both the EU and Member States individually make their official submissions to the UNFCCC Secretariat on 15 April.

Figure 3-13 Inventory system of the European Union



3.3.2. *Quality Assurance/Quality Control (QA/QC) Procedures*

The quality of the Union GHG inventory depends on the quality of the Member States' inventories, the QA/QC procedures of the Member States and the quality of the compilation process of the European Union inventory. The Member States and also the European Union as a whole have implemented QA/QC procedures in order to comply with the IPCC good practice guidance.

The EU QA/QC programme[26] describes the quality objectives and the inventory quality assurance and quality control plan for the Union GHG inventory including responsibilities and the time schedule for the performance of the QA/QC procedures. Definitions of quality assurance, quality control and related terms used are those provided in IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and Guidelines for National Systems under the Kyoto Protocol. The EU QA/QC programme is reviewed annually and modified or updated as appropriate.

The European Commission (DG Climate Action) is responsible for coordinating QA/QC activities for the Union inventory and ensures that the objectives of the QA/QC programme are implemented and the QA/QC plan is developed. The European Environment Agency (EEA) is responsible for the annual implementation of QA/QC procedures for the Union inventory.

The overall objectives of the EU QA/QC programme are:

- to establish quality objectives for the Union GHG inventory, taking into account the specific nature of this inventory as a compilation of Member States' GHG inventories;
- to implement the quality objectives in the design of the QA/QC plan, defining general and specific QC procedures for the EU GHG inventory submission
- to provide a Union inventory of GHG emissions and removals consistent with the sum of Member States' inventories and covering the EU's geographical area;
- to ensure the timeliness of Member States' GHG inventory submissions to the EU;
- to ensure the completeness of the Union GHG inventory, inter alia, by implementing procedures to estimate any data missing from the national inventories, in consultation with the Member State concerned;
- to contribute to the improvement of quality of Member States' inventories and
- to provide assistance for the implementation of national QA/QC programmes.

A number of specific objectives have been elaborated in order to ensure that the Union GHG inventory complies with the UNFCCC inventory principles of transparency, completeness, consistency, comparability, accuracy and timeliness.

In the QA/QC plan, quality control procedures before and during the compilation of the Union GHG inventory are listed. In addition, QA procedures, procedures for documentation and archiving, the time schedules for QA/QC procedures and the provisions related to the inventory improvement plan are included.

QC procedures are performed at several different stages during the preparation of the Union inventory. Firstly, a range of checks are used to determine the consistency and completeness of Member States' data so that they may be compiled in a transparent manner at EU level. Secondly, checks are carried out to ensure that the data are

26 SWD(2013) 308 final.

compiled correctly at EU level to meet the overall reporting requirements. Thirdly, a number of checks are conducted with regard to data archiving and documentation to meet various other data quality objectives.

Further improvement of the QA/QC procedures

One of the most important activities for improving the quality of national and Union GHG inventories is the organisation of workshops and expert meetings under the EU GHG Monitoring Mechanism. Since 2004, a number of workshops and expert meetings on QA/QC in GHG inventories have been organised. Workshop reports are available at the website of the EEA/ETC-ACM[27].

In recent years, workshops mostly focused on quality improvements in the sector LULUCF. Information on these workshops are available at the Joint Research Centre's website[28].

3.3.3. The EU Inventory Methodology and Data

This National Communication has been compiled using the Union inventory and with regards to the UNFCCC guidance for parties preparing their National Communications. The Union inventory is compiled, in accordance with the UNFCCC guidelines[29], on the basis of the inventories of the 15 or 28 Member States (until 2013, only 27 Member States, prior to the accession of Croatia from 1 July 2013). The estimates of emissions in the Union inventory are, where appropriate and feasible, consistent with the IPCC Revised 1996 Guidelines for National Greenhouse Gas Inventories[30], the 2000 Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories[31] and the 2003 Good Practice Guidance for Land Use, Land-Use Change and Forestry[32]. In addition to the Monitoring Mechanism Regulation, Commission Decision 2005/166/EC provides the legal framework for the compilation of the Union GHG inventory. It forms the implementing legislation of the previous Decision 280/2004/EC, which was replaced by the Monitoring Mechanism Regulation. The MMR itself is to be complemented by so-called implementing and delegated acts, which further specify reporting provisions. Due to the nature of the legislative process, by the time of submission of this NC, these additional legal acts may not be yet in place. In the interim period, Commission Decision 2005/166/EC continues to apply, until repealed. Many of the provisions of the new implementing and delegated acts may not differ substantially from those in the Decision.

The emissions of each source and sink category are the sum of the emissions of the respective source and sink categories of the 15 or 28 Member States. This also applies for the base year estimate of the EU-15 GHG inventory. Currently, 12 Member States have selected 1995 as the base year for fluorinated gases, while Austria, France and Italy have chosen 1990 (Table 3-7).

27 http://acm.eionet.europa.eu/meetings/past_html

28 http://afoludata.jrc.ec.europa.eu/index.php/public_area%5Cevents_policy

29 United Nations Framework Convention on Climate Change (UNFCCC), 2006. Updated UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of decision 14/CP.11. Nairobi. http://unfccc.int/resource/docs/2006/sbsta/eng/09.pdf

30 Intergovernmental Panel on Climate Change (IPCC), 1997. Revised 1996 IPCC guidelines for national greenhouse gas inventories. Geneva.

31 Intergovernmental Panel on Climate Change (IPCC), 2000. Good practice guidance and uncertainty management in national greenhouse gas inventories. Geneva.

32 Intergovernmental Panel on Climate Change (IPCC), 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Geneva.

Table 3-7 Base year emissions for EU-15 Member States

EU-15 MS	CO_2, CH_4, N_2O	HFC, PFC, SF_6	Base year emissions [1] (tonnes CO_2 equivalents)
Austria	1990	1990	79 049 657
Belgium	1990	1995	145 728 763
Denmark	1990	1995	69 323 336
Finland	1990	1995	71 003 509
France	1990	1990	563 925 328
Germany	1990	1995	1 232 429 543
Greece	1990	1995	106 987 169
Ireland	1990	1995	55 607 836
Italy	1990	1990	516 850 887
Luxembourg	1990	1995	13 167 499
Netherlands	1990	1995	213 034 498
Portugal	1990	1995	60 147 642
Spain	1990	1995	289 773 205
Sweden	1990	1995	72 151 646
United Kingdom [)]	1990	1995	776 337 201
EU-15	1990	1990 (AT, FR, IT) 1995 (other MS)	4 265 517 719

Source: Initial review reports of the EU-15 Member States (www.unfccc.int)
1 Base-year emissions exclude emissions and removals from the LULUCF sector but include emissions due to deforestation in the case of Member States for which LULUCF constituted a net source of emissions in 1990.
2 The base year emissions relate to the EU territory of Denmark and the UK.

Table 3-8 Base year emissions for new Member States

New MS	CO_2, CH_4, N_2O	HFC, PFC, SF_6	Base year emissions 1) (tonnes CO_2 equivalents)
Bulgaria	1988	1995	132 618 658
Croatia	1990	1990	31 321 790
Cyprus	Not relevant	Not relevant	
Czech Republic	1990	1995	194 248 218
Estonia	1990	1995	42 622 310
Hungary	1985-87	1995	115 397 149
Latvia	1990	1995	25 909 160
Lithuania	1990	1995	49 414 386
Malta	Not relevant	Not relevant	
Poland	1988	1995	563 442 774
Romania	1989	1989	278 225 022
Slovakia	1990	1990	72 050 764
Slovenia	1986	1995	20 354 042

Member States use different national methodologies, national activity data or country specific emission factors in accordance with IPCC and UNFCCC guidelines. The EU believes that this is consistent with the UNFCCC reporting guidelines and the IPCC good practice guidelines, provided each methodology is consistent with the IPCC good practice guidelines. In general, no separate methodological information is provided at EU level except summaries of methodologies used by Member States. Details can be found in the Annual European Union greenhouse gas inventory 1990-2011 and Inventory Report 2013 submission to the UNFCCC Secretariat. For some sectors quality improvement projects, including expert workshops, have been started with the aim of further improving estimates at Member State level. These sectors include energy background data, emissions from international bunkers, emissions and removals from LULUCF, emissions from agriculture, and waste.

Table 3-9 shows the geographical coverage of the EU-15 Member States' national inventories. The EU-15 inventory and the EU-28 inventory, respectively, are the sums of the Member States' inventories and cover the same geographical area as the inventories of the Member States, to the extent to which their territories are part of the Union (see some differences for Denmark, France and the United Kingdom).

Table 3-9 Geographical coverage of the EU-28 inventory

Member State	**Geographical coverage**	**EU-territory coverage (UNFCCC and Kyoto)**	**Party coverage (UNFCCC)**	**Party coverage (Kyoto Protocol)**
Austria	Austria	√	√	√
Belgium	Belgium consisting of Flemish Region, Walloon Region and Brussels Region	√	√	√
Denmark	Denmark (excluding Greenland and the Faeroe Islands)	√		
	Denmark, Faroe Islands and Greenland		√	
	Denmark and Greenland			√
Finland	Finland including Åland Islands	√	√	√
France	Metropolitan France, the overseas departments (Guadeloupe, Martinique, Guyana and Reunion) and the overseas communities (Saint-Barthelemy and Saint-Martin), excluding the French overseas communities (French Polynesia, Wallis and Futuna, Mayotte, Saint-Pierre and Miquelon) and overseas territories (the French Southern and Antarctic Lands) and New Caledonia.	√		√
	Metropolitan France, the overseas departments (Guadeloupe, Martinique, Guyana and Reunion), the overseas communities (French Polynesia, Saint-Barthelemy and Saint-Martin, Wallis and Futuna, Mayotte, Saint-Pierre and Miquelon) and overseas territories (the French Southern and Antarctic Lands) and New Caledonia.		√	
Germany	Germany	√	√	√
Greece	Greece	√	√	√
Ireland	Ireland	√	√	√
Italy	Italy	√	√	√
Luxembourg	Luxembourg	√	√	√

Member State	Geographical coverage	EU-territory coverage (UNFCCC and Kyoto)	Party coverage (UNFCCC)	Party coverage (Kyoto Protocol)
Netherlands	The reported emissions include those that have to be allocated to the legal territory of the Netherlands. This includes a 12-mile zone from the coastline and also inland water bodies. It excludes Aruba, Curaçao and Sint Maarten that are constituent countries within the Royal Kingdom of the Netherlands. It also excludes the isles Bonaire, Saba and Sint Eustatius that are since 10 October 2010 public bodies (openbare lichamen) with their own legislation that is not applicable to the European part of the Netherlands. Emissions from offshore oil and gas production on the Dutch part of the continental shelf are included.	√	√	√
Portugal	Mainland Portugal and the two Autonomous regions of Madeira and Azores Islands. Includes also emissions from air traffic and navigation bunkers realized between these areas.	√	√	√
Spain	Spanish part of Iberian mainland, Canary Islands, Balearic Islands, Ceuta and Melilla.	√	√	√
Sweden	Sweden	√	√	√
United Kingdom	England, Scotland, Wales and Northern Ireland, and Gibraltar, excluding the UK Crown Dependencies (Jersey, Guernsey and the Isle of Man) and the UK Overseas Territories (except Gibraltar).	√		
	England, Scotland, Wales and Northern Ireland, the UK Crown Dependencies (Jersey, Guernsey and the Isle of Man) and the UK Overseas Territories that have ratified the Kyoto Protocol (the Cayman Islands, the Falkland Islands, Bermuda, Montserrat and Gibraltar).		√	√
EU-15		√		
Bulgaria	Bulgaria	√	√	√
Croatia	Croatia	√	√	√
Cyprus	Area under the effective control of the Republic of Cyprus	√	√	√
Czech Republic	Czech Republic	√	√	√
Estonia	Estonia	√	√	√
Hungary	Hungary	√	√	√
Latvia	Latvia	√	√	√
Lithuania	Lithuania	√	√	√
Malta	Malta	√	√	√
Poland	Poland	√	√	√
Romania	Romania	√	√	√
Slovakia	Slovakia	√	√	√
Slovenia	Slovenia	√	√	√

3.3.4. Data Gap Filling Procedure

The Union GHG inventory is compiled by using the inventory submissions of the EU Member States. If a Member State does not submit all data required for the compilation of the Union inventory by 15 March of a reporting year, the Commission prepares estimates for data missing for that Member State. In the following cases gap filling is undertaken:

- to complete specific years in the GHG inventory time-series for a specific Member State;
- for the most recent inventory year(s);
- for the base year;
- for some years of the time series from 1990 to the most recent year;
- to complete individual source categories for individual Member States that did not estimate specific source categories for any year of the inventory time series and reported 'NE'. Gap filling methods are used for major gaps when it is highly certain that emissions from these source categories exist in the Member States concerned;
- to provide complete CRF background data tables for the European Union when some Member States only provided CRF sectoral and summary tables. (In this case, the gap filling methods are used to further disaggregate the emission estimates provided by Member States.)
- to enable the presentation of consistent trends for the EU.

For data gaps in the Member States' inventory submissions, the following procedure is applied by the ETC/ACM in accordance with the implementing provisions under the Monitoring Mechanism Regulation for missing emission data:

- If a consistent time series of reported estimates for the relevant source category is available from the Member State for previous years that has not been subject to adjustments under Article 5.2 of the Kyoto Protocol, extrapolation of this time series is used to obtain the emission estimate. As far as CO_2 emissions from the energy sector are concerned, extrapolation of emissions should be based on the percentage change of Eurostat CO_2 emission estimates if appropriate.
- If the estimate for the relevant source category was subject to adjustments under Article 5.2 of the Kyoto Protocol in previous years and the Member State has not submitted a revised estimate, the basic adjustment method used by the expert review team as provided in the 'Technical guidance on methodologies for adjustments under Article 5.2 of the Kyoto Protocol' is used without application of the conservativeness factor.
- If a consistent time series of reported estimates for the relevant source category is not available and if the source category has not been subject to adjustments under Article 5.2 of the Kyoto Protocol, the estimation should be based on the methodological guidance provided in the 'Technical guidance on

methodologies for adjustments under Article 5.2 of the Kyoto Protocol' without application of the conservativeness factor.

The Commission prepares the estimates by 31 March of the reporting year, following consultation with the Member State concerned, and communicates the estimates to the other Member States. The Member State concerned shall use the estimates referred to for its national submission to the UNFCCC to ensure consistency between the EU inventory and Member States' inventories.

The methods used for gap filling include interpolation, extrapolation and clustering[33]. The methods are consistent with the adjustment methods described in UNFCCC Adjustment Guidelines (Table 1 of the Technical Guidance on methodologies for adjustments under Art. 5, para. 2 KP) and in the IPCC Good Practice Guidance. On the basis of the general approaches mentioned above, concrete methodologies were developed for each sector and GHG as required by the UNFCCC reporting guidelines.

Starting with the GHG inventory 2011, estimates have been available for all EU Member States and no gap filling was therefore needed.

3.4. National registry

Directive 2009/29/EC adopted in 2009, provides for the centralization of the EU ETS operations into a single European Union registry operated by the European Commission as well as for the inclusion of the aviation sector. At the same time, and with a view to increasing efficiency in the operations of their respective national registries, the EU Member States who are also Parties to the Kyoto Protocol (26) plus Iceland, Liechtenstein and Norway decided to operate their registries in a consolidated manner in accordance with all relevant decisions applicable to the establishment of Party registries - in particular Decision 13/CMP.1 and Decision 24/CP.8.

With a view to complying with the new requirements of Commission Regulation 920/2010 and Commission Regulation 1193/2011, in addition to implementing the platform shared by the consolidating Parties, the registry of the EU has undergone major re-development. The consolidated platform which implements the national registries in a consolidated manner (including the registry of the EU) is called the Consolidated System of EU registries (CSEUR) and was developed together with the new EU registry on the basis the following modalities:

- Each Party retains its organization designated as its registry administrator to maintain the national registry of that Party and remains responsible for all the obligations of Parties that are to be fulfilled through registries;
- Each Kyoto unit issued by the Parties in such a consolidated system is issued by one of the constituent Parties and continues to carry the Party of origin identifier in its unique serial number;
- Each Party retains its own set of national accounts as required by paragraph 21 of the Annex to Decision 15/CMP.1. Each account within a national registry keeps a unique account number comprising the identifier of the Party and a unique number within the Party where the account is maintained;

33 ETC ACC technical note on gap filling procedures, December 2006.

- Kyoto transactions continue to be forwarded to and checked by the UNFCCC Independent Transaction Log (ITL), which remains responsible for verifying the accuracy and validity of those transactions;
- The transaction log and registries continue to reconcile their data with each other in order to ensure data consistency and facilitate the automated checks of the ITL;
- The requirements of paragraphs 44 to 48 of the Annex to Decision 13/CMP.1 concerning making non-confidential information accessible to the public would be fulfilled by each Party individually;
- All registries reside on a consolidated IT platform sharing the same infrastructure technologies. The chosen architecture implements modalities to ensure that the consolidated national registries are uniquely identifiable, protected and distinguishable from each other, notably:
  (a) With regards to the data exchange, each national registry connects to the ITL directly and establishes a distinct and secure communication link through a consolidated communication channel (VPN tunnel);
  (b) The ITL remains responsible for authenticating the national registries and takes the full and final record of all transactions involving Kyoto units and other administrative processes such that those actions cannot be disputed or repudiated;
  (c) With regards to the data storage, the consolidated platform continues to guarantee that data is kept confidential and protected against unauthorized manipulation;
  (d) The data storage architecture also ensures that the data pertaining to a national registry are distinguishable and uniquely identifiable from the data pertaining to other consolidated national registries;
  (e) In addition, each consolidated national registry keeps a distinct user access entry point (URL) and a distinct set of authorisation and configuration rules.

Following the successful implementation of the CSEUR platform, the 28 national registries concerned were re-certified in June 2012 and switched over to their new national registry on 20 June 2012. Croatia was migrated and consolidated as of 1 March 2013. During the go-live process, all relevant transaction and holdings data were migrated to the CSEUR platform and the individual connections to and from the ITL were re-established for each Party.

The following changes to the national registry have therefore occurred in 2012, as a consequence of the transition to the CSEUR platform:

Table 3-10 Changes to the EU national registry in 2012

Reporting Item	Description
15/CMP.1 Annex II.E paragraph 32.(a) Change of name or contact	N/A
15/CMP.1 Annex II.E paragraph 32.(b) Change regarding cooperation arrangement	The EU Member States who are also Parties to the Kyoto Protocol (26) plus Iceland, Liechtenstein and Norway have decided to operate their registries in a consolidated manner. The Consolidated System of EU registries was certified on 1 June 2012 and went into production on 20 June 2012. Croatia was migrated and consolidated as of 1 March 2013. A complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of the EU and all consolidating national registries. This description includes: • Readiness questionnaire • Application logging • Change management procedure • Disaster recovery • Manual Intervention • Operational Plan • Roles and responsibilities • Security Plan • Time Validation Plan • Version change Management The documents above are provided as an appendix to the latest EU inventory submission. A new central service desk was also set up to support the registry administrators of the consolidated system. The new service desk acts as 2nd level of support to the local support provided by the Parties. It also plays a key communication role with the ITL Service Desk with regards notably to connectivity or reconciliation issues.
15/CMP.1 Annex II.E paragraph 32.(c) Change to database structure or the capacity of national registry	In 2012, the EU registry has undergone major redevelopment with a view to comply with the new requirements of Commission Regulation 920/2010 and Commission Regulation 1193/2011 in addition to implementing the Consolidated System of EU registries (CSEUR). The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to the latest EU inventory submission. During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the Data Exchange Standard (DES). All tests were executed successfully and led to successful certification on 1 June 2012.

Reporting Item	Description
15/CMP.1 Annex II.E paragraph 32.(d) Change regarding conformance to technical standards	The overall change to a Consolidated System of EU Registries triggered changes the registry software and required new conformance testing. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to the latest EU inventory submission. During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the DES. All tests were executed successfully and led to successful certification on 1 June 2012.
15/CMP.1 Annex II.E paragraph 32.(e) Change to discrepancies procedures	The overall change to a Consolidated System of EU Registries also triggered changes to discrepancies procedures, as reflected in the updated manual intervention document and the operational plan. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to the latest EU inventory submission.
15/CMP.1 Annex II.E paragraph 32.(f) Change regarding security	The overall change to a Consolidated System of EU Registries also triggered changes to security, as reflected in the updated security plan. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to the latest EU inventory submission.
15/CMP.1 Annex II.E paragraph 32.(g) Change to list of publicly available information	N/A
15/CMP.1 Annex II.E paragraph 32.(h) Change of Internet address	The new internet address of the European Community registry is: https://ets-registry.webgate.ec.europa.eu/euregistry/EU/index.xhtml
15/CMP.1 Annex II.E paragraph 32.(i) Change regarding data integrity measures	The overall change to a Consolidated System of EU Registries also triggered changes to data integrity measures, as reflected in the updated disaster recovery plan. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The documentation is annexed to the latest EU inventory submission.
15/CMP.1 Annex II.E paragraph 32.(j) Change regarding test results	On 2 October 2012 a new software release (called V4) including functionalities enabling the auctioning of phase 3 and aviation allowances, a new EU ETS account type (trading account) and a trusted account list went into Production. The trusted account list adds to the set of security measures available in the CSEUR. This measure prevents any transfer from a holding account to an account that is not trusted.
The previous Annual Review recommendations	N/A

4. POLICIES AND MEASURES

Key developments

Cross-cutting policies and measures

- Many existing EU-level policies and measures are being strengthened to meet the targets for the year 2020 from the integrated Climate and Energy Package. This includes legislation put in place by the EU to reduce its greenhouse gas emissions by at least 20 % compared to 1990 by 2020, with a conditional offer to move to 30%, provided that other developed countries commit themselves to comparable emission reductions and developing countries contribute adequately according to their responsibilities and respective capabilities. Furthermore, the EU has committed to supplying 20 % of energy from renewable sources by 2020 (as a share of total EU gross final energy consumption), supplemented by a target to achieve a minimum of 10 % renewable transport fuel. Moreover, the EU has committed to a 20 % reduction of total primary energy consumption by 2020, compared to a Business as Usual baseline.

- The EU ETS has been revised and strengthened based on lessons learned. The third phase (2013-2020) has successfully started. The changes include a single, EU-wide emissions cap, auctioning of new allocations as default allocation method, harmonised allocation rules based on EU-wide performance benchmarks for free allocation, additional sectors and gases included. The EU ETS covered on average 41 % of total EU-28 GHG emissions during the 2008-2012 period.

- Member States have taken on binding annual targets (for each year from 2013 to 2020), reducing their greenhouse gas emissions from the sectors not covered by the EU ETS, such as housing, agriculture, waste and transport (excluding aviation), and a thorough annual compliance system has been established.

- The revised and strengthened Monitoring Mechanism Regulation (MMR) entered into force in 2013. It enhances current reporting rules on GHG emissions to implement the Climate and Energy package and to meet requirements arising from current and future international climate agreements.

- With regard to the EU's future climate strategy, the Commission adopted policy documents to promote the discussion on the long-term framework of climate and energy policies in Europe. It includes a roadmap on moving towards a competitive low carbon economy in 2050, a White Paper on competitive and efficient transport systems, a roadmap on energy, and a bioeconomy strategy. Furthermore, the Commission adopted a Green Paper to launch a public debate on the preparation of the EU climate and energy framework for 2030.

Energy

- Significant progress has been made to meet the 20% renewables target by 2020 laid down in the Climate and Energy Package. The share of gross inland energy consumption met by renewables has increased substantially over the last ten years to around 13 % in 2011. A substantial increase can be seen from renewable heat production, wind power generation and photovoltaics whereas hydro power production has been relatively constant. At national level, EU Member States prepared National Renewable Energy Action Plans and most Member States experienced significant growth in renewable energy on the way towards meeting their national binding targets. At present, many Member States are reviewing their national support schemes to improve the overall cost efficiency of policies on renewables. The Strategic Energy Technology Plan is guiding Member States since 2007 in prioritising the development of innovative solutions which will respond to the needs of the European energy system by 2020, 2030 and beyond.

- A wide range of policies and measures were also introduced to promote energy efficiency, most recently the Energy Efficiency Directive. This Directive aims at keeping the EU's energy efficiency target on track and explicitly sets goals for primary and final energy consumption by 2020.
- Overall, a decarbonisation of the energy sector has been experienced, as highlighted by the following data: the consumption of carbon-intensive coal and lignite decreased by 37 % by 2011 compared to 1990, while gas consumption increased by more than 30 %. Renewables have seen the most marked increase with consumption increasing by over 120 % in 2011 from 1990 levels.

Transport

- CO_2 emissions of motor vehicles are targeted by recent regulations which aim at reducing emissions of the passenger car fleet by 40 % and emissions of light commercial vehicles by 28 % by 2020, compared to the 2007 fleet emission average. These efforts are supplemented by environmental performance requirements such as tyre pressure monitoring systems and gear shift indicators.
- Significant progress has been made to reduce the average CO_2 emissions of the new passenger car fleet and meet the binding targets set at 130 g CO_2/km by 2015 and 95 g CO_2/km by 2020. Average emissions decreased to 132.2 g CO_2/km in 2012, compared with the 2007 fleet average of 158.7 g CO_2/km.
- In order to reduce fossil fuel consumption, the Fuel Quality Directive also introduced a binding target for fuel suppliers to reduce life-cycle GHG emissions per unit of energy by up to 6 % by 2020 compared to 2010. In addition, in 2013 the Commission adopted the Clean Power for Transport Package which supports the broad deployment of alternative fuels vehicles and vessels and the relevant infrastructures in Europe. .
- The Commission also adopted a strategy for progressively including GHG from maritime transport. As a first step, a proposed legislation for the monitoring, reporting and verification of emissions from large ships is under consideration by the Parliament and the Council.

- Transport activity, in particular freight transport and transport in the new EU Member States, has steadily increased in the EU since 1990 until the economic crisis. As a result, GHG emissions from transport have grown until 2007, albeit at a slower pace than real GDP, and are decreasing since.

Industry

- Emissions from F-gases are regulated, leading to a cumulative reduction of 2 861 kt CO_2 eq by 2010, since the adoption of two legislative acts on F-gases in 2006. Furthermore, a proposal to strengthen this legislation is under consideration by the Council and the European Parliament. It aims at limiting the use of F-gases in new equipment and introducing a phase-down measure of HFCs combined with some bans of use.
- The new Industrial Emissions Directive (IED) also aims at achieving significant benefits to the environment and human health by reducing polluting emissions to the atmosphere, water and soil, as well as waste from industrial and agricultural installations, in particular through better application of Best Available Techniques (BAT).

Agriculture

- In recent years, environmental considerations including climate change mitigation have been integrated into the Common Agricultural Policy (CAP). The new CAP (covering the2014-2020 period) will further enhance the existing policy framework for sustainable management of natural resources, contributing to both climate change mitigation and enhancing the resilience of farming to the threats posed by climate change and variability.
- Furthermore, legislation is in place (the Nitrates Directive) to contribute to decreasing CH_4 and N_2O emissions from agricultural activities. The European Soil Thematic Strategy also aims at preventing soil degradation and preserving soil as an important carbon pool.

Forestry

- The new EU Forest Strategy provides a framework that coordinates and ensures coherence of forest-related policies and allows synergies with other sectors that influence forest management. Member States are asked to consider the principles and goals of this strategy when setting up and implementing their action plans and national forest programmes. The new EU legislation on GHG accounting rules for LULUCF activities (going beyond forestry) lays down rules for the robust accounting in this sector. It will support the mitigation potential of this sector by improving the visibility and tracking progress of mitigation efforts.

Waste

- Since the last National Communication, focus has been put on the full and timely implementation of the EU waste legislation, which contributes directly or indirectly to a reduction of GHG emissions.

4.1. Introduction

In the European Union, there are two distinct levels of policies and measures (PaMs) that have an impact on greenhouse gas emissions:

- European Union policies, which are proposed by the Commission and subsequently approved, amended or rejected by the Council of the European Union and the European Parliament. These common and coordinated policies and measures (CCPM) are applicable to all Member States, though Member States may implement Directives at different points in time. The EU's National Communication concentrates on these CCPMs
- National policies developed and implemented by Member States themselves. As such, these policies and measures are outside the scope of this National Communication.

The scope of this section comprises

- A description of the policy making process in the EU (section 4.2),
- Additional Information Required Under the Kyoto Protocol (section 4.3),
- Descriptions of cross-sectoral PaMs and sectoral PaMs on energy, transport, industry, agriculture, forestry and waste (sections 4.4 to 4.10) and
- Descriptions of the interactions of policies and measures (section 4.12) and of the effects of PaMs on the modification of long-term trends (section 4.13).

Major parts of the contents of the PaMs chapter of the National Communication as required by the UNFCCC reporting guidelines for National Communications overlap with contents required for the Biennial Reports. Thus, in several sub-chapters of this section only a reference to the respective section in Annex 1: EU 1st Biennial Report is given.

Complementing the descriptions of policies and measures in the respective sectoral chapters, quantifications of the PaMs' impacts on GHG emission reduction are summarised in CTF table 3 in the Appendix: CTF for EU 1st Biennial Report of Annex 1: EU 1st Biennial Report. These (mostly) ex-ante estimates have been produced by the European Commission in individual policy impact assessments and assume full implementation of the CCPMs. However, estimates are not available for all CCPMs and all years covered in CTF Table 3. Some older estimates are also for the EU-15 while more recent estimates are for the EU-27 or the EU-28. In contrast, the estimates of expected GHG emission savings presented in the projections section 5 are uniquely derived from aggregating MS estimates.

4.2. The Policy Making Process

4.2.1. Introduction

Adoption of new legislation in Europe commonly follows the so-called co-decision procedure (ordinary legislative procedure), whereby both the Council of the European Union (Council of Ministers) and the directly elected European Parliament collectively amend, adopt or reject legislation proposed by the Commission. In this process the Parliament and the Council are given equal weighting.

With regards to the policy making process, there are four key stages:

- Policy demands are made and articulated. The impetus or demonstration of the need for a policy can come from a variety of sources, but only the Commission has the power of initiative to propose legislation.
- Once the proposal has been presented by the European Commission, the Council and the European Parliament, depending on procedure, can amend the proposal. This means that all three institutions can play an active role in shaping the final proposal.
- Policy proposals must then be formally agreed on by both the European Parliament and the Council. If no agreement can be reached the policy is not adopted and the procedure is ended.
- Policy proposals are then implemented. While the Commission takes the lead in implementation, it remains the responsibility of individual Member States to implement EU policies at the national level according to their own national systems and processes. Failure to meet agreed objectives can invoke infringement proceedings, which are dealt with by the European Court of Justice and can result in a fine for non-compliance with EU legislation.

A key step towards the formulation and implementation of any EU policy is to carry out an Impact Assessment[34] of the proposed policy or key policy changes. The Impact Assessment outlines a process that prepares evidence for political decision-makers on the advantages and disadvantages of possible policy options. The Impact Assessment is carried out by the Directorate General who takes the lead on a particular policy. The Impact Assessment process is an important element of implementing the EU's commitments under Article 4.2(e)(ii) of the UNFCCC to "identify and periodically review its own policies and practices which encourage activities that lead to greater levels of anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol than would otherwise occur".

There are a number of legal instruments available to the European Union to reach its objectives, with due respect for the subsidiarity principle[35]: Regulations, Directives, Decisions and Recommendations (see NC4 and NC5 for more details).

This section of the National Communication introduces the overall policy context in the European Union describing strategies and practices that have been set-up or revised since the Fifth National Communication. Moreover, the chapter presents information on the way economic, social and environmental consequences are assessed for policies and measures, and provides a description of the EU-wide monitoring and evaluation of policies and measures. Changes in institutional arrangements concerning monitoring and evaluation of GHG mitigation policies are highlighted as are legislative arrangements and enforcement and administrative procedures relevant to the implementation of the Kyoto Protocol.

34 SEC(2009) 92 Impact Assessment Guidelines: http://ec.europa.eu/governance/impact/docs/key_docs/iag_2009_en.pdf

35 The principle whereby the Union does not take action (except in the areas which fall within its exclusive competence) unless it is more effective than action taken at national, regional or local level, http://europa.eu/scadplus/glossary/subsidiarity_en.htm

4.2.2. Monitoring and Evaluation

For a description of EU-wide monitoring and evaluation please refer to section [BR1] 4.9.1 in Annex 1: EU 1st Biennial Report.

4.2.3. Overall Policy Context

4.2.3.1. Europe 2020

Europe 2020 is a new ten year growth strategy and builds upon the lessons learnt from the Lisbon Strategy and also draws on the benefits that have arisen from the coordinated response to the financial crisis in the European Recovery Plan (refer to section 5.1.2 of NC 5). The main objective of Europe 2020 is to deliver "smart, sustainable, inclusive growth" as a result of greater coordination of both national and European policy. The three priorities of the Europe 2020 strategy are outlined in a 2010 communication[36] entitled "Europe 2020: A strategy for smart, sustainable, inclusive growth" and include:

- Smart growth: developing an economy based on knowledge and innovation;
- Sustainable growth: promoting a more resource-efficient, greener and more competitive economy;
- Inclusive growth: fostering a high employment economy delivering social and territorial cohesion.

An emphasis on sustainability is included in the Europe 2020 strategy and therefore attaining the EU's 20/20/20 climate and energy targets is one of the five headline targets. Seven flagship initiatives have been presented to address these targets. In relation to sustainable growth, these include the "Resource Efficient Europe Flagship"[37] which was launched in 2011. The flagship initiative provides a long-term framework for actions in many policy areas, supporting policy agendas for climate change, energy, transport, industry, raw materials, agriculture, fisheries, biodiversity and regional development. It provides for the series of coordinated roadmaps that are discussed in section 4.2.3.5.

The European Semester is a policy coordination exercise, which assesses the progress of each Member State towards meeting the targets set out in the Europe 2020 strategy. The progress towards attaining the EU's 20/20/20 climate and energy targets is assessed based on the National Reform Programmes of Member States and projections of future greenhouse gas emissions. Following the analysis the Commission can provide Member States with specific recommendations that can help to strengthen the mainstreaming of climate action into broader economic policies.

The results of the European Semester 2013 indicate that the EU-27 is on track to meet its 2020 GHG emissions target. However, it is evident from the assessments that the projected performance of Member States is highly variable and several Member States have been identified as requiring additional effort.[38] For example, 13 Member States will not reach their 2020 emission target set under the Effort Sharing Decision without

36 COM (2010) 2020 Final.

37 COM (2011) 21.

38 http://ec.europa.eu/clima/policies/g-gas/progress/docs/16_energy_and_ghg_en.pdf

additional efforts. Furthermore although all Member States are expected to meet their national targets for 2020 set by the Renewable Energy Directive, the European Semester 2013 suggests that additional measures may be necessary due to the economic crisis and various barriers to renewable energy development hindering progress.

In order to further assist Member States with progressing towards the 20/20/20 energy and climate change targets, the European Semester 2013 recommends the following policy initiatives[39]:

- Planning effective, growth-friendly use of the revenue from auctioning of EU ETS allowances to start in 2013,
- Realising the full potential for increasing energy efficiency, particularly in the buildings sector,
- Providing a stable, coherent and cost-efficient framework for investment in green technologies, in renewable energy sources and in energy infrastructure,
- Exploiting the emissions reduction potential of transport,
- Fully exploiting the possibility of shifting the tax burden away from labour to tax bases less detrimental to growth and jobs, in particular through environmental taxation,
- Removing environmentally harmful subsidies.

4.2.3.2. European Climate Change Programme

The European Climate Change Programme (ECCP) was established in June 2000 to provide a cohesive framework to identify and develop the necessary elements of an EU strategy to implement the Kyoto Protocol. In autumn 2005, the Commission launched ECCP II as a continued programme for policy preparation and development. This second phase investigated new policy areas such as adaptation, aviation and carbon capture and storage, as well as reviewing and further implementing policies and measures that were the focus of ECCP I. Further information was included in the EU's 4th National Communication.

4.2.3.3. Climate and Energy Package

In December 2008, the European Parliament and the European Council agreed on the EU Climate and Energy Package, which for the first time provided an integrated and ambitious package of policies and measures to tackle climate change. The Climate and Energy Package was formally adopted in 2009. It includes the 20-20-20 targets, which set the following key objectives:

- To reduce greenhouse gas emissions by at least 20 % compared to 1990 by 2020, with a firm commitment to increase this target to 30 % in the event of a satisfactory international agreement being reached;

39 http://ec.europa.eu/clima/policies/g-gas/progress/index_en.htm

- To achieve 20 % of energy from renewable sources by 2020 (as a share of total EU gross final energy consumption), supplemented by a target to achieve a minimum of 10 % renewable transport fuel; and
- A commitment to save 20 % of total primary energy consumption by 2020 compared to a business as usual baseline.[40]

In order to meet these key objectives, the Climate and Energy Package comprises four pieces of complementary legislation[41]:

- A Directive revising the EU Emissions Trading Scheme (EU ETS), which covers some 40 % of EU greenhouse gas emissions (for a detailed description refer to Section 4.4);
- An "effort-sharing" Decision setting binding national targets for emissions from sectors not covered by the EU ETS (for a detailed description refer to Section 4.4);
- A Directive setting binding national targets for increasing the share of renewable energy sources in the energy mix (for a detailed description refer to sections 4.5 and 4.6);
- A Directive creating a legal framework for the safe and environmentally sound use of carbon capture and storage technologies. Carbon Capture and Storage Directive, detailed description in section 4.4).

The package is complemented by two further legislative acts that were agreed at the same time: A regulation requiring a reduction in CO_2 emissions from new cars (CO_2 regulation) and a revision of the Fuel Quality Directive (for details see section 4.6). Energy efficiency is not directly covered by the Climate and Energy Package; however the Energy Efficiency Directive was adopted in 2012 to help achieve the energy efficiency target. For more information on the Climate and Energy Package please refer to the 5th National Communication. Individual legislations are detailed in the relevant sectors.

The 20-20-20 targets have recently been adopted as one of the headline targets of the Europe 2020 strategy (see section 4.2.3.2) and progress towards achieving the three key objectives of the Climate and Energy Package includes:

- GHG emissions for the EU in 2011 have decreased by 17 % compared to 1990 levels.[42]
- The share of renewables in the final energy consumption of the EU-28 amounted to 13 % in 2011 – compared to 8.5 % in 2005.[43]

Primary energy consumption peaked in 2006 (approximately 1706 Mtoe) and has been decreasing since 2007, falling to 1583 Mtoe in 2011.[44]

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40 The 20 % EU energy efficiency target was legally defined in the Energy Efficiency Directive as the 'Union's (at that time: EU-27) 2020 energy consumption of no more than 1474 Mtoe primary energy or no more than 1078 Mtoe of final energy.

41 http://europa.eu/rapid/press-release_IP-09-628_en.htm

42 The scope includes aviation. http://www.eea.europa.eu/data-and-maps/indicators/greenhouse-gas-emission-trends/greenhouse-gas-emission-trends-assessment-5

43 http://ec.europa.eu/clima/policies/g-gas/progress/docs/16_energy_and_ghg_en.pdf

4.2.3.4. The Energy 2020 Strategy

The achievement of Europe's ambitious goals will require substantial change in Europe's energy system, with public authorities, energy regulators, infrastructure operators, the energy industry and citizens all actively involved, and tough choices to be made. The European Commission therefore published a Second Strategic Energy Review[45] on 13th November 2008 as a further step towards achieving the core energy objectives of sustainability, competitiveness and security of supply. In response to the political agenda outlined by the Second Strategic Energy Review (please refer to the 5th National Communication), the communication "Energy 2020 – A strategy for competitive, sustainable and secure energy"[46] was adopted by the European Commission on the 10th of November 2010.

The Energy 2020 strategy aims to respond to the longer term challenges of decarbonising the EU's energy supply whilst also ensuring energy security and the competitiveness of the region. The Communication is the product of extensive debates within the EU institutions and wider stakeholders, which provides an ambitious policy framework that "consolidates existing measures and steps up activity in areas where new challenges are emerging"[47]. Five key energy priorities for the EU over the next ten years are identified within the Energy 2020 communication:

- Achieving an efficient Europe;
- Building a truly pan-European integrated energy market;
- Empowering consumers and achieving the highest level of safety and security;
- Extending Europe's leadership in energy technology and innovation;
- Strengthening the external dimension of the EU energy market.

Each energy priority is accompanied by a series of actions to encourage the successful implementation of the Energy 2020 Strategy. Most importantly, these include legislation on energy efficiency (Energy Efficiency Directive, see section 4.5) and the Energy Infrastructure Regulation, entitled "Guidelines for trans-European Energy Infrastructure"[48] agreed upon in 2013.

The Energy 2020 Strategy acknowledges the importance of establishing a blueprint of the European Infrastructure for 2020-2030 and a subsequent proposal adopted by the European Commission in 2011[49] identified the priority infrastructure that needs to be constructed in order to facilitate a functioning internal market that can integrate a large scale production of renewables and guarantee security of supply. Further actions to support the building of a truly pan-European integrated energy market include the timely and accurate implementation of the internal market legislation, streamlining permit procedures and market rules for infrastructure developments and to provide the right financing framework.

44 http://ec.europa.eu/clima/policies/g-gas/progress/docs/16_energy_and_ghg_en.pdf

45 COM (2008) 781 final.

46 COM (2010) 639 final.

47 COM (2010) 639 final.

48 OJ L 115 25.04.2013, p.39.

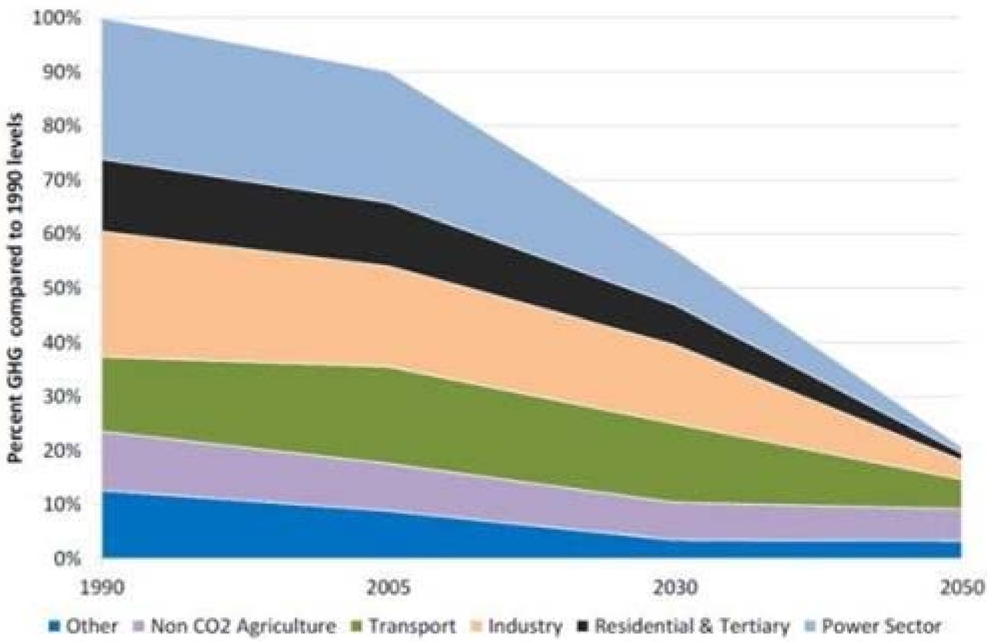
49 COM (2011) 658 final.

In order to extend Europe's leadership in energy technology and innovation the Energy 2020 Strategy calls for the implementation of the Strategic Energy Technology (SET) plan[50], which establishes an energy technology policy for Europe – accelerating the development and deployment of cost-effective low carbon technologies. The importance of funding for 'frontier research' and strengthening external links is also emphasised within the Energy 2020 Strategy.

4.2.3.5. Roadmaps 2050

In 2011, the European Commission launched three roadmaps to promote the discussion on the long-term framework of climate and energy policies in Europe: a) the "Roadmap for Moving to a Competitive Low Carbon Economy in 2050"[51] b) the "Roadmap to a Single European Transport Area - Towards a Competitive and Resource Efficient Transport System"[52] and c) the "Energy Roadmap 2050"[53]. The European Council reconfirmed in February 2011 that the objective of the EU is to reduce Europe's GHG emissions by 80 to 95 % below 1990 levels by 2050 as part of efforts by developed countries as a group to reduce their emissions by a similar degree. Although the EU is already committed to GHG emission reductions of at least 20 % below 1990 levels by 2020 as part of the Climate and Energy Package, longer-term policies are now required to ensure that the ambitious reduction target for 2050 is achieved. The European Commission has therefore published the communication entitled "Roadmap for moving to a competitive low-carbon economy in 2050", providing guidance on how the EU can decarbonise its economy.

Figure 4-1 EU Roadmap 2050 decarbonisation pathway



Source: COM (2011) 112 Final

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50 http://ec.europa.eu/energy/publications/doc/2010_setplan_brochure.pdf

51 COM (2011) 112 final.

52 COM (2011) 144 final.

53 COM(2011) 885/2.

The Roadmap for moving to a competitive low-carbon economy in 2050 is based on economic modelling and scenario analysis, which considers how the EU can move towards a low carbon economy assuming continued global population growth, increasing global GDP and, by varying trends in terms of international climate action (i.e. global action / fragmented action), energy (i.e. fossil fuel prices) and technological development (i.e. effective technology scenarios / delayed CCS and delayed electrification scenarios). 'The analysis of the projections of the different EU decarbonisation scenarios shows that by 2050, an 80 % EU internal reduction compared to 1990 is technically feasible with proven technologies if a sufficiently strong carbon price incentive is applied across all sectors (ranging from approx. €100 to €370 per ton of CO_2eq)'.[54] The cost-efficient pathway for achieving the 2050 target calls for domestic GHG reductions below 1990 levels of 25 % in 2020, 40 % in 2030 and 60 % in 2040 and this would require an additional annual investment of €270 billion[55] for all sectors over the next 40 years.

The extent and timing of these GHG reduction milestones are differentiated by sector reflecting the different abatement potentials that exist within the EU (*Figure 4-1*). It is assumed within the Roadmap strategy that electricity demand will significantly increase[56] (i.e. electrification of transport) and that in parallel GHG emissions from the power sector will need to reduce drastically by 93 to 99 % below 1990 levels by 2050.

The Energy Roadmap 2050[57] was therefore subsequently published by the European Commission to assess a range of scenarios (i.e. energy efficiency / high renewables / delayed CCS / low nuclear) for the region's future energy mix. The outcome of the assessment is that decarbonisation of the power sector is possible and that the total energy system may be less costly, as a percentage of European GDP, than current policies in the long run due in part to reduced exposure to fossil fuel price volatility in the future[58]. All scenarios for decarbonising the power sector result in higher capital expenditure and lower fuel costs.

The "Roadmap for Moving to a Competitive Low Carbon Economy in 2050" strategy envisages that GHG emissions associated with the transport sector need to be reduced by between 54 % and 67 % below 1990 levels by 2050. The European Commission has recently published a white paper entitled "Roadmap to a Single European Transport Area" to provide policy guidance on mitigation options which include:

- developing and deploying new and sustainable fuels and propulsion systems;
- optimising the performance of multimodal logistic chains, including making greater use of more energy-efficient modes;

54 SEC(2011) 289 final.

55 This estimated annual investment is averaged out over a 40 year period and is based on the effective technology scenario for both the global and fragmented action case.

56 Gross electricity consumption in 2050 in the Effective Technologies scenario than in the Delayed Electrification scenario and is around 850 TWh higher than in the reference scenario

57 COM (2011) 885/2.

58 Exposure to fossil fuel price volatility would drop in decarbonisation scenarios as import dependency falls to 35-45 % in 2050, compared to 58 % under current policies. This applies under the assumption of global carbon action.

- increasing the efficiency of transport and of infrastructure use with information systems (including SESAR and Galileo) and market-based incentives (such as the application of 'user pays' and 'polluter pays' principles)[59].

The Energy Roadmap and the Transport Roadmap are consistent with the emission reduction milestones. The European Commission expects Member States and stakeholders to take these Roadmaps - and any further sector specific Roadmaps - into account in the further development of EU and national policies for achieving a low carbon economy by 2050.

In addition to these roadmaps, a framework for transforming Europe's economy into a sustainable one by 2050 was set in 2001 with the "Roadmap to a Resource Efficient Europe"[60] with emphasis on resource productivity and decoupling of economic growth and resource use.

The Roadmaps are part of the Resource Efficiency Flagship of the Europe 2020 Strategy (see section 4.2.3.1).

4.2.3.6. European Bioeconomy Strategy

The European Bioeconomy Strategy[61] that was adopted in February 2012 promotes the transition to a post-petroleum society. It covers all biomass producing and processing sectors, aiming to substitute the use of fossil resources by renewable ones in industrial processes and to improve the resource efficiency of production processes through innovative solutions based on the use of industrial biotechnology (e.g. to green conventional chemical processes) and other innovative technologies. The Bioeconomy Strategy will ensure that substantial EU, national and private funding is provided for bioeconomy research and innovation and will improve the co-ordination of funding to support established priorities of bioeconomy related policies.

4.2.3.7. 2030 Framework for Climate and Energy Policies

In March 2013 the Commission adopted a Green Paper entitled 'A 2030 Framework for climate and energy policies'[62]. The key objectives of the 2030 framework will include the reduction of greenhouse gas emissions, securing energy supply and supporting economic growth.

An early adoption of the 2030 framework for climate and energy policies is justified in the Green Paper on the basis that it will provide longer term certainty for investors and will also enable the EU to set its level of ambition in the ongoing UNFCCC negotiations in advance of the expected 2015 deadline for an international agreement.

The 2030 framework will build upon the experience and lessons learnt from the 2020 framework and will take into account the longer term perspective outlined previously by the Commission in the 2011 Roadmap for moving to a competitive low carbon economy in 2050, the Energy Roadmap 2050 and the Transport White Paper. A stakeholder consultation allowed the Member States and other stakeholders to contribute their view on the type, nature and level of potential climate and energy targets for 2030. The

59 COM (2011) 144 final.

60 COM (2011) 571 final.

61 COM (2012) 60 final.

62 COM (2013) 169 final.

outcome of both the stakeholder consultation and the Impact Assessment will feed into a proposal by the Commission for the 2030 Framework expected early in 2014.

4.2.3.8. 7th Environmental Action Programme

General environment action programmes have guided the development of EU environment policy since the early seventies. The Sixth EU Environment Action Programme (EAP) covered the period 2002-2012. A Decision on a 7th EU Environment Action Programme, (entitled 'Living well, within the limits of our planet') was formally adopted in November 2013[63]. The 7th EAP- proposed by the European Commission in 2012 - provides an overarching framework for environmental policy (without specific set objectives for climate policy as this is now a separate policy area) up to 2020, identifying nine priority objectives for the EU and its Member States:

- protecting nature and strengthen ecological resilience
- boosting sustainable resource-efficient low-carbon growth
- effectively addressing environment-related threats to health,
- better promoting the implementation of EU environment law,
- ensuring that policies benefit from state of the art science,
- securing the necessary investments in support of environment and climate change policy,
- improving the way environmental concerns and requirements are reflected in other policies,
- enhancing the sustainability of EU cities, and
- improving the EU's effectiveness in addressing regional and global challenges related to the environment and climate change.

Based on these objectives the 7th EAP will 'create a shared understanding of the state of Europe's environment, the challenges we face and the opportunities we have'[64]. It is recognised within the Decision that most of the legislation for meeting these objectives are already in place; however additional efforts are required to improve implementation of current legislation, the evidence base for policy, the investment framework and integration on environment aspects into other policies and sectors.

4.2.4. Assessment of the economic and social consequences of response measures

For a description of the assessment procedures of the economic and social consequences of response measures in the EU, see section [BR1] 4.10 in Annex 1: EU 1st Biennial Report.

4.2.5. Legislative Arrangements and Enforcement/ Administrative Procedures Relevant to Kyoto Protocol Implementation

For the EU-15 Member States, the Kyoto Protocol's compliance procedures will only apply if the EU-15 as a whole misses its 8% reduction target. Should this occur, then each Member State will be held to its target under the EU's burden-sharing agreement,

63 http://ec.europa.eu/environment/newprg/pdf/PE00064_en.pdf

64 http://europa.eu/rapid/press-release_MEMO-12-908_en.htm

and the EU as a whole will be in non-compliance with its obligation to meet the -8 % target. On top of that, the European Commission can decide to start infringement procedures against EU-15 Member States that miss their targets under the burden-sharing agreement.

The remaining Member States with Kyoto targets (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia) are bound to their individual targets as set out in the Kyoto Protocol, both under the Kyoto Protocol's non-compliance procedures and under EU law.

Article 258 of the Treaty on the Functioning of the European Union gives the Commission powers to take legal action against a Member State that is not respecting its obligations.

If the Commission considers that there may be an infringement of EU law that warrants the opening of an infringement procedure, it addresses a "Letter of Formal Notice" (first written warning) to the Member State concerned, requesting it to submit its observations by a specified date, usually two months.

In light of the reply or absence of a reply from the Member State concerned, the Commission may decide to address a "Reasoned Opinion" (second and final written warning) to the Member State. This clearly and definitively sets out the reasons why it considers there to have been an infringement of EU law, and calls upon the Member State to comply within a specified period, usually two months.

If the Member State fails to comply with the Reasoned Opinion, the Commission may decide to bring the case before the Court of Justice. Where the Court of Justice finds that the Treaty has been infringed, the offending Member State is required to take the measures necessary for compliance.

Article 260 of the Treaty gives the Commission power to act against a Member State that does not comply with a previous judgement of the European Court of Justice. The article also allows the Commission to ask the Court to impose a financial penalty on the Member State concerned.

Further information on infringement procedures, including recent decisions on breaches of EU law, can be found on the Commission's website[65].

In addition, the EU has implemented a thorough compliance system as part of the climate and energy package. In the EU ETS compliance is determined for all installations and aviation operators on an annual basis. The Effort Sharing Decision establishes emission reduction targets for the non-ETS sector for each Member States individually for each year of the 2013-2020 period and also includes an annual compliance mechanism at the end of each reporting year with clear consequences when Member States fail to meet their commitments.

4.2.6. Changes in institutional arrangements

For a description of the changes in institutional arrangements, please refer to section [BR1] 4.9 in Annex 1: EU 1st Biennial Report.

65 http://ec.europa.eu/community_law/infringements/infringements_en.htm

4.3. Additional Information Required Under the Kyoto Protocol

4.3.1. Introduction

The following section contains information in accordance with UNFCCC Decision 15/CMP.1, and contains supplementary information required under Article 7 paragraph 2 of the Kyoto Protocol regarding:

- Member State use of Kyoto mechanisms (section 4.3.2),
- Supplementarity relating to the mechanisms pursuant to Articles 6, 12 and 17 (section 4.3.3),
- Policies and Measures Promoting Sustainable Development (Art. 2 (1) Kyoto Protocol) (section 4.3.4.1),
- Policies and Measures Related to Bunker Fuels (Art. 2 (2) Kyoto Protocol) (section 4.3.4.2) and
- Minimisation of adverse impacts (Art. 2 (3) Kyoto Protocol) (section 4.3.4.3).

4.3.2. Member State use of Kyoto mechanisms

For a description of Member State use of Kyoto mechanisms, please refer to section [BR1] 4.12 in Annex 1: EU 1st Biennial Report.

4.3.3. Supplementarity relating to the mechanisms pursuant to Articles 6, 12 and 17

Supplementarity obligations under the Kyoto Protocol require that any international credit purchases by Member States must be in addition to emission abatement action taken domestically. Within the EU the term has not been quantitatively defined.

Although the end of the first commitment period is reached, final information on compliance and on supplementarity for this period is not available before the end of the true-up period in 2015.

In general, for the EU the use of flexible mechanisms takes place on the one hand by operators in the EU ETS, on the other hand by governments for the achievement of Kyoto targets.

As part of the EU ETS, Member States were required to inform the European Commission in their Phase II NAPs on the maximum amount of JI and/or CDM credits that can be used. This limit was then assessed according to the principle of supplementarity, and where appropriate approved or revised by the European Commission. The percentages vary from 4 % of free allocation in Estonia to 22 % in Germany. In total, this adds up to 1.4 billion CERs or ERUs that could have been used in the second trading period[66]. The amended EU ETS Directive 2009/29/EC (Article 11a(8)) sets the upper limit for credit use for the period from 2008 to 2020 at a maximum of 50 % of the reduction effort below 2005 levels. This is further specified into installation-level limits in the Commission Regulation on international credit

66 EEA 2013 - Trends and Projections Report, http://www.eea.europa.eu/publications/trends-and-projections-2013

entitlements (RICE) [67]. The sum of the installation-level limits is expected to be lower than the upper limit, but higher than the 1.4 billion CERs and ERUs already allowed in the second period (see section [BR1] 4.2.2.4). Since some entitlements are expressed as a percentage of verified emissions, the overall maximum amount will only be known at the end of third trading period.

Information on the actual use of Kyoto mechanisms by governments cannot currently be estimated: Due to a change in the reporting of SEF tables, the separation between entities holding accounts (EHA) and operator holding accounts (OHA) is no longer reliable, making it impossible to distinguish between governmental use of flexible mechanisms and changes to the number of units induced by operators in the EU ETS. Information on the actual amounts of retired units by Member States for compliance in the first commitment period is shown in CTF Table 4b in the CTF Appendix. This information is too incomplete to discuss with regard to the percentage of flexible mechanisms used for compliance in the first commitment period.

In *Table 4-1* the initial Assigned Amount Units (AAU) for EU-15 and EU-28[68] are compared to actual emissions and the projected use of flexible mechanisms in the first commitment period (CP 1). The table bases on results from the EEA Trends and Projections Report 2013[69] and takes into account preliminary GHG emissions for the year 2012 and information on the planned governmental use of flexible mechanisms, as these have been reported by questionnaires under the biennial submission from Member States to the European Commission under the EU Monitoring Mechanism Decision[70].

With the issuance of EU ETS allowances (EUA) which are directly linked to AAU, a separation of the total assigned amount has indirectly been determined between ETS and non-ETS sector (see [BR1] section 4.2.2.2 in EU's 1st Biennial Report). In both sectors, emissions in the 2008-2012 period are below the designated targets for EU-15 and EU-28 aggregate. Nevertheless, 1 212 million units of flexible mechanisms are planned to be used in total in EU-15, of which 808 million units have already been surrendered in the EU ETS. In EU-28 the amount of units used in the EU ETS is 1 039 million units, whereas the net sum of the governmental units planned to be used is 17 million units. This is due to the fact that in most EU-13 Member States there are sales of units planned through the International Emission Trading (IET) and Joint Implementation, reducing the total amount from 403 million to 17 million units.

In total, the estimated effect of the use of flexible mechanisms in CP 1 (in the EU ETS and governmental) for EU-28 amounts to 1 056 Mt CO_{2eq} about 4 % of initial AAU. For more information by Member States please refer to section [BR1] 4.12 in Annex 1: EU 1st Biennial Report.

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67 Commission regulation on determining international credit entitlements pursuant to Directive 2003/87/EC of the European Parliament and of the Council (OJ L 299, 9.11.2013, p.32-33)

68 EU-28 is calculated as the sum of all EU Member States, although Cyprus and Malta do not have an individual target under the Kyoto Protocol.

69 http://www.eea.europa.eu/publications/trends-and-projections-2013

70 Decision no 280/2004/EC.

Table 4-1 Supplementarity: Use of flexible mechanisms 2008-2012 (preliminary results)

		EU-15	EU-28*
Initial assigned Amounts (2008-2012)	Mt CO_2 eq.	19 621	26 712
AAU issued for ETS (2008-2012)		7 803	10 341
Non-ETS target (2008-2012)		11 818	16 371
Actual Emissions (2008-2012)		18 735	23 376
of which ETS		7 394	9 614
of which Non-ETS (2012= proxy)		11 341	13 762
Preliminary difference to Non-ETS target without use of flexible mechanisms and effect of carbon sinks		477	2 609
Planned governmental net use of flexible mechanisms	Million units	403	17
Use of flexible mechanisms in EU ETS		808	1 039
CDM		528	663
JI		281	376
Planned total use of flexible mechanisms		1 212	1 056
* Cyprus and Malta have no individual target under the Kyoto Protocol			

Source: Data from EEA Trends and Projections Report 2013

4.3.4. Policies and measures in accordance with Art 2 (KP)

4.3.4.1. Policies and Measures Promoting Sustainable Development (Art. 2 (1) Kyoto Protocol)

Sustainable development is an overarching objective of the European Union set out in the Treaty, governing all the Union's policies and activities. Information on the EU's Sustainable Development Strategy (SDS) was included in the EU's 5th National Communication.

In 2009, the Commission adopted the 2009 Review of EU SDS[71]. The review stresses that the EU has mainstreamed sustainable development into a broad range of its policies. In particular, the European Union has taken the lead in the fight against climate change and the promotion of a low-carbon economy[72]. At the same time, unsustainable trends persist in many areas and the efforts need to be intensified. The review takes stock of European Union policy measures in the areas covered by the EU SDS and launches a reflection on the future of the EU SDS and its relation to the Lisbon strategy.

71 (COM (2009) 400 final, 24/07/2009, Mainstreaming sustainable development into EU policies: 2009 Review of the European Union Strategy for Sustainable Development. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0400:FIN:EN:PDF

72 http://ec.europa.eu/environment/eussd/

The review is complemented by Eurostat's bi-annual monitoring report on sustainable development (Eurostat, 2011[73]). The monitoring report aims to provide an objective, statistical picture of progress toward the goals and objectives of the EU SDS.

The European Council in December 2009 confirmed the review and emphasized that significant additional efforts are needed to curb and adapt to climate change, to decrease high energy consumption in the transport sector and to reverse the current loss of biodiversity and natural resources. It further states that the shift to a safe and sustainable low-carbon and low-input economy will require a stronger focus in the future. Priority actions should be more clearly specified in future reviews. Governance, including implementation, monitoring and follow-up mechanisms should be reinforced for example through clearer links to the future EU 2020 strategy and other cross-cutting strategies.

4.3.4.2. Policies and Measures Related to Bunker Fuels (Art. 2 (2) Kyoto Protocol)

Policies and measures relating to bunker fuels are described in Annex 1: EU's 1st Biennial Report, in section [BR1] 4.4.14 – “International marine transport” and for aviation in section in section [BR1] 4.2.2 – “EU Emissions Trading Scheme”.

4.3.4.3. Minimisation of adverse impacts (Art. 2 (3) Kyoto Protocol)

Information on how the EU strives to implement policies and measures under Article 2 of the Kyoto Protocol in such a way as to minimize adverse effects

According to paragraph 36 of the Annex to the UNFCCC decision 15/CMP.1, each Party shall provide information not reported elsewhere under these guidelines on how it strives to implement policies and measures under Article 2 of the Kyoto Protocol in such a way as to minimize adverse effects, including the adverse effects of climate change, effects on international trade, and social, environmental and economic impacts on other Parties, especially developing country Parties and in particular those identified in Article 4, paragraphs 8 and 9, of the Convention, taking into account Article 3 of the Convention.

The EU has reported on detailed activities on how it strives to minimize adverse effects on other Parties in its annual national inventory report in chapter 15.[74]

Section 7.3 provides information on EU programmes which aim to minimize adverse effects of climate change on developing countries, in particular those that are particularly vulnerable to climate change.

Impacts on third countries are mostly indirect and can frequently neither be directly attributed to a specific EU policy, nor directly measured by the EU in developing countries. Therefore, the reported information covers potential adverse social, environmental and economic impacts (including trade impacts) that result from complex assessments of indirect influences and that are based on accessible data sources in developing countries.

73 Eurostat (2011): Sustainable development in the European Union - 2011 monitoring report of the EU sustainable development strategy, http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-31-11-224/EN/KS-31-11-224-EN.PDF).

74 EEA (European Environment Agency) (2013): Annual European Union greenhouse gas inventory 1990-2011 and inventory report 2013. Technical report No 8/2013, http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2013.

The most important continuous activity in this respect is the EU's wide-ranging impact assessment system accompanying all new policy initiatives. This approach ensures that potential adverse social, environmental and economic impacts on various stakeholders and third Parties are identified and minimized within the legislative process. In general, impact assessments are required for all legislative proposals, but also for other important Commission initiatives which are likely to have far-reaching impacts. In chapter 15 of the EU's annual national inventory report, the impact assessment process is explained in more detail[75]. Consulting interested parties is an obligation for every impact assessment and all affected stakeholders should be engaged, using the most appropriate timing, format and tools to reach them. Existing international policy dialogues are also to be used to keep third countries fully informed of forthcoming initiatives, and as a means of exchanging information, data and results of preparatory studies with partner countries and other external stakeholders.

Major EU policies such as the Directive on the promotion of the use of renewable energy (Directive 2009/28/EC, the extension of the EU ETS to the aviation sector (Directive 2008/101/EC), updates of EU policies which should lead to a low carbon and energy efficient economy are also presented in more detail as examples in the 2013 submission of the EU's national inventory report.

Since the submission of the most recent national inventory report only two additional impact assessments have been completed and published that are related to the policies and measures covered in section 4 of this report:

Proposal for a Regulation of the European Parliament and of the Council on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport (see section [BR1] 4.4.14 in Annex 1: EU's 1st Biennial Report)

This proposal addresses ships above 5000 gross tons in respect of emissions released during their voyages from the last port of call to a port under the jurisdiction of a Member State and from a port under the jurisdiction of a Member State regardless of their flag. With regard to economic effects on third countries, the impact assessment of this proposal concludes that "based on the pass-through of costs and savings in maritime transport and on the price building mechanisms in different sectors, measurable increases of commodity prices (with transport costs being only an insignificant element of the commodities' prices) are only expected for natural gas of up to 0.1-0.5% and for iron ore of up to 0.1-0.3%. Such price impacts are far below the usual price fluctuation for these products. In conclusion, no impacts deriving from possible increases of commodity prices are expected for third countries.[76]

Commission regulation implementing Directive 2009/125/EC with regard to ecodesign requirements for computers, servers and displays.

Experts from third countries were involved in the stakeholder consultation process and the initiative was discussed in meetings of Commission staff with third country government representatives as e.g. USA, China, India, etc.

75 EEA Technical report No 8/2013

76 Impact Assessment – Part 1 Accompanying the document Proposal for a Regulation of the European Parliament and of the Council on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport and amending Regulation (EU) No 525/2013. Commission staff working document SWD(2013) 237 final/2.

The impact assessment found no significant impacts on the competitiveness of industry of the EU or third countries and in particular in the SMEs sector due to the small absolute costs related to product re-design and re-assessment.

With regard to impacts on trade, the process for establishing ecodesign requirements for computers, servers and displays has been fully transparent, and a notification under WTO-TBT was issued 60 days prior to the vote by the Regulatory Committee.

4.4. Cross-sectoral policies and measures

Cross-sectoral policies and measures comprise:

- The EU Emissions Trading Scheme
- The Effort Sharing Decision
- The CCS Directive
- Taxation of Energy Products and Electricity
- Research and Innovation in Climate and Energy
- Structural and Cohesion Funds
- The National Emissions Ceiling Directive

For a description of these policies and measures and a quantification of their impacts, please refer to section [BR1] 4.2 in Annex 1: EU 1st Biennial Report.

4.5. Sectoral policies and measures: Energy

EU policies and measures targeted on energy comprise:

- Renewable Energy Roadmap
- Renewable Energy Directive (2009/28/EC)
- Biomass Action Plan
- Cogeneration Directive (2004/8/EC)
- Directive on Energy End-use Efficiency and Energy Services (2006/32/EC)
- Energy Performance of Buildings (Directive 2010/31/EU)
- Energy Efficiency Plan 2011 (COM/2011/109)
- Energy Efficiency Directive (2012/27/EC)
- Internal Market in Electricity Directive (2009/72/EC)
- Ecodesign Framework Directive (Directive 2009/125/EC)
- Energy Labelling Directive (Directive 2010/30/EU)
- Green public procurement
- Energy star programme
- Motor Challenge Programme
- Strategic Energy Technology Plan (SET plan)

- Intelligent Energy Europe II Programme
- The Covenant of Mayors

For a description of these policies and measures and a quantification of their impacts, please refer to section [BR1] 4.3 in Annex 1: EU 1st Biennial Report.

4.6. Sectoral policies and measures: Transport

EU policies and measures targeted on transport comprise:

- Renewable Energy Directive (2009/28/EC)
- Strategy to reduce CO_2 from passenger cars and light-commercial vehicles (COM/2007/19)
- Regulation on CO_2 emissions from cars (443/2009)
- Regulation CO_2 emissions from light-commercial vehicles (510/2011)
- Biofuels Directive (repealed by Renewable Energy Directive)
- Fuel Quality Directive (2009/30/EC)
- Infrastructure charges for heavy goods vehicles (Directive 1999/62/EC as amended by Directives 2006/38/EC and 2011/76/EU)
- Proposal for an amendment of the Fuel Quality Directive and the Renewable Energy Directive
- Euro 5 and 6 Standards (Regulation (EC) No 692/2008)
- Euro VI Standard for heavy duty vehicles (Regulation (EC) No 595/2009)
- Environmental performance requirements for motor vehicles and tyres (Regulations (EC) 661/2009, (EC) 1222/2009 and (EU) 65/2012)
- Clean Power for Transport package including the deployment of alternative fuel infrastructure
- Clean Vehicles Directive (2009/33/EC)
- Roadmap to a Single European Transport Area
- International maritime transport.

For a description of these policies and measures and a quantification of their impacts, please refer to section [BR1] 4.4 in Annex 1: EU 1st Biennial Report.

4.7. Sectoral policies and measures: Industry

EU policies and measures targeted on industry comprise:

- Regulation on certain fluorinated greenhouse gases (EU F gas Regulation No. 842/2006)
- Proposed revision of the F-Gas Regulation

- Emissions from air conditioning systems in motor vehicles (MAC-Directive 2006/40/EC)
- Industrial Emission Directive (2010/75/EU)
- Ecodesign Framework Directive (Directive 2009/125/EC).

For a description of these policies and measures and a quantification of their impacts, please refer to section [BR1] 4.5 in Annex 1: EU 1st Biennial Report.

4.8. Sectoral policies and measures: Agriculture

EU policies and measures targeted on agriculture comprise:

- Agricultural Market and Income support (1st pillar of Common Agricultural Policy / CAP)
- Rural Development Policy (2nd pillar of CAP)
- Soil Thematic Strategy
- Nitrates Directive.

For a description of these policies and measures and a quantification of their impacts, please refer to section [BR1] 4.6 in Annex 1: EU 1st Biennial Report.

4.9. Sectoral policies and measures: Forestry

Major EU policies and measures targeted on forestry comprise:

- EU Forest Strategy
- Forestry measures within Rural Development Plan
- EU biodiversity strategy
- EU timber regulation
- EU Action Plan for Forest Law Enforcement, Governance and Trade (FLEGT)
- European Forest Fire Information System (EFFIS).

For a description of these policies and measures and a quantification of their impacts, please refer to section [BR1] 4.7 in Annex 1: EU 1st Biennial Report.

Please note that (according to the BR guidelines[77]) section [BR1] 4.7 is on "Land use, land use Change and Forestry" (LULUCF) policies and measures and thus has a broader scope than the present section which (according to the NC guidelines[78]) focuses on forestry only. Thus, in section [BR1] 4.7, LULUCF Accounting is covered in addition to the above mentioned policies and measures.

77 UNFCCC biennial reporting guidelines for developed country Parties: Annex I to Decision 1/CP.17; FCCC/CP/2011/9/Add.1.

78 Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications: Decision 4/CP.5; FCCC/CP/1999/7.

4.10. Sectoral policies and measures: Waste

EU policies and measures targeted on waste comprise:

- Waste Framework Directive
- Landfill Directive
- Waste Incineration Directive
- EU policies targeting waste streams
- Management of Biodegradable Waste
- Urban Waste Water Directive.

For a description of these policies and measures and a quantification of their impacts, please refer to section [BR1] 4.8 in Annex 1: EU 1st Biennial Report.

4.11. Policies and measures no longer in place

For policies and measures that are no longer in place, please refer to the respective sub-sections of section [BR1] 4.2 to section [BR1] 4.8 in Annex 1: EU 1st Biennial Report.

4.12. Interaction of policies and measures

The EU Emission Trading Scheme (ETS) is one of the overarching and key policy instruments implemented in the EU to achieve its climate policy objectives (for more information on EU ETS, see section [BR1] 4.2.2 in Annex 1: EU 1st Biennial Report). It covered 39 % of EU-15 GHG emissions (41 % of EU-28 GHG emissions) in the 2008-2012 period and interacts as a structural measure with many other policies and measures by giving a price to GHG emissions.

A particularly complex interaction can be observed for end-use energy efficiency policies and the EU ETS. For example, a measure to increase the efficiency of specific household goods could be examined: Such a measure might be set up by governments to raise attention on electricity consumption of households, but also by power plant operators. Plant operators in particular might have an incentive to increase efficiency for several reasons: i) as a marketing activity, ii) as a reaction to a governmental measure requiring to undertake energy efficiency measures for final users to reduce end-use energy consumption by a specific percentage (white certificates) or iii) to reduce electricity consumption in order to avoid the installation of additional generating capacities or to operate a plant more efficiently to reduce the need of ETS allowances. If the efficiency improvement saves electricity that is generated in fossil fuelled power plants, the induced reduction is reflected in the ETS, as power generators above 20 MW are generally included there. The reduction of electricity consumption might have no effect at all on ETS emissions (in case of complete autarky of households from electrical grid) or an effect on ETS emissions, depending on the share of renewables in the electrical grid. Such an example therefore demonstrates why it is difficult to quantify emission reductions resulting from the ETS.

In addition, the separation of emission reductions into ETS and non-ETS sectors is not always explicit, as especially the use of electricity is an interlinkage between all sectors (even the transport sector if electric vehicles are taken into account).

In general the interaction of market-based instruments and regulation need to be examined closely. While a market-based instrument, such as the ETS, sets an emissions reduction and provides flexibility as to where exactly the reduction might be achieved, a regulation might set a limit on emissions for a specific sector, technology or activity. If these activities are simultaneously covered under the ETS, the regulation would impact upon the efficiency of the ETS. This might particularly be the case where high-cost mitigation options need to be employed more under the regulation than they would under the ETS.

4.13. Effect of policies and measures on the modification of long-term trends

The precise impact of policies and measures on the EU-28's long-term emission trends, outlined in section 5, is difficult to isolate. In part as the information presented in Chapter 5 is based on the sum of MS projections (with somewhat different approaches and assumptions, see section 5.6) as well as the impact of other factors (e.g. energy prices), which also drive changes in longer-term trends.

However, looking at the historic trends from 1990 to 2011 in national circumstances (see section 2) and historic and projected emissions (1990–2020) across different sectors (see section 5.2) some high-level effects can be discerned:

In relation to energy use (excluding transport) primary and final energy consumption grew over the period to 2006, but from the early part of the 2000s, consumption appears to have started to plateau. After 2006, a declining trend in energy use is observed (with a dip in the 'economic crisis' year 2009). Electricity consumption has been following a similar pattern, however with a stronger increase rates up to the early 2000s. Over time generation has shifted towards a lower carbon intensity fuel mix. The EU-28 primary energy intensity has fallen from 1990 to 2011 by more than 25% (see section 2.7.1). As a result, EU-28 emissions from energy use have declined gradually from 1990 to 2011 (as well, with a dip in the year 2009 due to the economic crisis). Taking into account the existing measures these are projected to fall further to 30% below 1990 levels by 2020, whilst with additional measures they are expected to decline even more (30% below 1990 levels by 2020, see section **5.2.3.1**). This indicates that policies have a sizeable impact on (particularly end-use) energy efficiency and hence overall consumption itself, and are also strongly driving the shift towards low carbon electricity generation, particularly as a result of new renewables policies.

Transport activity, in particular freight transport and transport in the new EU Member States, has steadily increased in the EU since 1990 until the economic crisis. As a result, GHG emissions from transport have grown until 2007, albeit at a slower pace than real GDP, and are decreasing since. With existing measures, emissions are expected to remain stable and with additional measures expected to continue to decline. However, 2020 emission levels would still be 12% above 1990 levels (see section 5.2.3.2). This indicates that additional measures, e.g. driving improved vehicle efficiency (particularly the strategy for CO_2 in cars – see section 4.6), and to a lesser extent the introduction of biofuels, are expected to more than offset the increase in emissions from the expected continued increase in demand for transport.

Emissions from industrial processes show a strongly fluctuating trend for the past since 1990 (see section 5.2.3.3): After a sharp decrease since 2007, emissions appear to have stabilised since 2009 with a slightly increasing trend. In the projections emissions are estimated to remain static with additional measures and with a slightly increasing trend with existing measures.

Policies and measures in agriculture, coupled with a decrease in activity already appear to have had a significant effect on historic emissions; driving increased productivity, reduced nitrogen fertiliser production, reductions in livestock numbers, improved manure management, etc. In the projections (see section 5.2.3.4) emissions are estimated to remain broadly static both with existing and with additional, indicating a more limited impact from policies on longer term trends.

Similarly, in the waste sector emissions have declined strongly from the mid-1990s to 2011, in particular, as a result of policies such as the Landfill Directive (see section 4.10). Emissions are expected to decrease further, although the rate of decrease slows down slightly under both the existing and with additional measure scenarios (see section 5.2.3.5), indicating that the impact of policies on longer-term trends is also gradually declining.

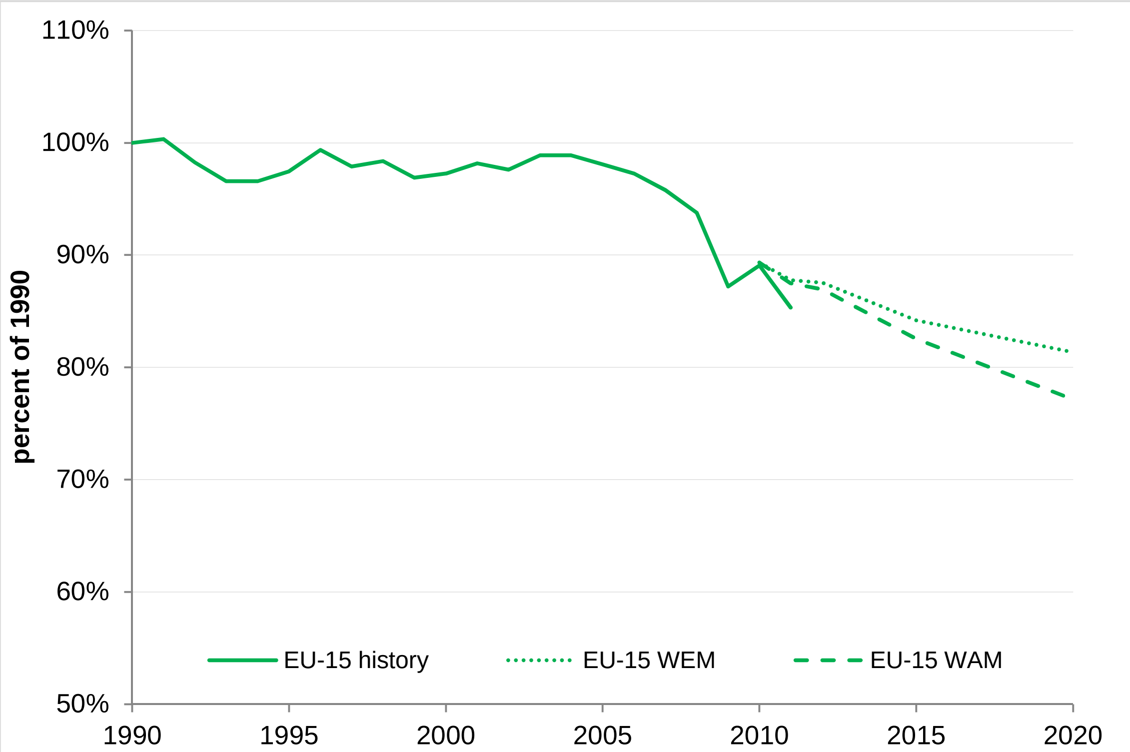
The impact of policies on long-term emission trends in other key sectors, such as marine and aviation (see section 5.2.3.7), is more difficult to discern. The underlying trend is a continued and rapid increase in emissions from these sectors, but new policy action such as the incorporation of aviation into the EU ETS will likely reduce the rate of this increase. However, not all MS have reported projections in these sectors and where they have done so, they do not necessarily include the impact of the latest policy changes.

5. PROJECTIONS AND THE TOTAL EFFECTS OF POLICIES AND MEASURES

Key developments

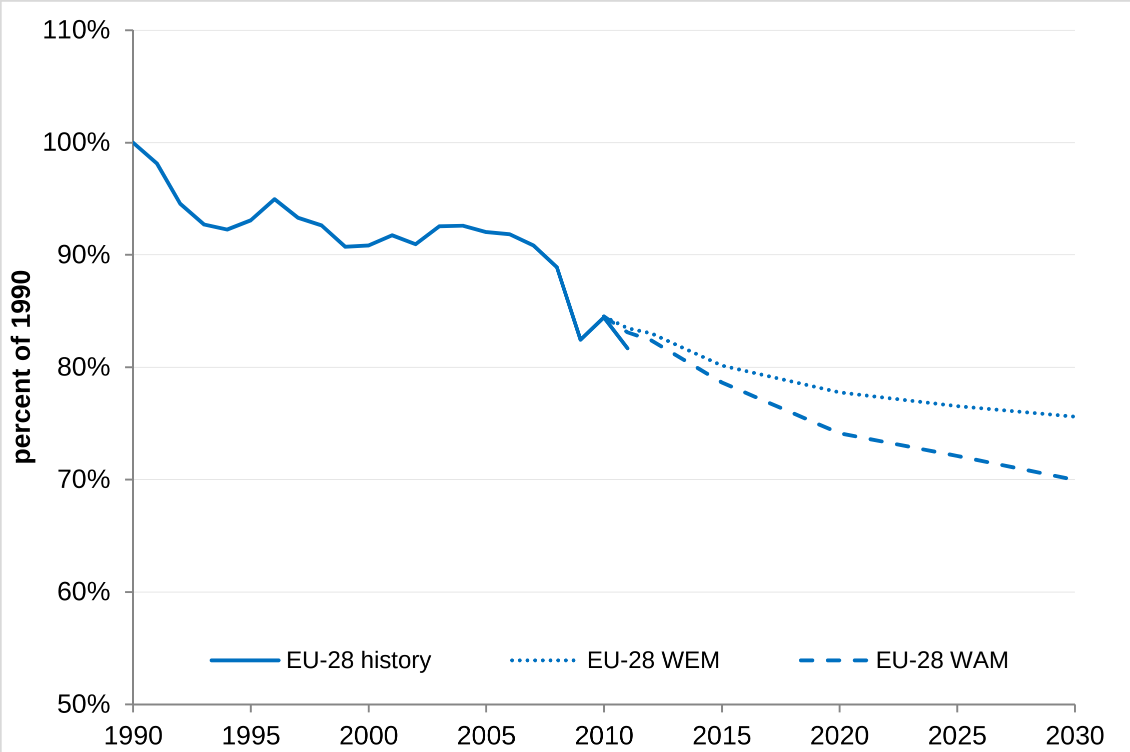
In 2020, emissions of GHG in the EU-15 as a result of implemented measures (WEM scenario) are projected to be 18.7 % below 1990 levels. Considering also planned measures (WAM scenario), the projected GHG emission reductions increases to 22.9 % below 1990 levels (see Figure 5-1).

Figure 5-1 Total aggregate GHG emission projection for EU-15, including historic values, relative to 1990



In 2020, in the EU-28, total GHG emissions as a result of implemented measures (WEM scenario) are projected at 22 % below 1990 levels. Considering also planned measures (WAM scenario) the projected GHG emission reductions would be 26 % below 1990 levels (see Figure 5-2).

Figure 5-2 Total aggregate GHG emission projection for EU-28, including historic values, relative to 1990



The most significant sectoral contribution in absolute GHG emission reductions in the EU-28 WEM scenario from 1990 to 2020 is projected to stem from the energy sector (1 051 Mt CO_2eq), followed by agriculture, industry and the waste sector. GHG emissions in the transport sector are projected to increase by 18% compared to 1990 levels. If also additional measures are considered (WAM scenario), the pattern of sectoral shares in emission reductions remains the same, while the emissions growth in the transport sector in EU-28 is less prominent (12% increase by 2020 compared to 1990 levels).

Reductions in CO_2 emissions are expected to contribute most to overall emission reductions in the EU-28. Under the WEM scenario, CO_2 contributes to 70% of the aggregate GHG emission reductions in 2020 compared to 1990, followed by CH_4, and N_2O.

5.1. Introduction

5.1.1. Context

Please refer to Section [BR1] 5.1.1 in Annex 1: EU 1st Biennial Report for information on the context. Here, and in the following, solid lines refer to historic values, dotted and dashed lined refer to scenarios.

5.1.2. Scenarios

For an introduction of the scenarios presented in the National Communication, please refer to section [BR1] 5.1.2 in Annex 1: EU 1st Biennial Report.

5.1.3. Key parameters and assumptions

The key parameters and assumptions underlying the EU-15 are aggregated from data reported by individual Member State projections and are summarised in Table 5-1 below.

Table 5-1 Key parameters and assumptions EU-15 projections[79]

Parameter	2015	2020
CO2-price (Euro (2010)/tCO2_eq)	12	17
GDP (Bio. Euro (2005))	12	13
International coal price (Euro (2010)/boe)	18	20
International gas price (Euro (2010)/boe)	50	54
International oil price (Euro (2010)/boe)	87	95
Population (Mio.)	398	404

For an introduction of the key parameters and assumptions that underlie each of the scenarios for the **EU-28**, please refer to section [BR1] 5.1.3 in Annex 1: EU 1st Biennial Report.

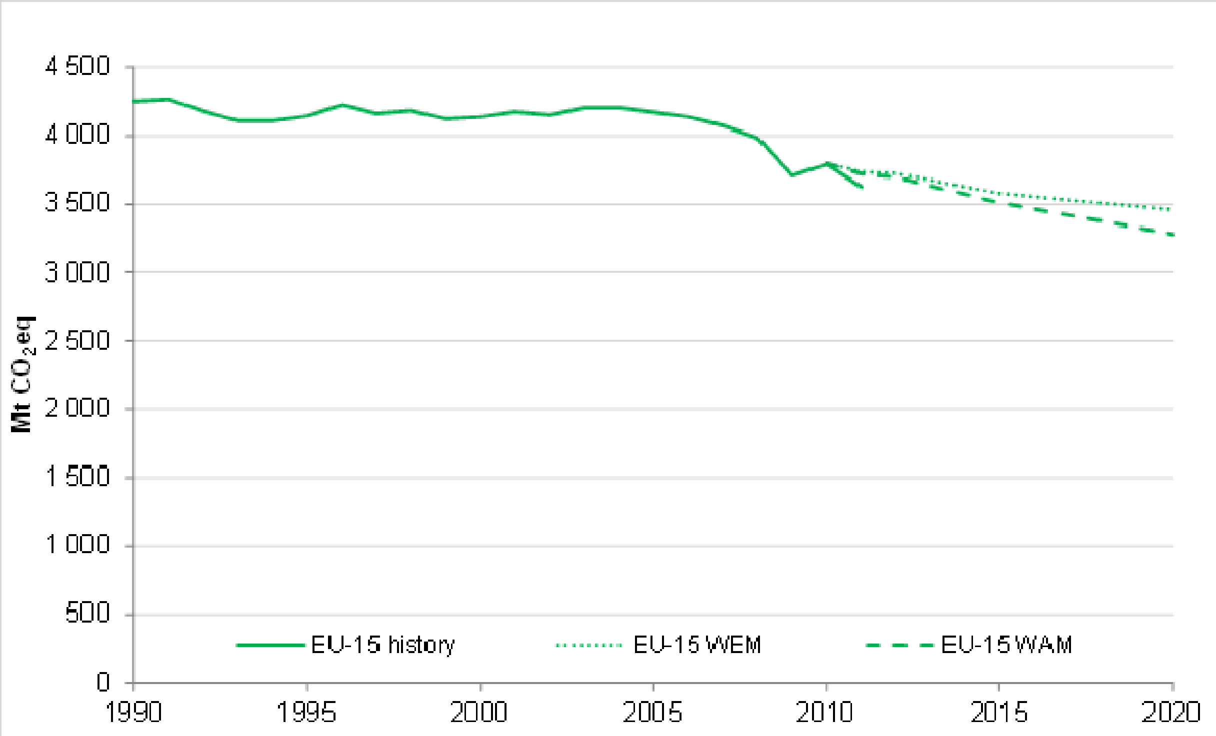
5.2. Projections

This section and its subsections present the GHG projections for EU-15 only. For the presentation of the GHG emission projections of the EU-28, please refer to Section [BR1] 5.3 in Annex 1: EU 1st Biennial Report.

Figure 5-3 demonstrates the development of total greenhouse gas (GHG) emissions for the **EU-15** aggregate in Mt CO_2eq, calculated as the sum of projections by Member States (see methodology documentation in Section [BR1] 5.6.1). Historic and projected GHG emissions are shown. The data reported in later sections is indexed to the year 1990, as it is the base year for CO_2, CH_4 and N_2O emissions.

79 Gap filling: GDP: Missing GDP values on Member State level in 2010 gap-filled with AMECO data obtained via EEA in constant Euro (2005). Missing projected values gap-filled with EUCLIMIT average annual growth rate of EU-28 GDP. Prices: projected data gap-filled with weighted average (based on GDP). Population: Missing 2010 data gap-filled with Eurostat data, missing projected values gap-filled with linear extrapolation of trend. In case all values were missing, 2010 values were gap filled with Eurostat data and projected values were held constant.

Figure 5-3 Total aggregate EU-15 GHG projections relative to 1990 GHG emissions; WEM and WAM scenario



In 2020, emissions of GHG in the **EU-15** as a result of implemented measures (WEM scenario) are projected to be 18.7 % below 1990 levels. Considering also planned measures (WAM scenario) increases the projected GHG emission reductions to 22.9 % below 1990 levels.

Section 5.2.5 provides all information reported in Sections 5.2.1 through 5.2.3.7 in tabular format.

5.2.1. Total aggregate GHG emission projections per sector

Figure 5-4 provides a qualitative impression of sector shares on projected total aggregate GHG emissions for EU-15.

Figure 5-4 Sector breakdown of projected total aggregate EU-15 GHG emissions; WEM and WAM scenario

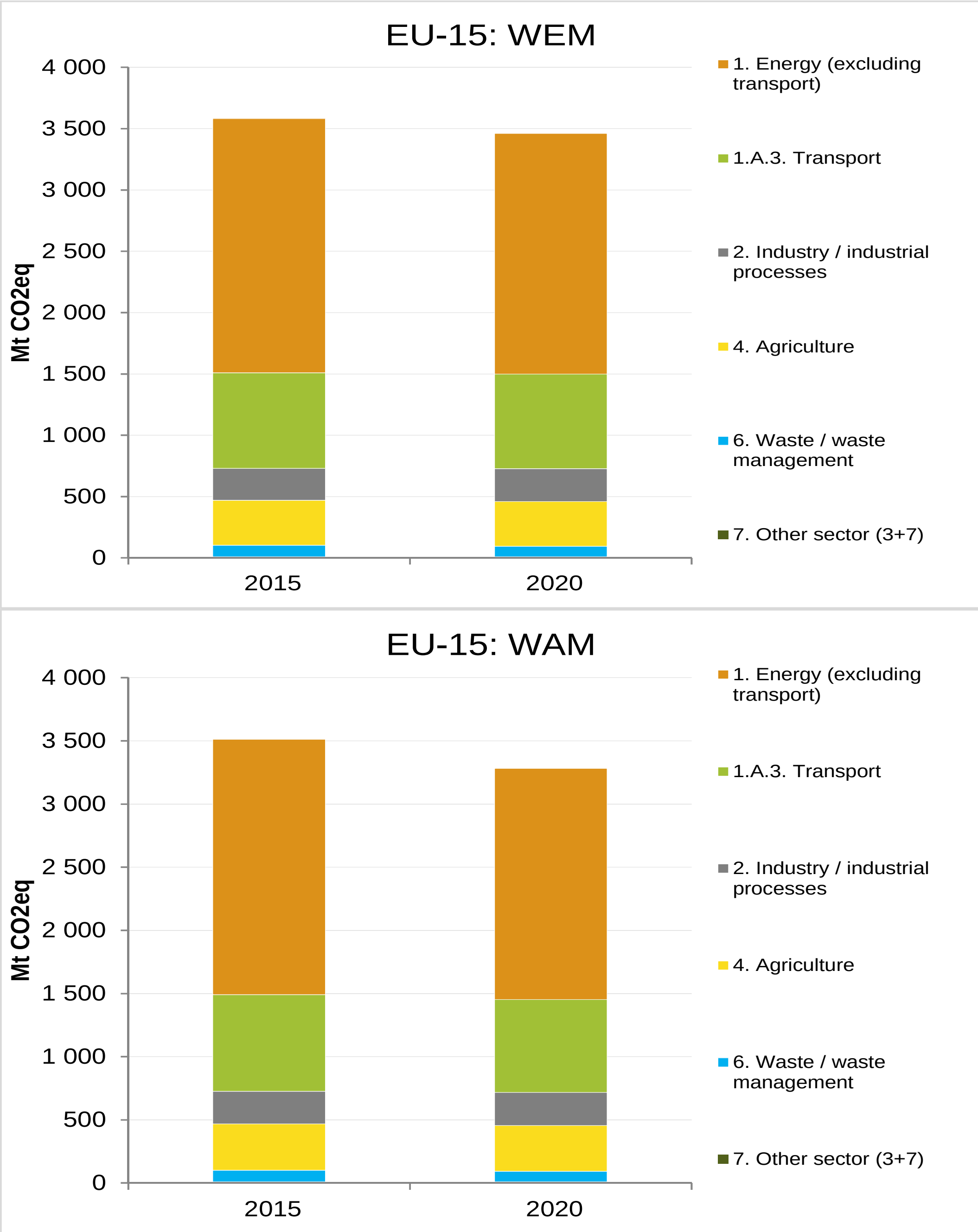


Figure 5-5 provides information on total aggregate GHG emissions on sector level relative to 1990. EU-15 projections are displayed for 2015 and 2020, excluding carbon sinks and governmental use of Kyoto Mechanisms for each sector.

In the **WEM** scenario, emissions of total aggregate GHG in the **EU-15** are projected to be 794 Mt CO_2eq (18.7 %) below 1990 levels in 2020. The most significant contribution of absolute GHG emission reductions in the EU-15 from 1990 to 2020 is projected to stem from the energy sector (625 Mt CO_2eq) followed by the waste sector

(86 Mt CO_2eq) and the industrial sector (85 Mt). Projected GHG emissions in the transport sector increase by 75 Mt CO_2eq by 2020.

In the **WAM** scenario, emissions of total aggregate GHG in the **EU-15** are projected to be 973 Mt CO_2eq (22.9 %) below 1990 levels in 2020. The most significant share of absolute GHG emission reductions from 1990 to 2020 is projected to stem from the energy sector (757 Mt CO_2eq), followed by the industrial sector (91 Mt CO_2eq) and the waste sector (90 Mt CO_2eq). GHG emissions in the transport sector are projected to increase by 38 Mt CO_2eq until 2020. Figure 5-5 visualizes the above paragraphs relative to 1990. Figure 5-6 visualizes total GHG emission changes for WEM and WAM scenarios for the EU-15.

Figure 5-5 Total aggregate EU-15 GHG emissions per sector relative to 1990; WEM and WAM scenario

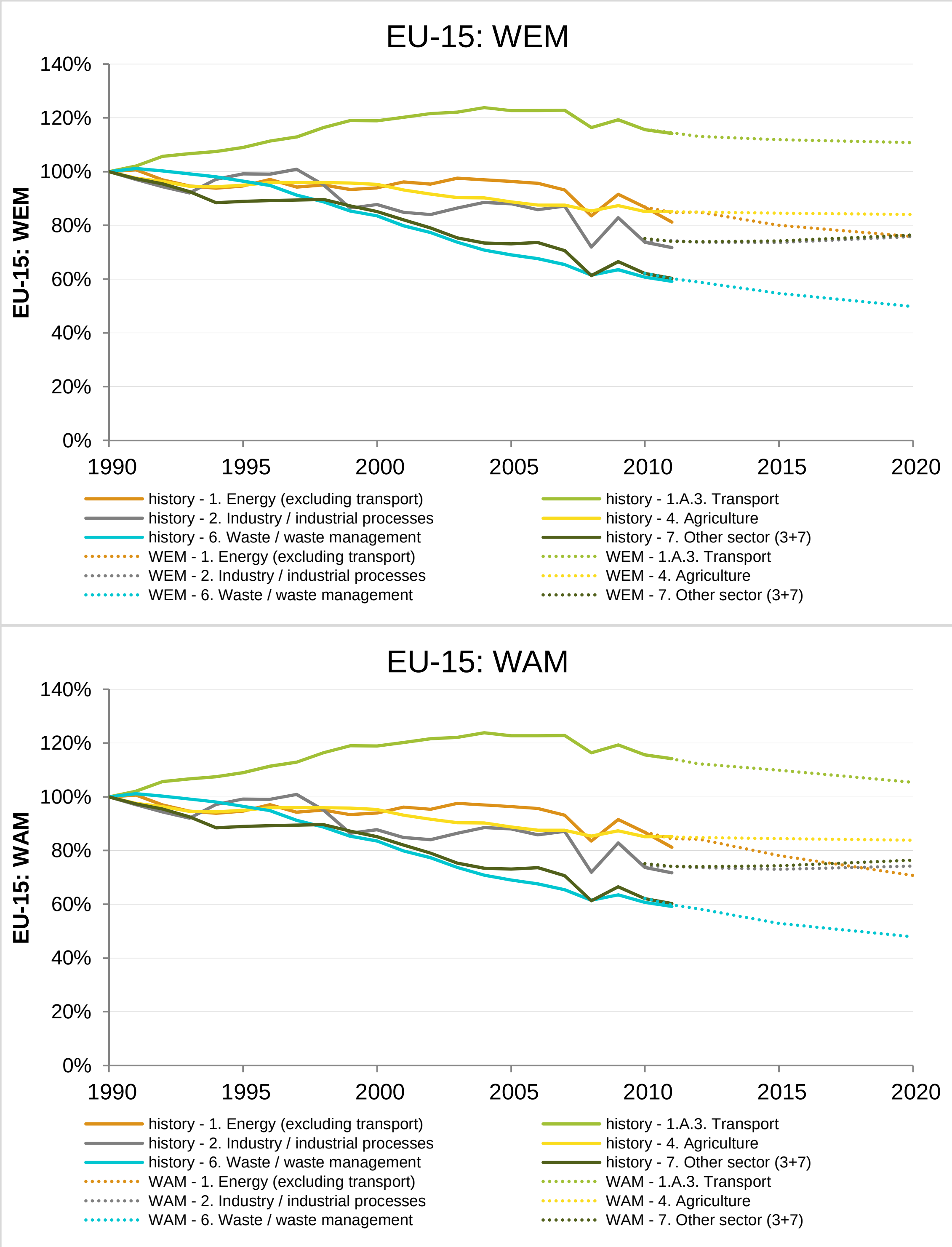
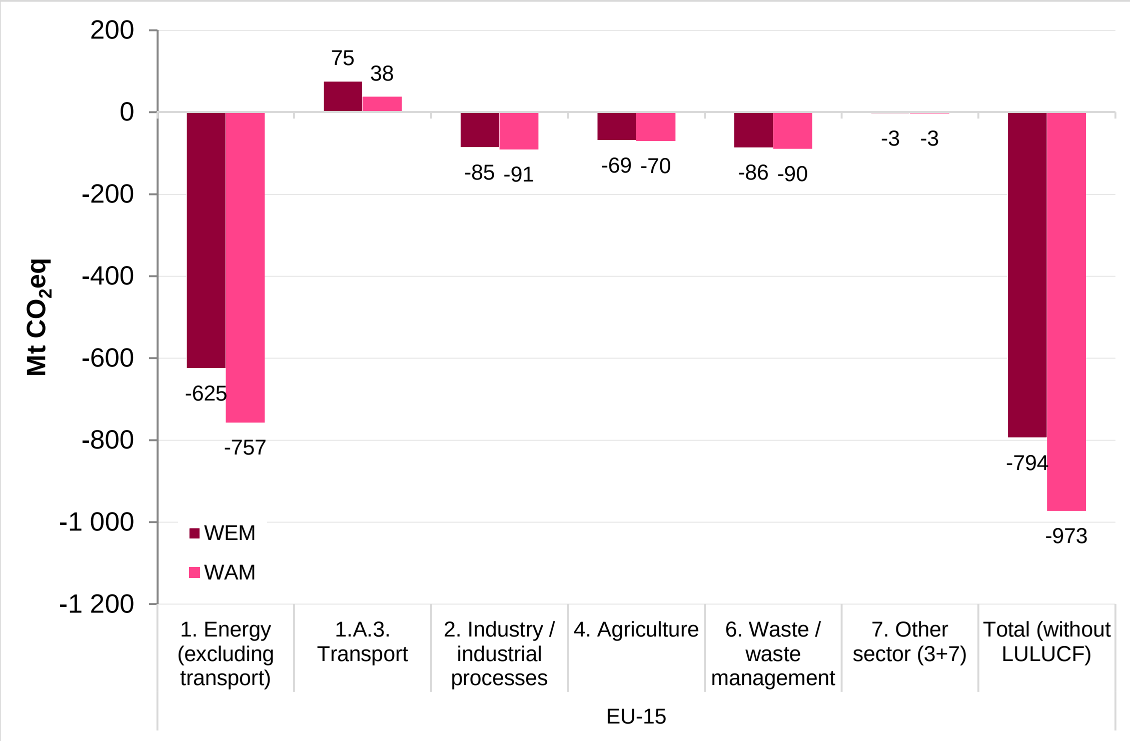


Figure 5-6 Absolute projected EU-15 GHG emission changes per sector between 1990 and 2020; WEM and WAM scenario



The common factors which drive historic trends and projections are discussed in more detail in section 2 and in the national inventory and projection reports of individual Member States. Policies and measures which influence GHG emissions in each sector are discussed in more detail in section 4.

5.2.2. *Total aggregate GHG emission projections per gas*

Figure 5-7 below illustrates the expected change in emissions from individual greenhouse gases between 1990 and 2020 under the "with existing measures" and "with additional measures" scenarios.

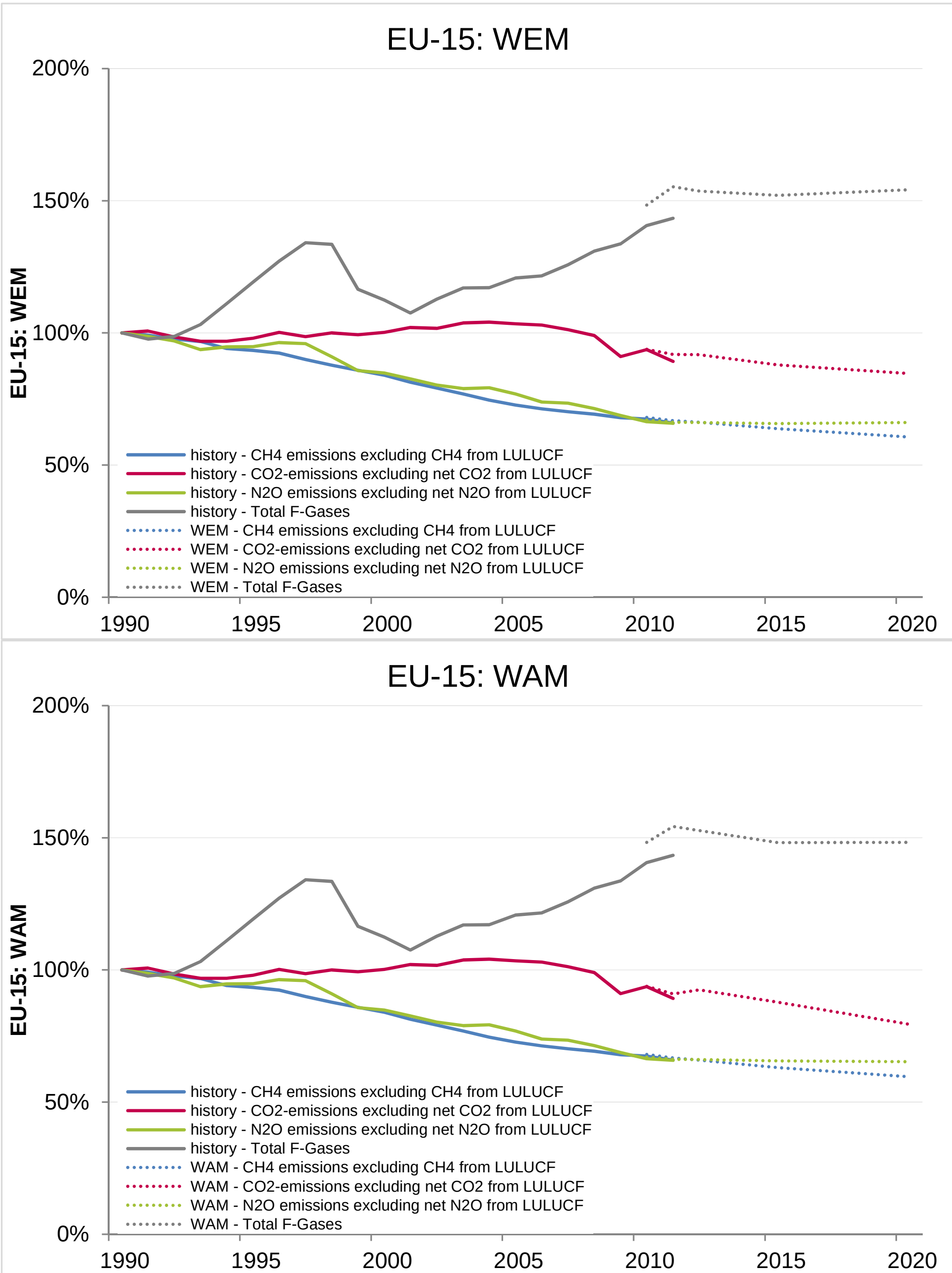
The projected overall reduction of **EU-15** GHG emissions (excluding LULUCF) in the **WEM** scenario from **1990-2020** is 794 Mt CO_2eq.

Reductions in CO_2 emissions are expected to contribute most to overall emission reductions, the absolute reduction of CO_2 emissions under the WEM scenario from 1990-2020 are projected to be 518 Mt CO_2eq in the EU-15. Reductions in CH_4 emissions are projected to be 172 Mt CO_2eq. N_2O emissions are projected to be reduced by 134 Mt CO_2eq by 2020. F-gases are the only gases projected to increase relative to 1990 levels. However, the absolute contribution of F-gases to overall emissions is less significant: the projected additional F-gas emissions in 2020 compared to 1990 levels are 30 Mt CO_2eq in the EU-15 under the WEM scenario.

The projected overall reduction of **EU-15** GHG emissions (excluding LULUCF) from **1990-2020** under the **WAM** scenario is 973 Mt CO_2eq.

Reductions in CO_2 emissions are expected to contribute most: the absolute reduction of CO_2 emissions from 1990-2020 is projected to be 687 Mt CO_2eq. Reductions in CH_4 emissions are projected to be 176 Mt CO_2eq and N_2O emissions are projected to decrease by 138 Mt CO_2eq. F-gases are the only gases projected to increase relative to 1990 levels. However, the absolute contribution of F-gases to overall projected emissions is less significant: the projected additional F-gas emissions in 2020 compared to 1990 levels are 27 Mt CO_2eq in the EU-15 when considering also additional measures of the WAM scenario.

Figure 5-7 Total EU-15 GHG emissions per gas relative to 1990; WEM and WAM scenario



5.2.3. *GHG emission projections per UNFCCC sector (level 1) and separately for bunker fuels*

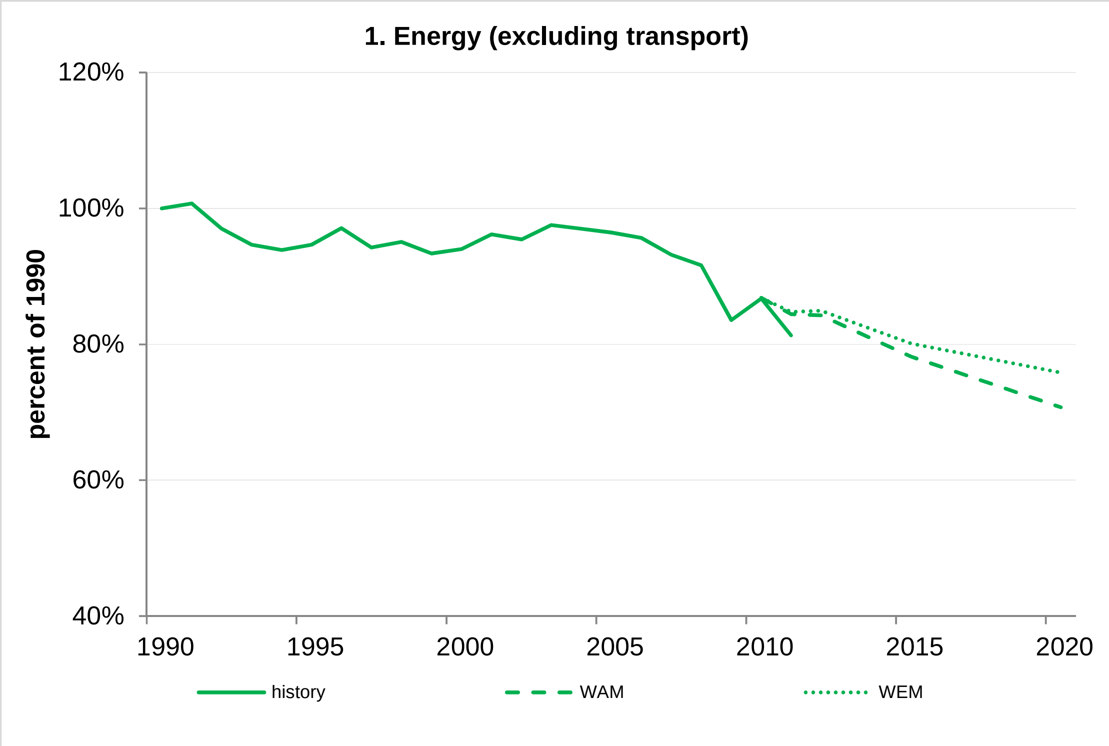
5.2.3.1. Energy

Figure 5-8 shows the EU-15 GHG emissions and projections from the energy sector excluding transport. For the EU-15 emissions from the energy sector (excluding transport) have fallen since 1990 mainly due to fuel switching to gas (also reducing CH_4 emissions from coal mining), increased energy and technical efficiency, decreases in fuel combustion in manufacturing industries and construction and restructuring of industry in the new Member States. In part, such reductions have been counteracted by increased housing stock and growth in the services sector, resulting in increased demand for energy services in buildings and homes, and in particular strong growth in demand for electricity to provide these. In addition, recent economic growth in the new Member States has begun to increase demand for energy services. In general, EU-15 emissions from the energy sector show a gradual downward trend from 1990 to the present day, with a short and steep decrease during the economic crisis, after which they increased again to pre-crisis levels and continue with the downward trend also in projections.

Projections for the sector demonstrate Member States expectations that emissions from the sector will decrease as the result of existing policies and measures in the EU-15. The actual magnitude of the decreases in GHG emissions from the energy sector that can be achieved up to 2020 is also dependent on the successful implementation of planned additional measures.

Figure 5-8 shows that under the **WEM** scenario, **EU-15** GHG emissions from the energy sector are projected to decrease, reaching 24.2 % below 1990 levels by 2020. Considering also additional policies and measures (**WAM** scenario), decreases of emissions could reach 29.3 % below 1990 levels by 2020.

Figure 5-8 Projected EU-15 GHG emissions relative to 1990 in the energy sector (excluding transport)



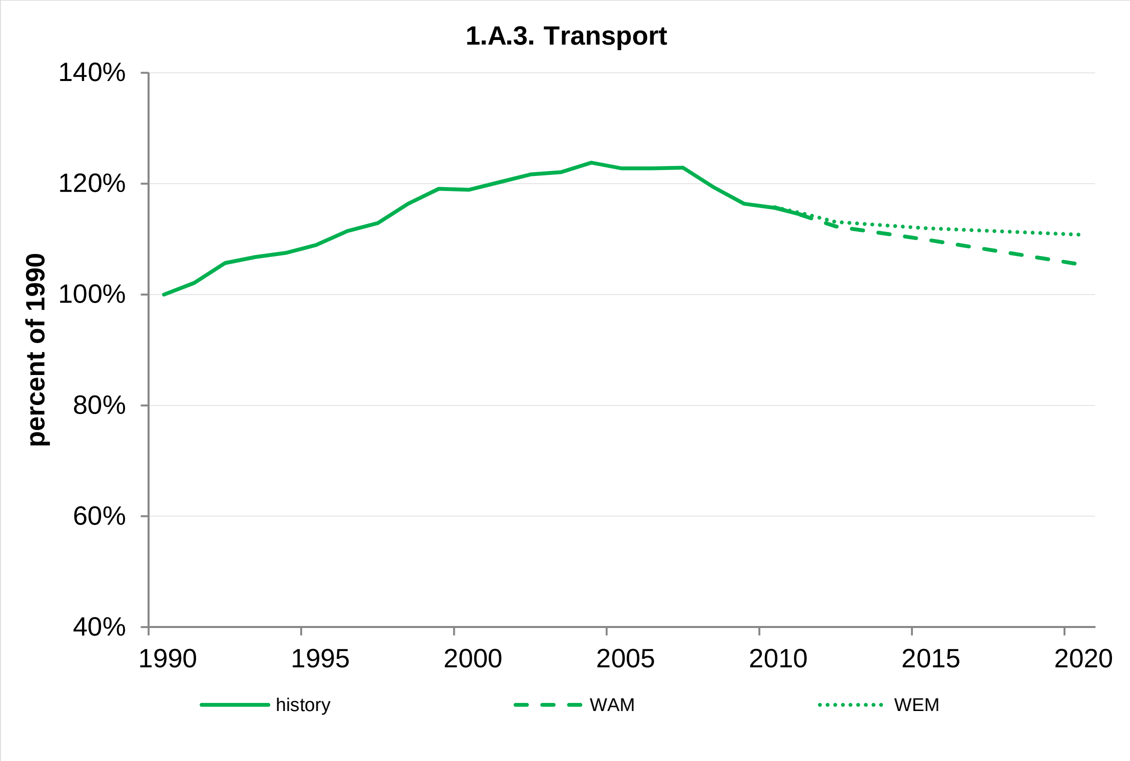
5.2.3.2. Transport

The transport sector caused the largest increase in greenhouse gas emissions between 1990 and 2011 (14.2 %) and is the only sector expected to experience an increase in emissions between 1990 and 2020 under the WEM scenario.

Figure 5-9 below shows projected GHG emissions relative to 1990 in the transport sector for EU-15. Generally it can be observed that GHG emissions from transport remain above 1990 levels until 2020. **EU-15** emissions in the sector are projected to be 10.8 % above 1990 levels in 2020 under the **WEM** scenario.

Considering additional policies and measures of the **WAM** scenario results in a further decline of emissions in the transport sector, so that these are projected to be 5.4 % above 1990 levels in 2020.

Figure 5-9 *Projected EU-15 GHG emissions relative to 1990 in the transport sector*



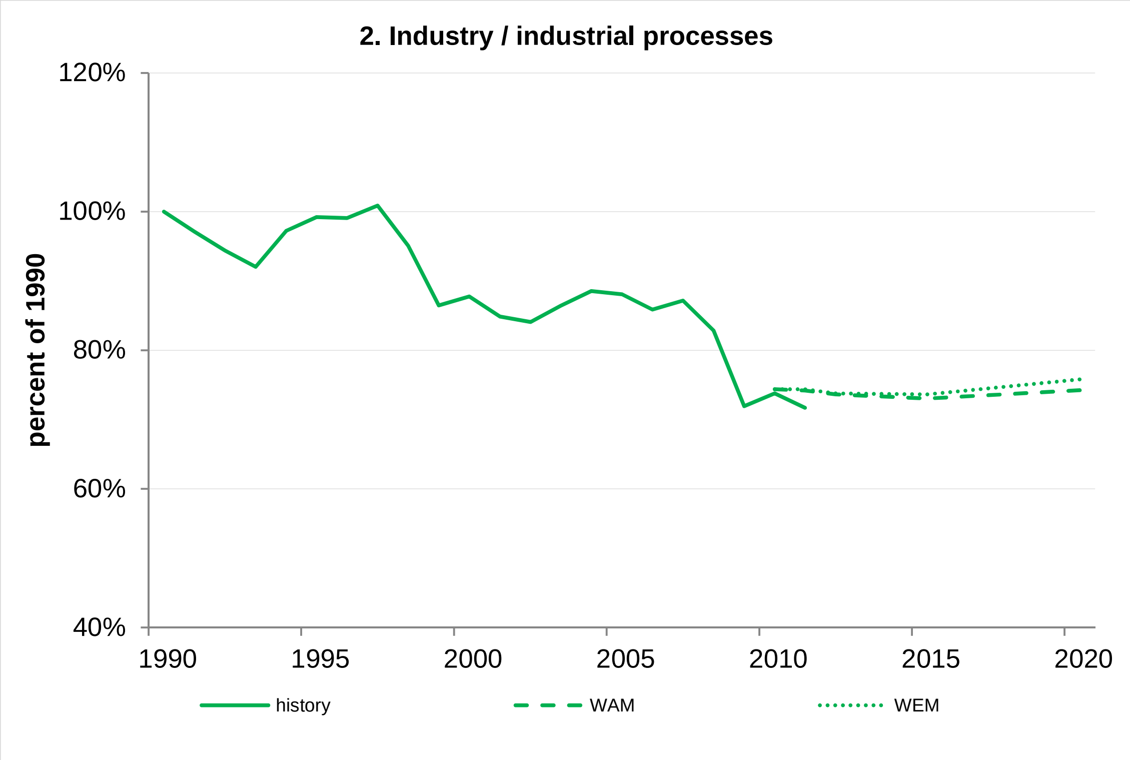
5.2.3.3. Industry / industrial processes

EU-15 emissions from the industry/industrial processes sector have decreased considerably since their peak in 1997. They have sharply declined between 2007 and 2009, then continued slightly upwards and after 2011 a slight upward trend is projected; specifically in the WEM scenario. Their fluctuating nature is driven by economic conditions (affecting activity levels) but also by EU and national regulation (affecting efficiency).

Projected **EU-15** GHG emissions from industrial processes under the **WEM** scenario are expected to reach 24.2 % below 1990 levels by 2020.

Under the assumption of the implementation of **additional measures**, GHG emissions from industrial processes in the EU-15 could reach levels of and 25.8 % below 1990 levels by 2020 (see Figure 5-10 below).

Figure 5-10 Projected EU-15 GHG emissions relative to 1990 in the industry / industrial processes sector



5.2.3.4. Agriculture

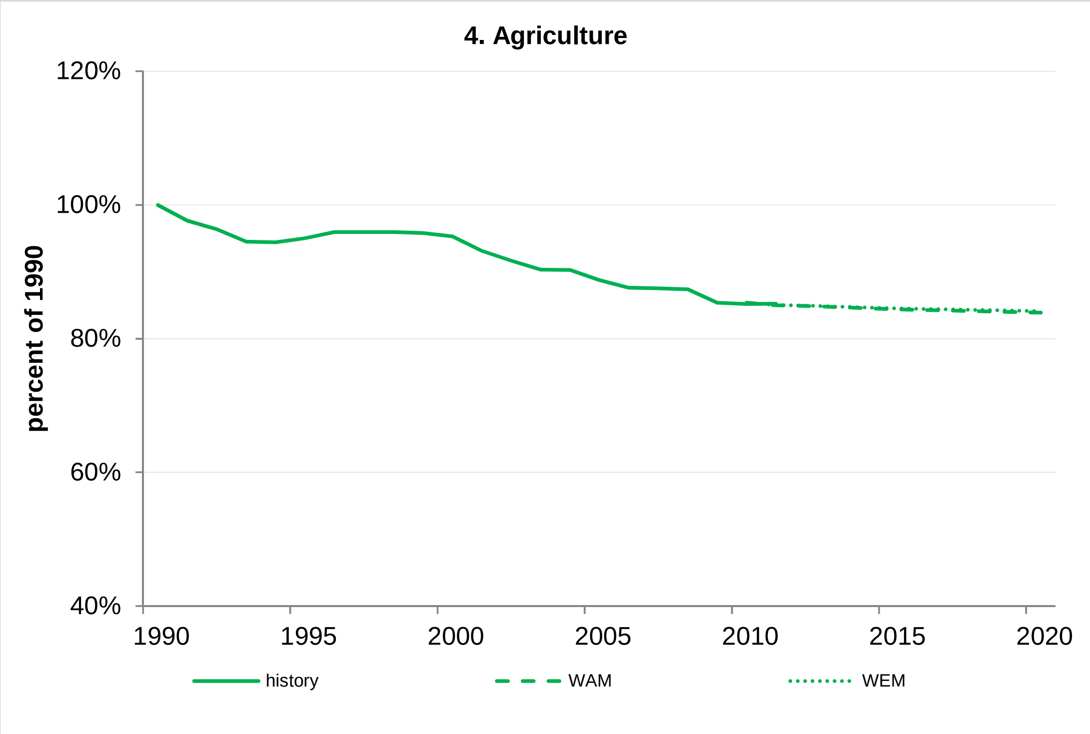
EU-15 GHG emissions from the agricultural sector have shown a steady decrease over the past years.

Changes in agricultural policy and farming subsidies as well as increased productivity have driven reduced animal numbers, reduced nitrogen fertiliser production and use and improved manure management resulting which have resulted in reduced emissions from agricultural soils and livestock.

EU-15 GHG emissions from the agricultural sector are expected to continue decreasing up to 2020 in both WEM and WAM projections but at a slower pace than in previous decades.

Figure 5-11 shows that GHG emissions from the agricultural sector are projected to reach 15.9 % below 1990 levels by 2020 under the **WEM** scenario. Considering **additional measures** would slightly increase GHG emission reductions in the EU-15 to 16.1 % below 1990 levels.

Figure 5-11 Projected EU-15 GHG emissions relative to 1990 in the agriculture sector



5.2.3.5. Waste

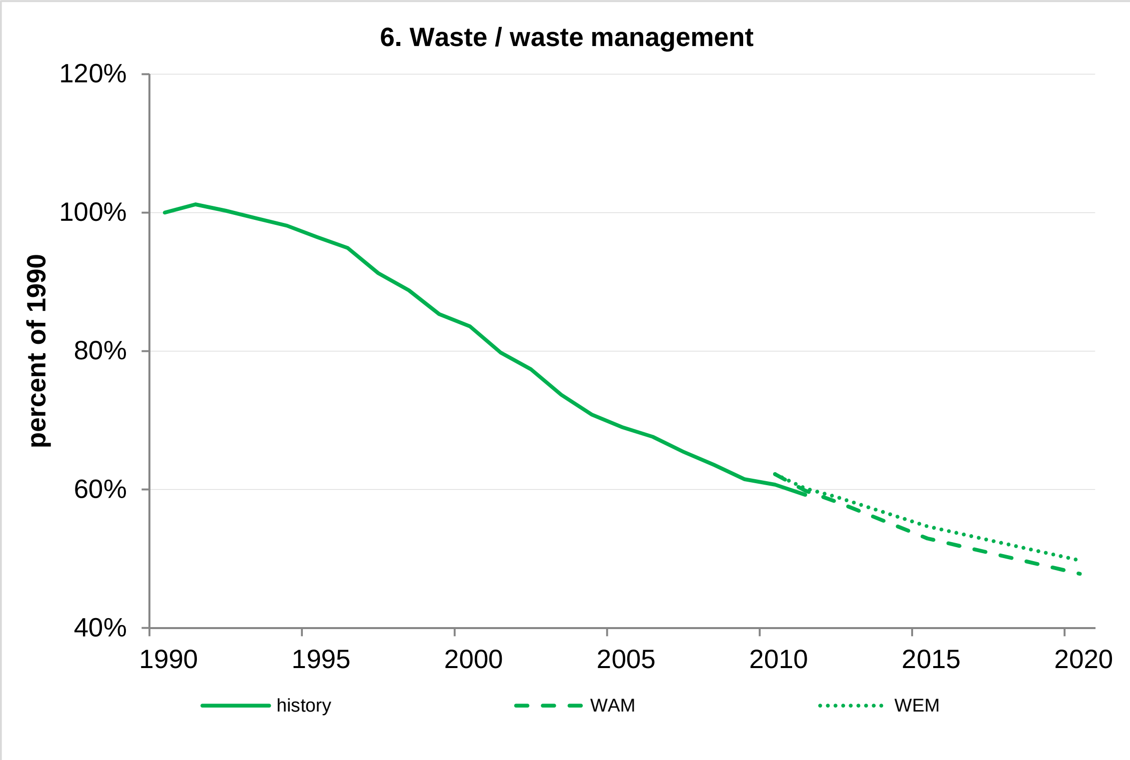
EU-15 GHG emissions from the waste sector have shown a steady and sharp decrease over the past 23 years. EU-15 emissions from the sector are projected to continue to decrease sharply up to 2020. Planned additional measures of the WAM scenario are projected to have a modest impact on further emission reductions.

GHG emissions from the waste sector in the **EU-15** and under **existing measures** are projected to continue to decrease, reaching 50.2 % below 1990 levels by 2020.

The additional measures considered in the **WAM** scenario would contribute to further GHG emission reductions, which are projected to 52.1 % below 1990 levels in 2020 (see Figure 5-12 below).

Past and future emission decreases can largely be attributed to successful waste legislation, e.g. increased recycling, bans on landfill deposit, landfill taxes and methane recovery from treated wastewater and landfill. In particular, the Landfill Directive (see section [BR1] 4.8.3 in Annex 1: EU 1st Biennial Report) has established objectives for the progressive reduction of biodegradable waste to landfill by 25 % within five years of Member State implementation of the Directive, 50 % within eight years, and by 65 % within fifteen years, compared to 1995 levels.

Figure 5-12 Projected EU-15 GHG emissions relative to 1990 in the waste sector



5.2.3.6. Other Sector (3+7)

The ‘Other sector’ is the sum of emissions from Common Reporting Format (CRF) sectors 3 (Solvent and Other Product Use) and 7 (Other).

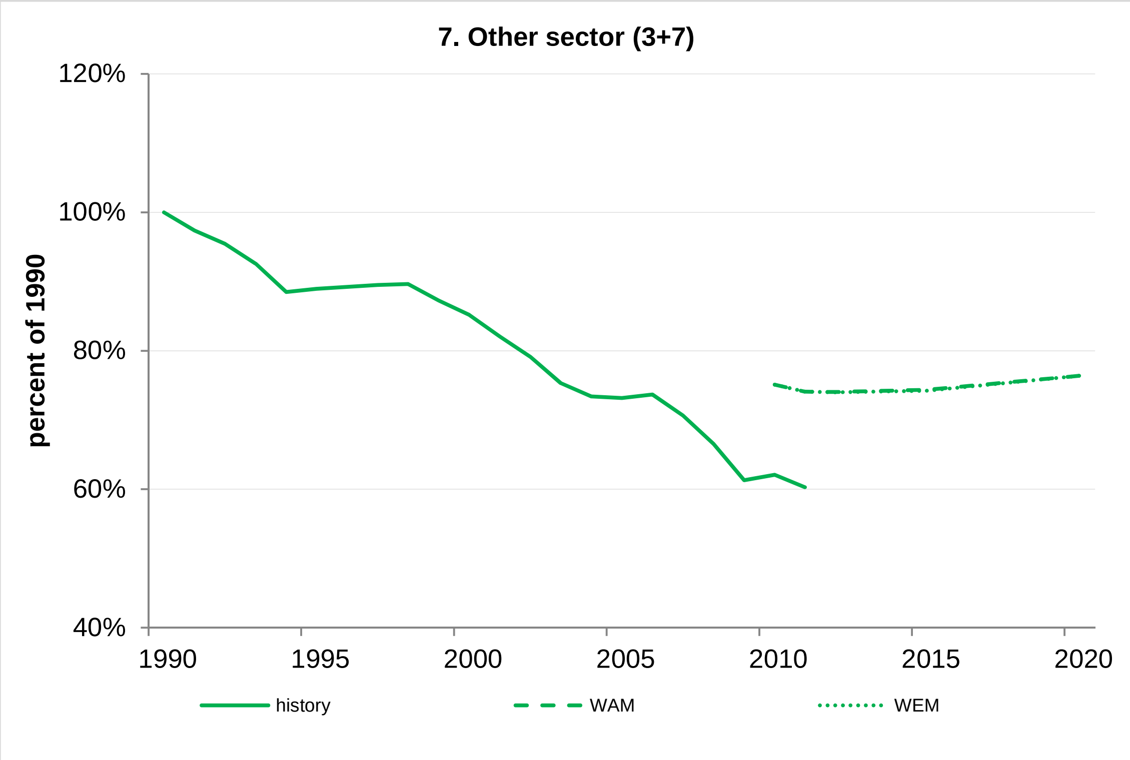
The contribution to the overall emissions from this sector has historically[80] been very small (0.2 % in 2011 for EU-15). EU-15 GHG emissions from 'other' sources have shown a steady and sharp decrease in the past.

Member State projections however indicate a rather stable (slightly increasing) trend after 2015 in both, WEM and WAM scenarios.

In the **EU-15**, there is very little difference between the **WEM and WAM** projections. Figure 5-13 shows that emissions are projected to slowly increase, reaching 23.6 % below 1990 levels by 2020.

80 The inventories list a zero value for the “Other Sector”, so historically speaking, only the share from the “Solvents and Other Product Use”is listed here .

Figure 5-13 Projected EU-15 GHG emissions relative to 1990 in the other sector (solvent and other product use, other sector)



5.2.3.7. Aviation and maritime bunker fuels

WEM projections of emissions from international bunker fuels sold to aircrafts are reported by 26 Member States. WAM projections of emissions from international bunker fuels sold to aircrafts are reported by 22 Member States. Missing values were gap-filled by WEM values. With this broad coverage nearly all emissions from international aviation are covered in the projections. The same holds for emissions from international bunker fuels sold to ships. Figure 5-14 below shows the projected emissions for the aviation sector for the EU-15 for the WEM (dotted line) and WAM (dashed line) scenarios.

The figure shows that the rapid increase which was dampened by the economic crisis is projected to continue up to 2020, but at a slightly slower pace.

In the **EU-15** under the **WEM** scenario, emissions from international aviation are projected to continue to increase, reaching 107.3 % above 1990 levels by 2020.

If additional measures from the **WAM** scenario are also considered, this increase is slightly slowed down and is projected to reach 102.3 % above 1990 levels by 2020.

Figure 5-14 Projected EU-15 GHG emissions relative to 1990 in the international bunkers – aviation sector

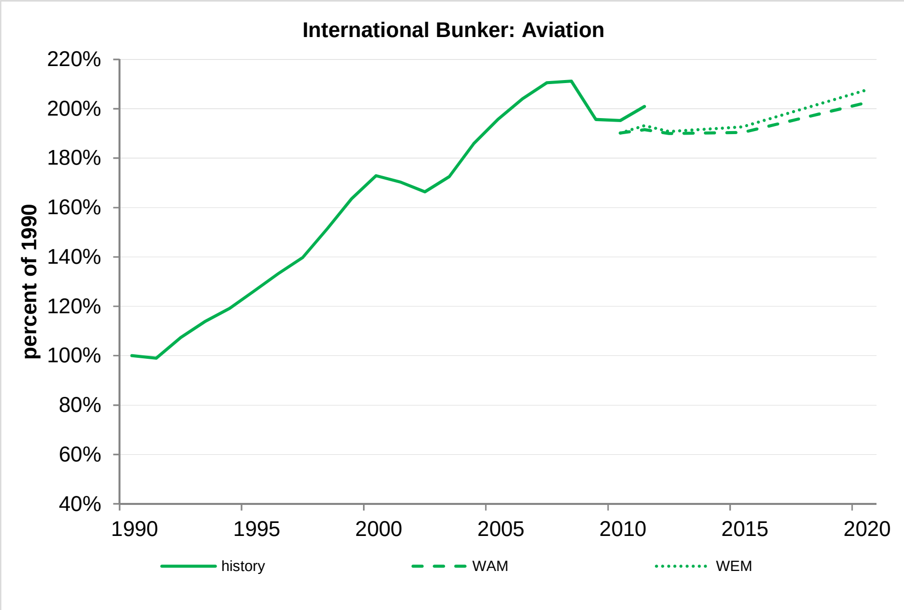
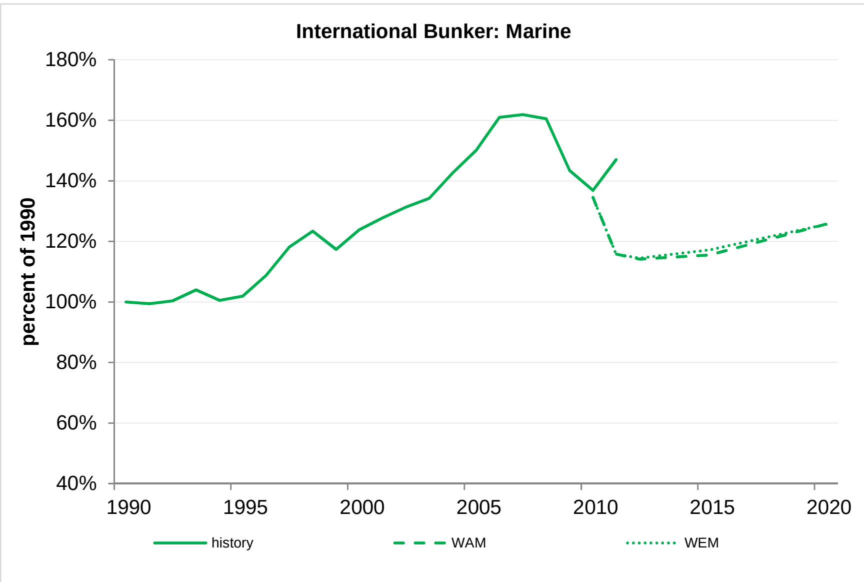


Figure 5-15 below shows the projected emissions for the marine sector for the EU-15, and both reported scenarios. The increase in emissions from the marine sector was broken by the economic crisis but is projected to continue up to 2020, but at a lower level and pace. In the **EU-15** under the **WEM** scenario, emissions from the marine sector are projected to continue to increase, reaching 25.7 % above 1990 levels by 2020. If additional measures from the **WAM** scenario are also considered, there are no significant changes in the projected emissions.

Figure 5-15 Projected EU-15 GHG emissions relative to 1990 in the international bunkers – marine sector



5.2.4. Projections of indirect GHG

It is not possible to present indirect GHG emission projections.

5.2.5. Tabular representation of EU-15 GHG emission projections

Table 5-2 shows detailed information on GHG emission projections for the EU-15 in tabular format.

Table 5-2[81] Tabular representation of EU-15 GHG emissions, historic and projected

Sector/Gas	1990	1995	2000	2005	2010	2011	2015	2020
history (Gg CO2eq)								
1. Energy (excluding transport)	2585574	2447189	2430835	2493046	2242219	2101994		
1.A.3. Transport	696628	758964	828335	855188	805309	795734		
2. Industry / industrial processes	353202	350331	309929	311069	260581	253234		
4. Agriculture	433868	412156	413446	385133	369491	369785		
6. Waste / waste management	172019	165928	143744	118674	104420	101941		
7. Other sector (3+7)	13212	11749	11254	9667	8205	7969		
CH4 emissions excluding CH4 from LULUCF	435572	406653	366015	316737	293459	287160		
CO2-emissions excluding net CO2 from LULUCF	3367101	3297510	3372961	3484095	3155308	3002815		
N2O emissions excluding net N2O from LULUCF	395852	460796	416334	388578	336115	334839		
Total F-Gases	55979	66722	62912	67629	78687	80279		
Memo Item: International Bunker: Marine	*105542*	*107537*	*130733*	*158352*	*144430*	*155136*		
Memo Item: International Bunker: Aviation	*64854*	*81822*	*112102*	*126985*	*126636*	*130295*		
WEM (Gg CO2eq)								
1. Energy (excluding transport)					2244569	2192111	2070903	1960753
1.A.3. Transport					806287	797684	779736	771671
2. Industry / industrial processes					262738	262591	260139	267760
4. Agriculture					370348	368928	366737	364884
6. Waste / waste management					107009	103495	94050	85605
7. Other sector (3+7)					9922	9788	9806	10095
CH4 emissions excluding CH4 from LULUCF					296230	291181	277593	263960
CO2-emissions excluding net CO2 from LULUCF					3156375	3094313	2958661	2848862
N2O emissions excluding net N2O from LULUCF					265195	262159	260049	261717
Total F-Gases					83074	86906	85118	86279
Memo Item: International Bunker: Marine					*141933*	*122145*	*123668*	*132618*
Memo Item: International Bunker: Aviation					*123348*	*125267*	*124954*	*134441*
WAM (gg CO2eq)								
1. Energy (excluding transport)					2244569	2183066	2020981	1828891
1.A.3. Transport					806287	794804	765479	734527
2. Industry / industrial processes					262738	262022	257926	262108
4. Agriculture					370348	368830	366250	363948
6. Waste / waste management					107009	102924	91082	82313
7. Other sector (3+7)					9922	9792	9827	10095
CH4 emissions excluding CH4 from LULUCF					296230	290577	274427	259721
CO2-emissions excluding net CO2 from LULUCF					3156375	3082435	2894773	2680928
N2O emissions excluding net N2O from LULUCF					265195	262058	259530	258282
Total F-Gases					82972	86332	82918	83000
Memo Item: International Bunker: Marine					*141933*	*122257*	*121945*	*132676*
Memo Item: International Bunker: Aviation					*123348*	*124205*	*123489*	*131195*

5.3. Assessment of aggregate effects of policies and measures

Please refer to Section [BR1] 5.6.2 for details on the methodology.

For the EU-15, the assessment of the aggregate effects of policies and measures is accomplished for the periods to 2015 and 2020. The effects of policies and measures in Figure 5-16 are displayed in total, distinguishing between WEM and WAM scenario. The disaggregation of the total effects of policies and measures into sectors and gases is provided in Table 5-3 and Table 5-4.

For the aggregate effects of policies and measures in the WEM scenario, a bottom-up approach was used whereas a top-down approach was used to assess the aggregate effects of policies and measures in the WAM scenario. The effects were disaggregated

81 Historic GHG emissions are presented up to 2011. Projections are represented starting 2010. Thus, there is an overlap of historic and projected values. Note that if 2010 and 2011 GHG emission trajectories do not match this is due to the fact that projected GHG emissions were aggregated from individual Member State projections, which may not have taken into account the latest inventory values as the base year in the preparation of their projections.

into sectors in both scenarios, WEM and WAM. However, the sector split differs between the approaches (see Table 5-3) and the sector policy effects in WEM and WAM are therefore not fully comparable.

Figure 5-16 Total effects of policies and measures for EU-15, in Mt CO_2eq avoided GHG emissions

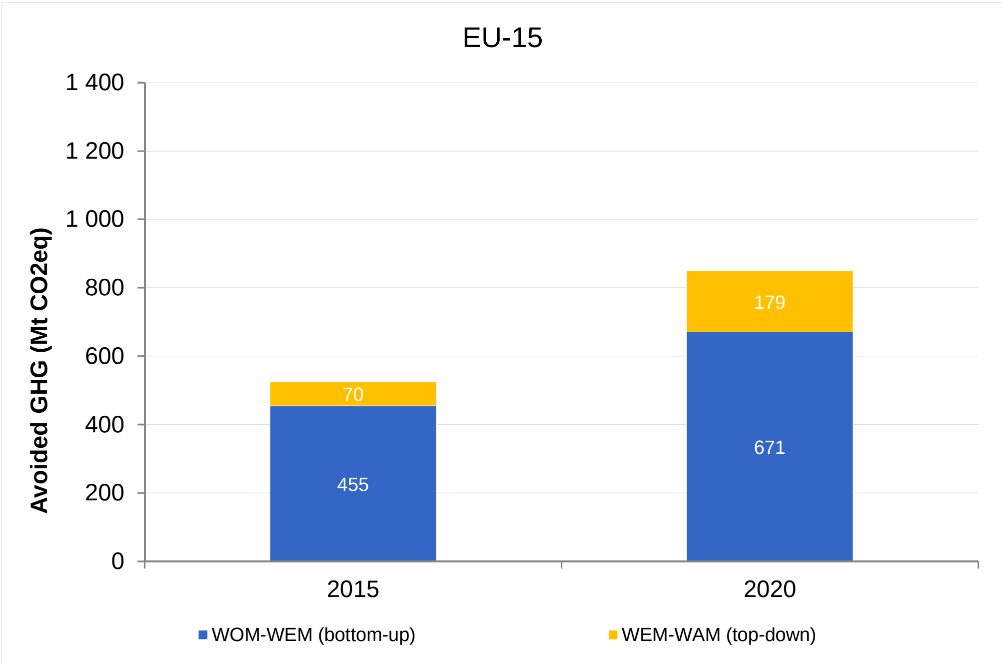


Table 5-3 Total effects of policies and measures EU-15, by sectors in Mt CO_2eq avoided GHG emissions

EU-15	2015	2020
	Mt CO_2 eq.	
WOM-WEM (bottom-up)	**455**	**671**
Energy consumption + supply	284	448
Transport	57	102
Industrial Processes	13	16
Agriculture	18	26
Waste	54	46
Cross-cutting	29	32
WEM-WAM (top-down)	**70**	**179**
1. Energy (excluding transport)	50	132
1.A.3. Transport	14	37
2. Industry / industrial processes	2	6
4. Agriculture	0	1
6. Waste / waste management	3	3
7. Other Sector (3+7)	0	0
Total effects of policies and measures	**525**	**850**

Table 5-4 Effects of polices and measures as avoided GHG emission by gas for EU-15 in Mt CO_2eq avoided GHG emissions

	2015	2020
EU-15	*Mt CO_2 eq.*	
WOM-WEM (bottom-up)	**520**	**748**
CO_2	382	594
CH_4	77	74
N_2O	34	39
HFC, PFC, SF_6	27	41
WEM-WAM (top-down)	**70**	**179**
CO_2	64	168
CH_4	3	4
N_2O	1	3
HFC, PFC, SF_6	2	3

5.4. Sensitivity Analysis

For the sensitivity analysis of EU-28 projections, please refer to section [BR1] 5.4.

5.5. Supplementarity

To meet international greenhouse gas targets, Annex I Parties can use Kyoto Protocol mechanisms. Information on the intended use in the first commitment period is given in Section 4.3.3 and in Section [BR1] 4.12 in Annex 1: EU 1st Biennial Report.

As this current chapter on projections only focuses on the development of GHG emissions up to 2020, the question of supplementarity cannot be raised for this time horizon, as no targets have been set and no final decisions taken with regard to the (supplementary) use of Kyoto mechanisms. In addition the group of EU-15 Member States will no longer have a common greenhouse gas reduction target in the second commitment period.

5.6. Methodology

The methodology applied for the EU-15 aggregate is analogous to the one applied to the EU-28 aggregate. All methodological aspects to be considered are documented in detail in Section [BR1] 5.6.

6. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

Key developments

While reducing GHG emissions is of paramount importance to avoid dangerous climate change, the EU also recognises that some climate change impacts are unavoidable because of past emissions. The EU has therefore undertaken research and taken action to understand these impacts, develop adaptation responses and assist developing countries in strengthening their capacity to cope with climate change.

Since the 5th National Communication, progress has been made on assessing the impacts of climate change and developing adaptation policies across Europe. Comprehensive information on past and projected climate change and related impacts has been published for Europe, in particular as part of the European climate adaptation platform (Climate-ADAPT).

Action has been strengthened since the 5th National Communication in particular through the EU Strategy on adaptation to climate change, which was adopted in 2013. The strategy promotes and supports actions by Member States, by promoting adaptation in key vulnerable sectors at EU level and by ensuring better-informed decision-making.

6.1. Introduction

Both public and political recognition of the need to take urgent action to combat climate change has emerged in recent years. The European Commission has shown global leadership on climate change and is committed to maintain this role. The target of the European Union is to stabilize the global mean temperature to 2°C above pre-industrial levels.

However, significant changes in climate and its impacts are already visible in Europe today. Increasing temperatures, rising sea level, melting of glaciers and ice sheets as well as more intense and frequent extreme weather events are among the challenges for Europe already triggered by climate change (see section 6.2). Further climate change impacts are projected for the future which can increase existing vulnerabilities and deepen socio-economic imbalances in Europe[82] (see section 6.3).

Thus, in view of the specific and wide-ranging nature of climate change impacts across the EU's territory, the European Union has recognised its important role in developing an EU-wide framework for adaptation supplementing mitigation efforts. The European Commission has recognised that planning for adaptation requires a strategic approach to ensure timely, efficient and effective adaptation actions coherently across different sectors and levels of governance. The development process for an adaptation framework for Europe first led to the adoption of a Green Paper on adapting to climate change in Europe[83], recognising that all parts of Europe will increasingly feel the adverse effects of climate change. In 2009 a White Paper "Adapting to climate change: Towards a European framework for action"[84] set out concrete steps to be taken in preparing the

82 http://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012

83 http://eur-lex.europa.eu/LexUriServ/site/en/com/2007/com2007_0354en01.pdf

84 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0147:FIN:EN:PDF

2013 EU strategy on adaptation to climate change, adopted on 16 April 2013[85]. As stated in the White Paper and further strengthened by the EU Adaptation Strategy, the EU sees its key role to support the public and private sector at national, regional or local levels by providing comprehensive information on adaptation (mainly through the European information platform Climate-ADAPT), by giving directions and advice to ensure coherent adaptation approaches (e.g. through guidelines) and by allocating funding (e.g. through the LIFE programme) for adaptation action. In addition, the EU has a strong role in supporting EU Member States in the case of transboundary issues and further strengthening and institutionalising mainstreaming of adaptation into certain sectors that are closely integrated at EU level through the single market and common policies (see section 6.4).

Emerging policy fields such as climate change adaptation are particularly dependent on research results as the knowledge base for better-informed decisions. Thus, since the 5th National Communication, research on the impacts of climate change, vulnerability and adaptation options has become a high priority for Europe. New research results within the EU's Sixth and Seventh Framework Programme for Research and Technological Development (FP6, FP7) and many other programmes at transnational and national levels have provided improved insights into the impacts and vulnerabilities of climate change to Europe and potential adaptation responses (see section 6.5).

Adaptation is already taking place across the EU. Since the publication of the NC5 in 2009, not only the European Union but also its Member States have significantly increased the number of actions for coping with the impacts of climate change at international, national and local levels as well as across sectors. In April 2013, 15 EU Member States had adopted a National Adaptation Strategy (NAS)[86]. Most of the existing strategies include only little information on implementation (e.g. monitoring, financing of adaptation action) and therefore, some countries have set out concrete action plans (NAP). These strategies and action plans are undoubtedly a good starting point for adaptation action but the 2013 EU strategy recommends that all 28 EU Member States should have their own adaptation policies adopted. *Figure 6-1* shows an overview of the status of National Adaptation Strategies in the EU. Further information on adaptation activities in all EU Member States can be accessed via the country pages on Climate-ADAPT[87] and more detailed updates are expected to be delivered in the respective 6th National Communications to the UNFCCC.

85 http://ec.europa.eu/clima/policies/adaptation/what/docs/com_2013_216_en.pdf

86 http://ec.europa.eu/clima/policies/adaptation/what/docs/com_2013_216_en.pdf (with reference to Climate-ADAPT)

87 http://climate-adapt.eea.europa.eu/web/guest/countries

Figure 6-1 Overview of National Adaptation Strategies in the EU

Source: Environment Agency Austria, December 2013 (adjusted from Climate-ADAPT)

The following sections outline some of the main findings on impacts, vulnerability and adaptation and some of the key current and planned activities that have been developed since the 5th National Communication.

6.2. Observed patterns of climate change across the EU and projections for the future

Significant changes in climate and its impacts such as increase in mean temperature, changes in precipitation, sea level rise, etc. are already visible globally and in Europe. Observed impacts of climate change are projected to continue due to further climate change.

In 2012, a report by the European Environment Agency[88] (EEA) has been published providing a recent compilation on observed and projected climate change impacts across Europe. Its main findings are briefly summarized in this section.

6.2.1. Observed and projected change in temperature

Observed changes

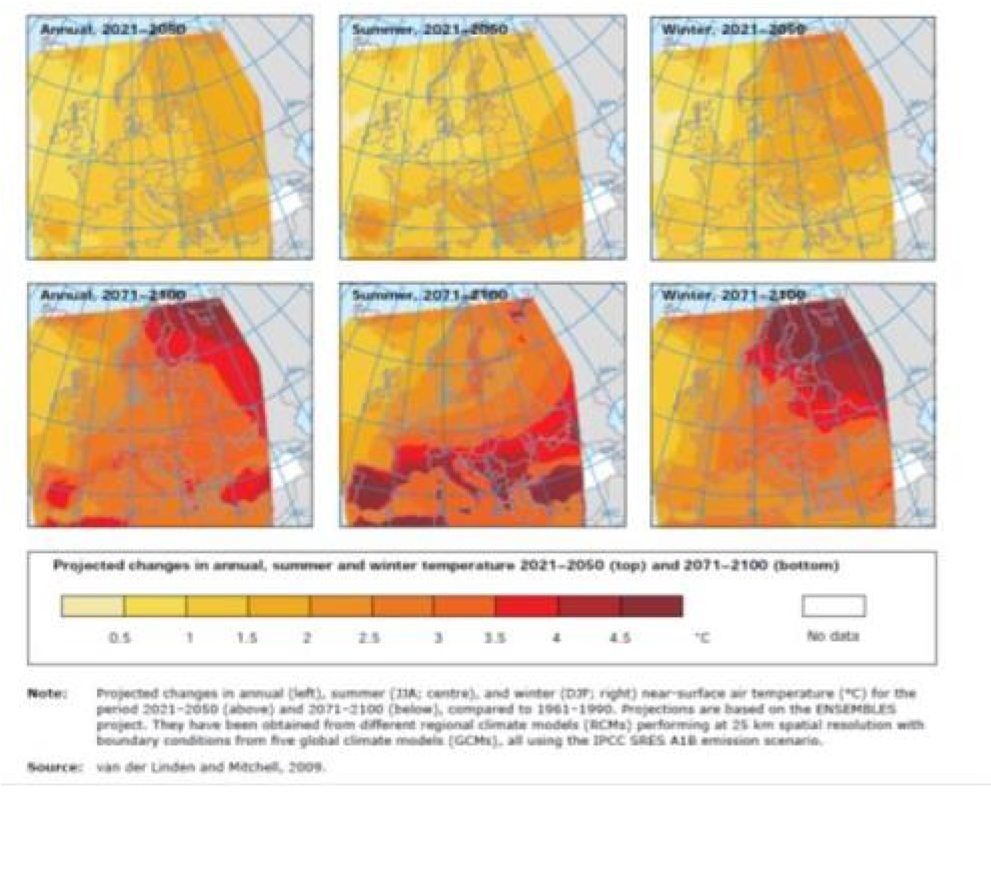
88 .http://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012

Regarding observed temperature change, the average temperature over land in Europe in the last decade was 1.3 °C warmer than the preindustrial level, which makes it the warmest decade on record. The average temperature for Europe has increased significantly more than the global average, which was 0.77 to 0.80 °C. High-temperature extremes (hot days, tropical nights, and heat waves) have become more frequent. Since 1880, the average length of summer heat waves over Europe has doubled and the frequency of hot days has almost tripled. In addition, the five warmest summers in Europe in the last 500 years all occurred between 2002-2011 (in 2002, 2003, 2006, 2007 and 2010). In comparison, low temperature extremes (cold spells, frost days) have become less frequent in Europe.

Projected changes

During the 21st century annual average land temperature over Europe is projected to continue increasing by more than the global temperature (Figure *6-2*). The largest temperature increase is projected over eastern and northern Europe in winter and over southern Europe in summer. Increases in land temperature in Europe for the SRES A1B emission scenario are projected between 1.0 and 2.5 °C by 2021–2050, and between 2.5 and 4.0°C by 2071–2100. Extreme high temperatures and heat waves are projected to become more frequent and last longer across Europe over the 21st century. The most severe increases in hot summer days and tropical nights are projected in low-altitude river basins and along the Mediterranean coasts.

Figure 6-2 Projected changes in annual, summer and winter temperature across Europe



Note: Projected changes in annual (left), summer (JJA; centre), and winter (DJF; right) near-surface air temperature (°C) for the 2021–2050 period (above) and 2071–2100 (below), compared to 1961–1990. Projections are based on the ENSEMBLES project. They have been obtained from different regional climate models (RCMs) performing at 25 km spatial resolution with boundary conditions from five global climate models (GCMs), all using the IPCC SRES A1B emission scenario.

Source: van der Linden and Mitchell 2009 in EEA 2012[89]

6.2.2. Observed and projected change in precipitation

Observed changes

Precipitation changes across Europe show more spatial and temporal variability than temperature. Since the mid-20th century, annual precipitation has been generally increasing across most of northern Europe by 10-40%, most notably in winter, but decreasing in parts of southern Europe by up to 20% in average annual precipitation (IPCC 2007[90]). More precisely, annual precipitation trends since 1950 show an increase of up to 70 mm per decade in north-eastern and north-western Europe and a decrease of up to 70 mm in some parts of southern Europe. The SREX report published by the IPCC in 2012[91] identifies a likely increase in the frequency of heavy precipitation events or proportion of the total rainfall. In addition, snow mass in Europe has decreased by 7 % in the month of March from 1982 to 2009.

Projected changes

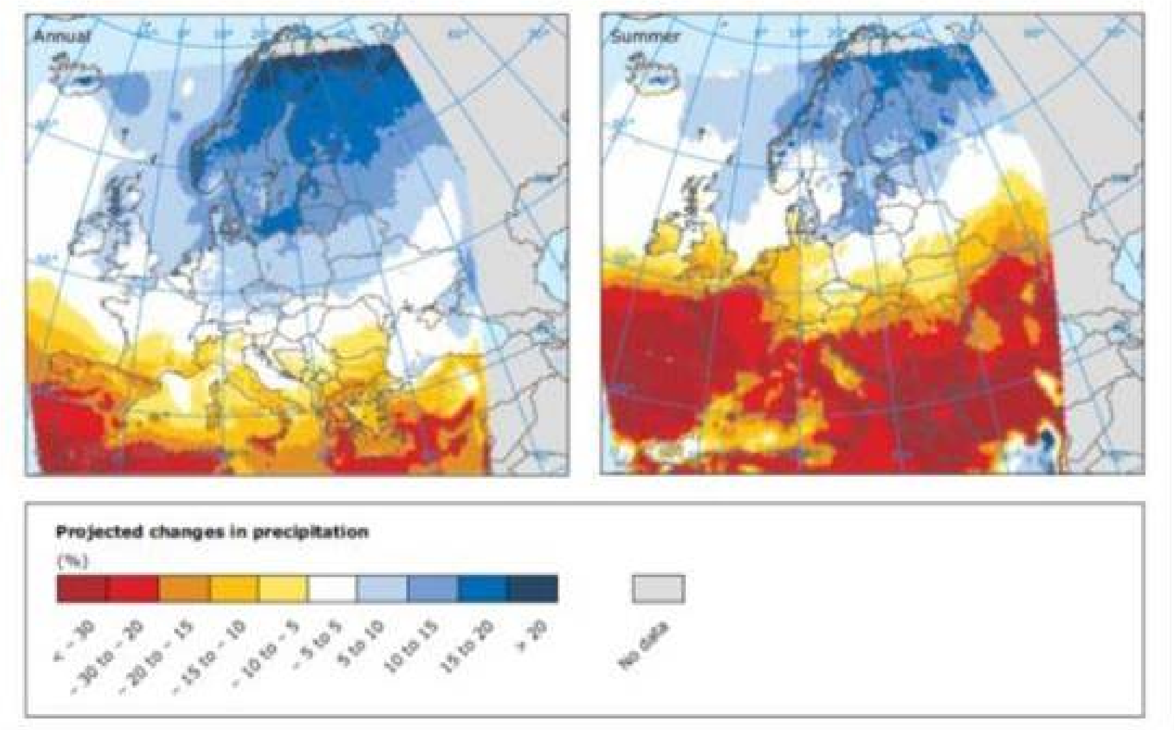
Most climate model projections show continued precipitation increases in northern Europe (most notably during winter) and decreases in southern Europe (most notably during summer). The change in annual mean precipitation between 1961–1990 and 2071–2100 would increase between 10% and 20 % in northern Europe and decrease between 5 and 20 % in southern Europe and the Mediterranean (Figure 6-3, left). Projections for summer precipitation show a decrease over southern (up to 60 %), central and northwest Europe Mediterranean (Figure 6-3, right). Heavy precipitation events are projected to become more frequent for most parts of Europe. The changes are strongest in Scandinavia in winter and in northern and eastern central Europe in summer.

Figure 6-3 Projected changes in annual (left) and summer (right) precipitation (%) between 1961–1990 and 2071–2100

89 .http://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012

90 http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4_wg1_full_report.pdf

91 IPCC – Intergovernmental Panel on Climate Change (2012): Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change.



Note: Projections are based on the ENSEMBLES project. They have been obtained from different regional climate models (RCMs) performing at 25 km spatial resolution with boundary conditions from five global climate models (GCMs), all using the IPCC SRES A1B emission scenario.

Source: van der Linden and Mitchell 2009 in EEA (2012), corrigendum[92]

6.2.3. Observed and projected change in freshwater

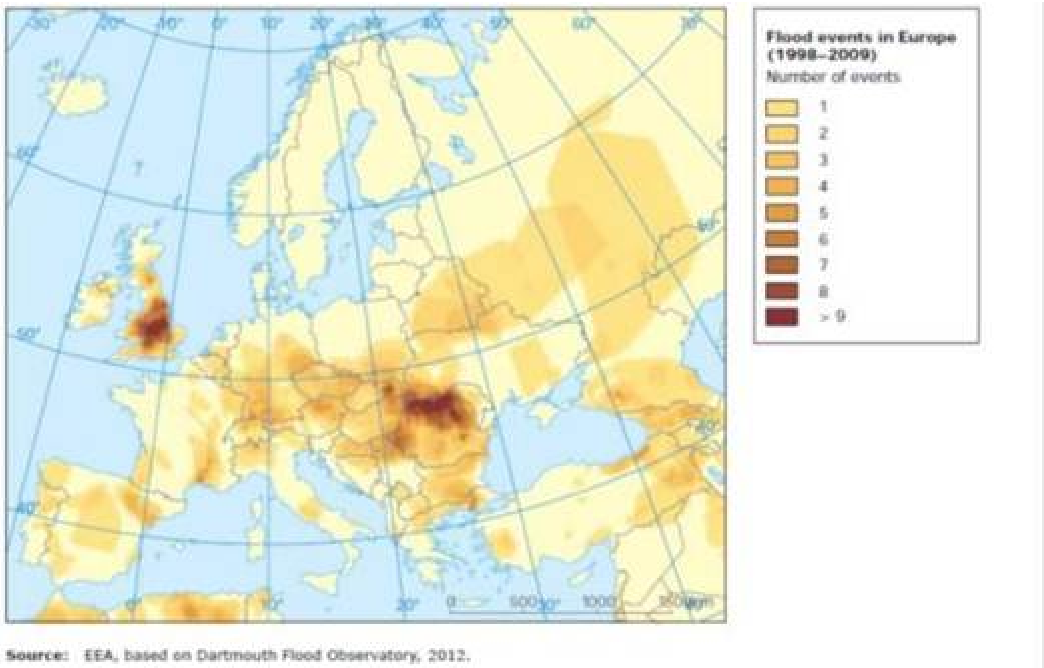
Observed changes

Climate change has already affected river flow but other factors (e.g. soil sealing, spatial development) also have a strong influence, which makes attribution difficult. Overall, annual river flow has decreased in southern and Eastern Europe, and increased elsewhere. In general, river flows have increased in winter and decreased in summer, but with substantial regional and seasonal variation. The impact of river flow droughts is currently largest in southern and south-eastern Europe. In comparison, large areas throughout Europe have been affected by flooding over the last decade (Figure 6-4). Flood losses in Europe have increased substantially over recent decades but the influence of climate change remains inconclusive up to now.

Regarding water temperature in major European rivers and lakes, an increase by 1-3°C has been recorded over the last century. The combination of increased temperatures and altered river flows are already affecting freshwater ecosystem and water quality.

92 http://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012

Figure 6-4 Occurrence of major floods in Europe (1998-2009)



Source: EEA 2012, based on Dartmouth Flood Observatory[93]

Projected changes

Climate change is projected to result in strong changes in the seasonality of river flows across Europe. Summer flows are projected to decrease in most of Europe, including in regions where annual flows are projected to increase. River flow droughts are projected to increase in frequency and severity in southern and south-eastern Europe, Benelux, France, western parts of Germany and the United Kingdom over the coming decades. Regarding river flood hazards, an increase is projected for several of Europe`s major rivers.

6.2.4. Observed and projected change in oceans including sea level rise

Observed changes

Impacts of climate change are observed in all European seas, although the extent to which impacts have been documented in time and space varies among the seas. For example, surface ocean pH has declined from 8.2 to 8.1 over the industrial era which corresponds to a 30 % increase in oceanic acidity. In addition, the heat content of the World Ocean has increased since around 1970. Sea surface temperature in European seas increased in the past more rapidly than in the global oceans.

Measured trends have shown that sea-level rise is not constant over Europe but varies regionally due to physical processes (e.g. salinity, wind patterns). Since 1992 the following trends were recorded in selected regions across Europe (based on satellite observation): The Baltic Sea shows an increase of between around 2 mm/year and 5 mm/year, Mediterranean Sea shows regions with increases of more than 6 mm/year and

93 http://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012

with decreases of more than – 4 mm/year, the Black Sea has seen an increase in sea level of between zero and around 5 mm/year.

Projected changes

Average surface water pH is projected to decline further to 7.7 or 7.8 by the year 2100 which represents a 100 to 150 % increase in acidity. These may affect many marine organisms and could alter ecosystems substantially. In addition, a further warming of the oceans is expected with projected climate change, although quantitative projections of ocean heat content are not available yet. Sea surface temperature is projected to rise more slowly than atmospheric temperature.

Projections of global mean sea-level rise in the 21st century range between 20 cm and about 2 m, showing that the level of uncertainty is high. Current projections suggests that sea-level rise is more likely to be less than 1 m than more than 1 m. Future projections of the spatial pattern of sea-level rise remain highly uncertain too. For example, a study estimates sea-level rise around the United Kingdom for the 21st century in the range of 12 cm to about 76 cm (depending on the emission scenario used). Another study estimated the plausible high-end scenario for 21st century sea-level rise on the North Sea coast of the Netherlands in the range of 40 to 105 cm[94].

6.2.5. Observed and projected change in the cryosphere

Observed changes

The extent and volume of the Arctic Sea ice and the Greenland ice sheet have declined rapidly since a couple of decades. Record low sea ice cover in the Arctic in September 2007, 2011 and 2012 was roughly half the size of the normal minimum extent in the 1980s. Regarding the Greenland ice sheet, the contribution of ice loss to global sea-level rise is estimated at 0.14–0.28 mm/year for the 1993–2003 period and has since increased.

Regarding glaciers, the vast majority in the European glacial regions are in retreat. Glaciers in the European Alps have lost approximately two thirds of their volume since 1850, with clear acceleration since the 1980s.

In the past 10–20 years European permafrost has shown a warming trend and the active layer thickness (i.e. thawing depth) has generally increased at some European permafrost sites.

Projected changes

Arctic Sea ice is projected to continue to shrink in extent and thickness and may even disappear at the end of the summer melt season in the coming decades. For the Greenland ice sheet model projections suggest further declines in the future but the processes determining the rate of change are still poorly understood.

It can be expected that the volume of European glaciers will further decline between 22 % and 66 % compared to the current situation by 2100 under a business-as-usual emission scenario.

94 .http://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012

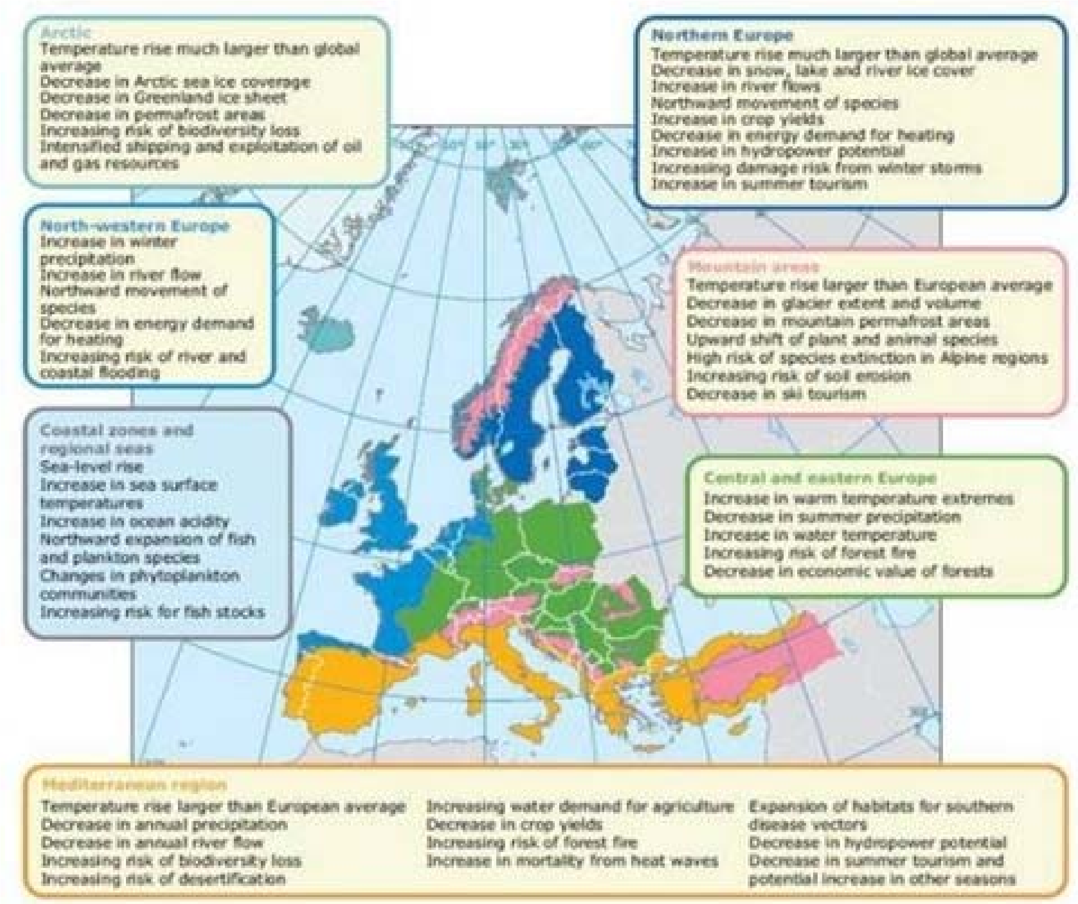
Permafrost areas are affected by the rate of warming and will very likely continue to thaw across Europe[95].

6.3. Expected impacts and vulnerabilities of climate change in the EU

Climate change is expected to have far-reaching consequences for Europe. Current and projected impacts in Europe, together with their related costs, suggest that climate change will — either directly or indirectly — test the vulnerability of European society with economic, environmental, societal, geopolitical and technological risks. The security, health and quality of life of European citizens are at the core of the matter and climate change constitutes an additional pressure that challenges most of the components of human and natural systems[96].

The impacts of and vulnerabilities to climate change vary considerably across Europe, in terms of the regions, territories and sectors affected. The EEA 2012 report summarises the main observed as well as projected climate change impacts for the main regions in Europe in an overview map (Figure 6-5).

Figure 6-5: Key observed and projected climate change impacts for the main regions in Europe



95 http://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012

96 http://ec.europa.eu/clima/policies/adaptation/what/docs/background_report_part1_en.pdf

Source: EEA 2012[97]

Regarding projected climate change impacts and vulnerabilities for sectors of relevance across Europe, some conclusions that can be drawn are presented below (based on McCallum et al. 2013, please refer to the report for the sources and literature used[98]).

6.3.1. Agriculture

Agriculture is the main user of land and water and still plays a dominant economic role in many rural areas of Europe. The stress imposed by climate change on agriculture is likely to intensify the regional disparities between European countries. In northern Europe increases in productivity and expansion of suitable cropping areas are expected to dominate. These are related to a lengthened growing season and an extension of the frost-free period. In southern Europe however, the benefits of projected climate change will be limited, while the disadvantages will be prevalent. Disadvantages include increased water demand and periods of water deficit, extreme weather events (heat, drought, storms), loss of soil carbon content, erosion, lower harvestable yield and higher yield variability, new pests and plant diseases and crop damages, and reduction in suitable areas of traditional crops (also CION 2009[99]). Positive effects on agriculture in the whole of Europe include a potential increase in CO_2 fertilization of plants.

Rising sea levels may lead to a loss of farmland as a result of inundation and increasing salinity of soils and fresh water supplies, particularly in low-lying areas such as the Netherlands. Warming and extreme events, such as heat spells, will also have direct impacts on animal health, growth and output, as well as on reproduction. There will also be indirect effects through changes in the productivity of pastures and forage crops, and in the distribution of animal diseases.

Socio-economic characteristics also influence the vulnerability and adaptive capacity of the European agriculture. Impacts of climate change and variability largely depend on farm characteristics (e.g. intensity, size, land use). Farm characteristics influence management types and adaptation. As different farm types adapt differently, a large diversity in farm types reduces impacts of climate variability at regional level. Certain farm types may remain vulnerable while others are resilient to climatic changes. Farmers continuously adapt to changes, which affects the current situation as well as future impacts.

6.3.2. Forestry

The impacts of climate change will vary throughout the different geographic regions of Europe, with forest fires likely to dominate in southern Europe and the limited diversity of tree species in boreal forests enhancing the risk of significant pest and disease impacts. Next to negative climate change impacts, especially in the long term, opportunities arise as well in the forestry sector. Evidence to date suggests that productivity in northern and central Europe has increased and is likely to continue to increase. Further, northward expansion of potential distribution of some tree species is expected and potentially more favorable conditions for summer recreation in

97 http://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012

98 http://ec.europa.eu/clima/policies/adaptation/what/docs/background_report_part1_en.pdf

99 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0147:FIN:EN:PDF

mountainous regions will exist. However, with more drastic changes in climate towards the end of the 21th century, severe and wide ranging negative climate change impacts have to be expected in most European regions, with the Mediterranean region being the most vulnerable to climate change based on potential impact assessment and adaptive capacity.

6.3.3. Water resources and fisheries

Floods, droughts and water scarcity have already affected large parts of the European Union and have an important impact on our water resources and socio-economic developments. In the future, climate change is likely to change water availability and global warming will probably increase both the number and magnitude of hydrological extremes.

Water stress is spreading in Europe, affecting one third of the territory all year round. During summer months water scarcity is more pronounced in southern European basins but is also becoming increasingly important in Northern basins, including UK and Germany (CION 2012[100]).

The frequency and intensity of floods and droughts and their environmental and economic damage appear to have increased over the past thirty years. South-eastern Europe is increasingly facing extended periods of droughts, and both northern and Western Europe have been affected in more recent years (EEA 2012[101]).

The ClimWatAdapt project[102] investigated the future water situation and developments in the water sector in Europe until 2050 in terms of "vulnerability to water scarcity", "vulnerability to droughts", and "vulnerability to floods". The ClimWatAdapt project concludes that changes in future water scarcity are mainly driven by changes in water withdrawals. Under the EcF (Economy First) scenario, the percentage of area under severe water stress is expected to increase in all regions until 2050, with major changes in particular in eastern, western, and southern Europe. Increasing water withdrawals are the main cause in eastern and Western Europe. In southern Europe a decrease in water availability due to climate change exacerbate the situation with agriculture as the major water use sector potentially suffering significant economic losses. Mostly, water stress will not occur in northern Europe. In river basins under severe water stress, there will be strong competition for scarce water resources between households, industry, agriculture, and nature. Overall, this situation is most severe during summer when river flows are low and are becoming lower due to climate change. Additionally, the water demands are highest during the summer due to irrigation demands and tourism water use.

An analysis of the impacts of climate change on fisheries and aquaculture of the EU research project CLAMER[103] shows clear evidence from all European seas that "rising

100 European Commission (2012): Commission Staff Working Document Impact Assessment accompanying the document Communication from the Commission to the European Parliament, the Council, the European Social and Economic Committee and the Committee of the Regions: A Blueprint to Safeguard Europe's Water Resources. SWD(2012) 382 final. Brussels.

101 EEA – European Environment Agency (2012): Climate change, impacts and vulnerability in Europe 2012. An indicator-based report. EEA Report No 12/2012, Copenhagen.
http://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012

102 http://climwatadapt.eu/

103 http://www.clamer.eu/

temperatures, along with overfishing, are causing substantial changes to fish stocks such as herring, sand eels and cod, as well as to their ranges and migration routes. Warmer water fish species are gradually moving north so that unfamiliar fish species are now appearing on fish market stalls". For the future CLAMER expects "Northerly extension of warmer-water fish is expected to continue, with development of new exploitable populations. Stocks of cold-adapted species are projected to decline in, for instance, the North Sea, but to benefit from higher temperatures in areas such as the Barents Sea. Fish production is sensitive to the combined effects of climate, ocean acidification and plankton community changes, and heavily exploited fish stocks are likely to be especially vulnerable." Warmer waters may increase the growth rate for aquaculture species but can also place some species outside their comfort zone. Rising acidity may affect the ability of shellfish to construct their shells.

6.3.4. Energy

Climate threats for the European energy system do already exist and are projected to increase. Impacts of climate change, such as an increased frequency of extreme weather events or changing water and air temperatures have effects on all three major parts of the system: transmission and distribution, supply/generation and demand. Transmission and distribution of energy (mainly electricity) is challenged by new demand patterns as well as direct physical destruction due to a higher magnitude and frequency of extreme weather events (explicitly under threat are overhead transmission/distribution facilities, but also other infrastructure – e.g. substations, transformers or fragile supply infrastructure). Supply/generation of electrical energy is affected by efficiency decreases due to climate change and the more complex vulnerability setting of renewable energy (as compared to fossil fuel based energy supply) to changing climate parameters. Demand of energy is already triggered particularly by extreme periods (heat waves, floods/mass movements, droughts) causing demand-driven overstress of energy infrastructure, their direct destruction and consequent interruptions in energy supply. In particular, more intense and frequent heat waves can shift demand patterns to critical constellations at times where energy supply is low, e.g. as a result of decreased efficiency of thermal plants due to temperature increases of ambient and cooling water. This coincides with increased demand for cooling for private households, offices and storage of for example food and pharmaceutical products.

These impacts will be aggravated due to i) increasing interconnection of grid-dependent European internal energy market and thus increasing amounts of transmitted energy/less domestic supply in many regions; ii) projected further shift towards increasing electricity demands and according shifts in primary energy consumption and iii) increasing share of renewable energy generation that will entail a more complex picture of climate threats (e.g. increasing dependency from solar irradiation, wind velocities, river run-off regimes). Threats to the energy system might increase regional disparities with the EU with southern countries suffering from i) high electricity import dependency and thus relying on transmission infrastructure that is not yet resilient and ii) projected impacts from gradual temperature increase, heat wave and drought frequency further threats to domestic supply aggravating import dependency. Meanwhile, northern countries show a more complex and uncertain picture of potential gains and losses for energy supply and security.

6.3.5. *Transport infrastructure*

In the past, precipitation in its various forms caused the most damage to transport. This is true for all parts of Europe and all forms of transport such as rail, road, shipping and aviation. For example, heavy snowfall complicates road traffic, rail transport and airport operations regardless of where in Europe it occurs. Heavy rain causes flash flooding, which disrupts transport connections, inhibits inland waterway traffic and damages earth structures such as road, bridge and rail embankments.

Consequences of future climate change will both be negative and positive for transportation infrastructure, but will differ from region to region. In particular, the projected increase in frequency and intensity of weather and climate extremes, such as heavy rain (e.g. causing floods), heavy snowfall, extreme heat and cold, drought and reduced visibility can enhance negative impacts on the transport infrastructure, causing injuries and damages as well as economic losses. But also some beneficial impacts on transport due to climate change can be expected, such as reduced snow fall for most European regions improving traffic conditions. However, the vulnerability of the transport sector is also influenced by human behaviour and societal changes as the kind of mobility chosen by individuals also influences the vulnerability of the sector.

In terms of cost estimates for future climate change impacts on the transport sector, the Weather project[104] concludes that from 2010 to 2050, due to weather extremes, rail transport would experience the most substantial increase in all cost categories (i.e. comprising direct costs to the transport sector and indirect costs to its users and to other sectors). Aviation and road transport would also be affected, with varying levels of impacts for different EU regions.

6.3.6. *Construction and buildings*

The impact of climate change is particularly pertinent to the construction sector given the life expectancy of buildings, both in terms of new developments and the existing built environment to climatic changes to withstand a potentially very varied and uncertain climatic impact. The vulnerability of buildings and constructions is mainly influenced by the design (low resistance to storms) and location (e.g. in flood-prone areas, landslides, avalanches).

In the past, precipitation in its various forms caused the most damage to buildings and infrastructure. This is true for all parts of Europe and all forms of buildings and civil engineering works. For example, heavy snowfall caused building collapses, heavy rain and storm waters causing flash flooding lead to infiltration of water into buildings, damage or destruction. Additional salt water intrusion can cause deterioration of facades, statues and monuments. Heavy snowfall and landslides can seriously affect not only the day to day functioning of infrastructure (i.e. railways, roads) but also fast and efficient relief activities. With more intense extreme precipitation events expected, there is also a significant risk of drains and foul sewers flooding and failing to function. Recurring flooding and changes in ground water levels will require investment in flood resistance and resilience, while urban flash flooding must also be considered during extreme rainfall events. In coastal areas, coastal protection (e.g. sea walls, barriers) might lead to increased maintenance costs and higher frequency of updating works.

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104 http://www.weather-project.eu/weather/inhalte/deliverables.php

Urban areas are particularly at risk due to higher sealing rates related to construction and buildings (e.g. higher water run-off, heat island effect during summertime, and lack of fresh water during droughts).

Major threats to construction and buildings requiring short-term action can be aggregated to: i) extreme precipitation which can be expected European wide (e.g. leading to water intrusion, damage to foundations and basements, destruction of buildings); ii) summer heat, especially in southern Europe (e.g. leading to material fatigue, decreased comfort and health, high energy use for cooling); iii) exposure of constructions to heavy snowfall and iv) rising sea levels that increase the risk of flooding in particular as many European cities are located next to the shore or rivers.

6.3.7. Biodiversity

Climate change is also leading to indirect impacts on biodiversity through changes in socio-economic drivers, working practices, cultural values, and policies. These have the potential to exacerbate many of the main pressures driving biodiversity loss, including habitat fragmentation and loss, over-exploitation, pollution of air, water and soil, and spread of invasive species (EEA 2010[105]). Due to their scale, scope and speed many could be more damaging than direct impacts, with knock-on implications for ecosystem services on which our society and economy rely. Further, human consumption and production patterns are causing ecosystems to degrade and depriving them of their capacity to withstand climate change and deliver essential services, such as crop pollination, clean air and water, and control of floods or erosion (RUBICODE project 2006–2009[106]).

The vulnerability of habitats to climate change is also likely to be a problem for species, particularly those that are habitat specialists and are already constrained by habitat availability and/or condition. Climate change is likely to exacerbate such threats, rather than create new opportunities[107].

6.3.8. Health

Climate change will impact Europe citizens' health, animal (livestock) and plant (food security) health as well as cause (damage) costs related to direct and indirect health impacts.

The relation between human health and climate change are complex and interact with several other factors. Important factors are the population health status, population demographics and the health infrastructure. Vulnerable groups among others are children, elderly, pregnant women, low income groups and people with health issues (WHO 2010[108]). In many parts of Europe population is aging. Communicable diseases continue to emerge in Europe and elsewhere, and it is by now widely understood that myriad social and environmental risk factors influence their emergence. Major drivers of emerging infectious diseases that could threaten control efforts in Europe include

105 http://www.eea.europa.eu/publications/10-messages-for-2010
http://www.eea.europa.eu/soer/europe/biodiversity
http://www.eea.europa.eu/publications/assessing-biodiversity-in-europe-84
http://www.eea.europa.eu/publications/eu-2010-biodiversity-baseline/

106 http://www.rubicode.net/rubicode/index.html

107 http://acm.eionet.europa.eu/reports/docs/ETCACC_TP_2010_14_Habitat_vulnerability_assessment.pdf

108 http://www.euro.who.int/__data/assets/pdf_file/0005/95882/Parma_EH_Conf_edoc06rev1.pdf

globalization and environmental change (including climate change, travel, migration, global trade); social and demographic drivers (including population ageing, social inequality, lifestyles); and public health system drivers (including antimicrobial resistance, health care capacity, animal health, food safety). These factors, alongside many others, interact in dynamic and stochastic ways to drive the emergence and re-emergence of new diseases.

Besides its effects on infectious diseases, climate change impacts human health also through air quality, with negative consequences for respiratory and cardiovascular diseases. Changes in weather patterns may also change the seasonality of allergies, while changing ultraviolet radiation may increase the incidence of skin cancer and cataract.

Climate change may also impact animals' living conditions and bring forth pathologies such as parasitic diseases, nutritional disorders, sunstroke or dehydration which can be very important for the farmers' economic situation.

Regarding plant health an expansion of a range of pests that so far could not establish in Europe can be expected due to increased temperatures allowing them to survive wintertime and to have multiple generation cycles per year, and by increasing the susceptibility of crops and trees to new dangerous pests of plants from other continents.

6.3.9. Food security

Altered food supply and potential price increases could have potential impacts on the 'EU's food imports. For many years the EU has been a net food importer. Today the 'EU's overall trade is in fairly close balance (livestock and cereals), for many product groups the EU still remains a substantial importer (fruit, vegetables, cotton, tobacco, oilseeds and oils).

However, EU food production per capita has constantly increased in the past while simultaneously the share of income that households spend on food has steadily declined. Forecasts predict roughly stable or increasing production quantities for the EU – even in the case of subsidy and tariff cuts. The expected main effect of climate change in the coming decades will be to shift production from southern to northern Europe without significantly curtailing overall production.

If food prices rise dramatically, the EU could increase the agricultural area used for growing cereals; in particular, by cultivating abandoned land or shifting from biofuel and livestock production to more cereals. Furthermore, agricultural labour and capital input could be multiplied. An additional measure would be to enhance investments into agricultural productivity.

6.3.10. Economic activity and employment

Climate change is expected to cause a mix of positive and negative impacts on economic activity and employment, with substantial disparities among regions in Europe. In general, modest changes in climatic conditions are expected to have a relatively minor impact at macro level in Europe due to redistribution effects (between economic sectors, as well as between countries/regions) and adaptation capability. However, and even under optimistic scenarios, climate change could have significant adverse impacts at local level in terms of economic activity and employment.

The impact of temperatures increase, changes in precipitation regimes and sea-level rise will affect – directly or indirectly – productivity and viability of nearly all economic sectors across the EU, although some sectors are more weather-sensitive than others and will have more impact on people's lives and income possibilities. Rising temperatures and erratic weather pattern will reduce the land and natural capital productivity in many places. More frequent and intense heat waves, and altered transmission seasons and geographic range of important vector-borne diseases will lower labour productivity. As a result of sea level rise and increased intensity of climate extremes, physical capital assets will be more frequently impaired and important lifelines disrupted with wide reaching economic and social consequences. For the private sector (defined as privately owned or controlled companies, organisations and entities) impacts are expected to fall disproportionately on SMEs (CION 2013[109]) including disrupting business operations, property damage, disruption to supply chains and infrastructure leading to increasing costs of maintenance and materials, and raising prices. In other cases, climate change may also offer new business opportunities for products and services that would help people to adapt in the form of expanding market share and creating wealth in communities (innovation and job creation) and accessing new finance streams (increased public funding and financial products and services).

Tourism is another major economic sector affected by climate change. The effects of climate change on the tourism sector vary widely, depending on the location and the season. The biggest adverse impacts would appear to be from changes in summer tourism flows (in the Mediterranean region) and winter skiing (in the Central region). Thus, the attraction of tourist destinations will change with the variation of tourist flows affecting regional economies. Conversely, some benefits are to be expected in other areas, which may benefit from a shift in tourist flows.

6.3.11. Social issues

Climate change impacts might affect people's daily lives in terms of employment, housing, health, water and energy access as well as the implementation of gender equality and other human rights. However these impacts are not too well understood at the EU level.

Main potential impacts on social issues that are expected to be most relevant for the EU level with regard to climate change impacts relate to **migration**, **gender**, and **ageing population.** The areas of **social protection** dealing with reduction of poverty and social exclusion, access to healthcare, pensions, long-term care, social security, employment and training services, social housing, child care and social assistance are facing climate change related negative impacts and at the same time directly influence the capacity of societies to adapt to all types of climate change impacts.

6.4. EU-level actions for adaptation to climate change

In view of the specific and wide-ranging nature of climate change impacts across the EU's territory, the European Union has long assumed its important role in developing an EU-wide framework for adaptation. Thus, the European Commission started in 2007

109 European Commission (2013): Commission Staff Working Document – Accompanying document to the EU Strategy on adaptation to climate change. Impact Assessment - Part 2. SWD(2013) 132 final. European Commission, Brussels. http://ec.europa.eu/clima/policies/adaptation/what/docs/swd_2013_132_2_en.pdf

by adopting a Green Paper "Adapting to climate change in Europe – options for EU action"[110], followed by the White Paper "Adapting to climate change: Towards a European framework for action"[111]. Both documents started a process that has recently been brought to a new level through the adoption of the EU strategy on adaptation to climate change on 16 April 2013[112].

6.4.1. Towards a European Framework for adaptation: the Green and White Papers

In 2007, the European Commission adopted a **Green Paper on adapting to climate change in Europe**, recognising that all parts of Europe will increasingly feel the adverse effects of climate change. Responding to the feedback gathered from the broad stakeholder involvement for the Green Paper, the EU adopted an **Adaptation White Paper** in 2009. This White Paper set out the steps to be taken in preparing the 2013 EU strategy on adaptation to climate change. The White Paper highlighted five main reasons for the EU to take action on climate change adaptation:

- Many climate change impacts and adaptation measures have cross-border dimensions;
- Climate change and adaptation affect EU policies;
- Solidarity mechanisms between European countries and regions might need to be strengthened because of climate change vulnerabilities and adaptation needs;
- EU programmes could complement Member State resources for adaptation;
- Economies of scale can be significant for research, information and data gathering, knowledge sharing, and capacity building.

The White Paper was framed to complement and ensure synergies with actions by Member States. It adopted a phased approach. Phase 1 (2009-2012) laid the ground work for preparing a comprehensive EU Adaptation Strategy to be implemented during phase 2, commencing in 2013. The first phase comprised a total of 33 actions arranged across four 'pillars'. The outcomes of these activities informed the elaboration of the EU Adaptation Strategy adopted in 2013.

Main achievements under the four pillars of the White Paper are summarised in the following[113].

Pillar 1: Develop and improve the knowledge base at regional level on climate change impacts, vulnerabilities mapping, costs and benefits of adaptation

Noting that information on climate change impacts, vulnerability and adaptation is available, but not sufficiently shared across EU Member States, the Commission started a process, to develop a Clearing House mechanism that would establish a

110 http://eur-lex.europa.eu/LexUriServ/site/en/com/2007/com2007_0354en01.pdf

111 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0147:FIN:EN:PDF.

112 http://ec.europa.eu/clima/policies/adaptation/what/docs/com_2013_216_en.pdf

113 More detailed information on each of the 33 actions announced in the White Paper is available in: European Commission (2013): Commission Staff Working Document – Accompanying document to the EU Strategy on adaptation to climate change. Impact Assessment - Part 2. SWD(2013) 132 final. European Commission, Brussels. pp.96-106. http://ec.europa.eu/clima/policies/adaptation/what/docs/swd_2013_132_2_en.pdf

comprehensive European information platform, which was launched on 23 March 2012 as the 'European Climate Adaptation Platform' (Climate-ADAPT[114]).

Hosted by the European Environment Agency (EEA), Climate‑ADAPT contains information on impacts, vulnerability and adaptation policy across Europe, and also includes adaptation case studies as well as a number of software tools to facilitate accessing this information. Climate-ADAPT is the EU entry point to information on adaptation, and it complements other initiatives implemented or planned at national and sub‑national levels[115].

The platform Climate-ADAPT organises information under the following main entry points:

- adaptation information (observations and scenarios, vulnerabilities and risks, adaptation measures, national adaptation strategies, research projects);
- EU sectoral policies (agriculture and forestry, biodiversity, coastal areas, disaster risk reduction, financing, health, infrastructure, marine issues and fisheries, water management);
- transnational regions, countries and urban areas and
- tools (Adaptation Support Tool, Case Study Search Tool, Map Viewer).

To support the implementation of this pillar, the European Commission was assisted by a Working Group on Knowledge Base on Climate Change Impacts, Vulnerability and Adaptation (WG-KB), made up of representatives of Member States, research institutions and other stakeholders.

Pillar 2: Integrate adaptation into EU policies (mainstreaming)

This pillar aimed at ensuring that climate change impacts and adaptation are taken into consideration in all relevant EU policy sectors. The key policy initiatives subject to mainstreaming concentrate on the following nine sectors: water management, marine and fisheries, coastal areas, agriculture and forestry, biodiversity, infrastructure, finance and insurance, disaster risk reduction, and health (EEA 2013).

The EU's Seventh Framework Programme for Research and Technological Development (FP7), as well as several European Commission service contracts, played an important role in informing mainstreaming activities and potential policy intervention. The European Commission also supports mainstreaming efforts by providing sectoral guidelines for several EU policy areas to ensure that climate change impacts are taken into account (e.g. for Environmental Impact Assessment (EIA) and Strategic Environment Assessment (SEA)).

Work on mainstreaming has expanded to include strategic financial planning. The 2011 Commission proposal for the next Multiannual Financial Framework[116] (MFF) 2014-

114 http://climate-adapt.eea.europa.eu

115 EEA - European Environment Agency (2013): Adaptation in Europe. Addressing risks and opportunities from climate change in the context of socio-economic developments, EEA Report 3/2013, Copenhagen. http://www.eea.europa.eu/publications/adaptation-in-europe

116 The Multiannual Financial Framework (MFF) shall ensure that European Union expenditure develops in an orderly manner and within the limits of its own resources. It shall be established for a period of at least five years. The annual budget of the Union shall comply with the multiannual

2020 recognises this approach and includes a minimum contribution of 20 % for climate related expenditure, stipulating that all EU funds will need to take climate change into account in their funding allocation decisions[117].

Pillar 3: Use a combination of policy instruments – market-based instruments, guidelines, and public-private partnerships – to ensure effective delivery of adaptation

The European Commission carried out several studies to identify policy instruments suited for adaptation purposes and to develop specific guidelines (e.g. for CAP[118] and Cohesion[119] under the next financing period). Further, stakeholder involvement has taken place with the private sector on specific issues, such as standards and insurance. For example, a mandate has been adopted which would require standardisation organisations to consider, in the context of their work, updating Eurocodes[120], developing a technical report analysing and providing guidance for potential amendments for Eurocodes with regard to relevant impacts of future climate change[117].

Pillar 4: Work in partnership with the Member States and strengthen international co-operation on adaptation by mainstreaming adaptation into the EU's external policies.

To develop this pillar, the Commission created an Adaptation Steering Group (ASG) in September 2010. The ASG brought together Member States and a diverse range of stakeholders, including business organisations and NGOs and was to support the European Commission in implementing the White 'Paper's actions in preparation of the EU Adaptation Strategy. The Group met7 times in total between September 2010 and January 2013.

For strengthening the international co-operation on adaptation the EU has been taking an active role in the negotiations under the UNFCCC to ensure adaptation issues are adequately dealt within a post-2012 agreement and will continue to do so. In addition, adaptation to climate change has been mainstreamed into EU development cooperation. For the 2007 to 2013 financial perspective, the EU has adopted a package of new instruments for the implementation of external assistance which is mainly based on three "geographical" instruments: Development Cooperation Instrument (DCI), European Neighbourhood and Partnership Instrument (ENPI), and European Development Fund (EDF).

Across the 4 pillars of the 2009 White Paper, most of the 33 actions announced have been implemented.

6.4.2. The EU Strategy on Adaptation to Climate Change

Building on the results of the above-mentioned initiatives carried out under the 2009 White Paper and in-depth assessments of policy areas concerned, an **EU strategy on**

financial framework (European Commission, 2008). The MFF de facto sets political priorities for future years and constitutes therefore a political as well as budgetary framework ('in which areas should the EU invest more or less in the future?').

117 http://ec.europa.eu/clima/policies/adaptation/what/docs/swd_2013_132_en.pdf

118 http://ec.europa.eu/clima/policies/adaptation/what/docs/swd_2013_139_en.pdf

119 http://ec.europa.eu/clima/policies/adaptation/what/docs/swd_2013_135_en.pdf

120 The EN Eurocodes are a series of 10 European Standards, EN 1990 - EN 1999, providing a common approach for the design of buildings and other civil engineering works and construction products.
http://eurocodes.jrc.ec.europa.eu/

adaptation to climate change was adopted by the European Commission on 16 April 2013. The overall aim of the EU Adaptation Strategy is to contribute to a more climate-resilient Europe. This means enhancing the preparedness and capacity to respond to the impacts of climate change at local, regional, national and EU levels, developing a coherent approach and improving coordination.

The Communication “An EU Strategy on adaptation to climate change”[121] is the main political document adopted. It sets out eight actions to be taken to meet the Strategy’s three specific objectives:

(1) Promoting action by Member States,

(2) Better informed decision-making, and

(3) Climate-proofing EU action: promoting adaptation in key vulnerable sectors.

The European Commission also adopted a Green Paper on insurance in the context of natural and man-made disasters, launching a wide debate on the adequacy and availability of existing insurance options.

The Communication is complemented by a set of accompanying documents[122] reflecting the broad scope of climate change and adaptation to be considered:

- A first group of documents aims at facilitating adaptation processes across the EU by offering non-binding concrete suggestions to Member States and other stakeholders as a result of analyses and consultation. These include Guidelines on developing adaptation strategies, and other guidance documents for the integration of climate change adaptation into different key EU programmes and investments, such as the Cohesion Policy, the 2014-2020 rural development programmes under the Common Agricultural Policy (CAP);
- A second group of documents focuses on adaptation in specific sectors and policy areas. They illustrate some of the sectoral or territorial impacts of climate change (for coastal and marine issues; human, animal and plant health; and infrastructure) highlighting some of the measures currently being proposed by the European Commission to address these issues and bring about a complementary perspective on some particular issues (e.g. environmental degradation and migration).

In addition, some Guidelines for Project Managers on making vulnerable investments climate resilient were released.

In the following, the three objectives with their proposed actions set out in the EU Adaptation Strategy are described in detail[123]:

Objective 1: Promoting action by Member States

Action 1: Encourage all Member States to adopt comprehensive adaptation strategies

One of the greatest challenges for cost-effective adaptation in Europe is to achieve coordination and coherence at the various levels of planning and management. As

121 http://ec.europa.eu/clima/policies/adaptation/what/docs/com_2013_216_en.pdf

122 http://ec.europa.eu/clima/policies/adaptation/what/documentation_en.htm

123 http://ec.europa.eu/clima/policies/adaptation/what/docs/com_2013_216_en.pdf

National Adaptation Strategies (NASs) are widely accepted as key tools to guarantee consistent action at country level, the EU Adaptation Strategy encourages all Member States to adopt a comprehensive NAS.

In 2017, the Commission will assess whether action being taken in the Member States is sufficient, to eventually consider further action, including the possibility to propose a legally binding tool.

Action 2: Provide LIFE funding to support capacity building and step up adaptation action in Europe (2013-2020)

The EU will provide financial support for adaptation through the proposed EU financial instrument for the Environment (LIFE), which for the first time includes a climate action sub-programme with a budgetary allocation dedicated specifically to climate change adaptation[124]. The Commission will use multi-annual work programmes to define strategic goals and thematic priorities to ensure alignment with the EU Adaptation Strategy.

Action 3: Introduce adaptation in the Covenant of Mayors framework (2013/2014)

Active engagement on the part of local and regional authorities will be essential, given the importance of adaptation action at local level. Building upon the success of an initial EU initiative[125] adaptation action by cities will be further developed in coordination with other EU policies following the model of the Covenant of Mayors[126].

Objective 2: Better informed decision-making

Action 4: Bridge the knowledge gap

The Strategy, recognizing that substantial knowledge gaps need to be filled, identifies the need for the European Commission to work with Member States and stakeholders in refining these knowledge gaps and identifying the relevant tools and methodologies to address them. Therefore, it establishes a solid link to feed the EU Framework Programme for Research and Innovation 2014-2020 – Horizon 2020 – with its finding, which will be addressed through specific programmes and mainstreaming climate action across the full programme (35 % of the budget).

Action 5: Further develop Climate-ADAPT as the 'one-stop shop' for adaptation information in Europe

The European Commission aims to continuously improve the Web platform Climate-ADAPT, to fulfil the need to facilitate access to sound adaptation information in Europe

124 The LIFE programme is the EU Financial instrument for the environment with the general objective to contribute to the implementation, updating and development of EU environmental policy and legislation by co-financing pilot or demonstration projects with European added value. Different LIFE projects have been actively working on ways to both mitigate the effects of climate change and to help the EU adapt to its impacts. These projects represented a total investment of approximately €24 million in EU co-financing in the period of 2007-2013. An overview on recent adaptation to climate change related LIFE projects can be found in the internet.
The Commission proposes to allocate in total EUR 3.2 billion over 2014-2020 to a new LIFE Programme for the Environment and Climate Action.

For more details on the proposal see: http://ec.europa.eu/environment/life/about/beyond2013.htm.

125 http://eucities-adapt.eu/cms/

126 The Covenant of Mayors was officially launched in January 2008. Since then, this initiative has met large international success: 2.108 European cities had signed political commitments by November 2012. The initiative addresses local and regional authorities, voluntarily committing to increasing energy efficiency and use of renewable energy sources on their territories.

for all the relevant stakeholders, within and outside the EU territory. In this regard, since the launch of the Strategy the Commission and the EEA have continued developing the platform and disseminating its contents, and these efforts will be maintained and reinforced as an essential element of implementing the EU Adaptation Strategy.

Objective 3: Climate-proofing EU action: promoting adaptation in key vulnerable sectors

Action 6: Facilitate the climate-proofing of the Common Agricultural Policy (CAP), the Cohesion Policy and the Common Fisheries Policy (CFP)

The European Commission remains strongly committed to mainstreaming adaptation into key EU funds, policies and programmes. Together with the mainstreaming efforts referred above (indicate section), the Commission intends to ensure improved access to funding as a critical factor in building a climate-resilient Europe and supporting Member States' adaptation activities. As mentioned above, the objectives for all relevant EU finance programmes for 2014-2020 includes a minimum contribution of 20% for climate related expenditure.

Action 7: Ensuring more resilient infrastructure

Infrastructure projects, which are characterised by a long life span and high costs, need to withstand the current and future impacts of climate change. The European Commission will explore all the potential ways at its hand to enhance the adaptation capacity of European infrastructures, from mainstreaming to standardisation, or providing further guidance to project developers. It will also explore ecosystem-based approaches to adaptation and the potential for developing green infrastructure as a climate change adaptation resource.

Action 8: Promote insurance and other financial products for resilient investment and business decisions

The European Commission's aim is to improve the market penetration of natural disaster insurance and to unleash the full potential of insurance pricing and other financial products for risk awareness prevention and mitigation and for long-term resilience in investment and business decisions.

The Green Paper on the insurance of natural and man-made disasters (CION 2013[127]), adopted together with the Strategy, is a first step in encouraging insurers to improve the way they help to manage climate change risks. Stakeholder discussions with the insurance and bank sectors on the basis of the Green Paper have been initiated.

Governance and review

The European Commission will cooperate with Member States through the relevant *fora*, including the Climate Change Committee and appointed adaptation national focal points, and continue to engage with stakeholders for proper and timely **implementation** of the EU Adaptation Strategy.

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127 European Commission (2013): Green Paper on the insurance of natural and man-made disasters. COM(2013) 213 final. European Commission. Strasbourg. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0213:FIN:EN:PDF

In 2017, the Commission will report to the European Parliament and the Council on the state of implementation of the Strategy and propose its review if needed.

6.5. Other EU research and assessment activities

Research is key for effective adaptation, as practical adaptation actions and measures must be based on sound, scientific, technical and socio-economic information. This has been recognised by the European Commission and the level of spending on impacts and vulnerability assessment and adaptation has increased significantly since NC5.

European research has been supported mainly through the Framework Programmes for Research and Technological Development[128]. The European Commission is funding research on the scientific, technical and socio-economic aspects of human-induced climate change, its potential impacts and options for adaptation and mitigation not only in Europe, but also in cooperation with third countries, including developing countries.

Under the EU's 7th Framework Programme for Research and Technological Development - FP7 (2007- 2013) climate change was a key priority including research on climate change adaptation[129].

A number of projects funded under FP7 have and will continue to contribute to the improvement of the assessment framework by advancing of the understanding of the climate system and its processes, the quantification of climate change impacts on human and natural systems (including extreme events), and the identification and assessment of mitigation and adaptation options including their costs. Results from research projects serve as a knowledge basis for the development and support of climate policies as well as policies on, for example, disaster risk reduction.

Some examples of projects on impacts, vulnerability and adaptation for various themes funded over the last few years under the European Commission 6th and the 7th Framework Programmes are summarised in Table 6-1.

Table 6-1 Selected research project financed by FP6 and FP7

Acronym and Link	Project title	General aim	Duration
ENSEMBLES	ENSEMBLES – A changing climate in Europe	An ensemble prediction system giving the first probabilistic climate projections of temperature and rainfall changes for Europe this century	2004-2009
IMPACT2C	Quantifying projected impacts under 2°C warming	IMPACT2C enhances knowledge, quantifies climate change impacts, and adopts a clear and logical structure, with climate and impacts modelling, vulnerabilities, risks and economic costs, as well as potential responses, within a pan-European sector based analysis. IMPACT2C utilises a range of models within a multi-disciplinary international expert team and assesses effects on water, energy, infrastructure, coasts, tourism, forestry, agriculture, ecosystems services, and health and air quality-climate interactions.	2011-2015
ClimateCost	the Full Costs of Climate	Advance the knowledge in long-term targets and	2008-2011

128 http://cordis.europa.eu/fp7/home_en.html

129 http://ec.europa.eu/research/infocentre/theme_en.cfm?item=Environment&subitem=Climate%20%26%20global%20change&start=1

Acronym and Link	Project title	General aim	Duration
	Change	mitigation policies; costs of inaction (the economic effects of climate change) and costs and benefits of adaptation	
ADAM	ADaptation And Mitigation Strategies: supporting European climate policy	ADAM supports the EU in the development of post-2012 global climate policies, the definition of European mitigation policies to reach its 2020 goals, and the emergence of new adaptation policies for Europe with special attention to the role of extreme weather events	2006-2009
RESPONSES	European responses to climate change: deep emission reductions and mainstreaming of mitigation and adaptation	Its objective is to identify and assess integrated EU climate-change policy responses that achieve ambitious mitigation and environmental targets and, at the same time, reduce the Union's vulnerability to inevitable climate-change impacts.	2011-2013
MEDIATION	Methodology for effective decision-making on impacts and adaptation	MEDIATION will: • integrate, consolidate and enhance access to the existing knowledge in the proper context of local, regional and sectoral application, methods and data. • further develop and improve methods in selected priority areas, such as cost-effectiveness analysis and vulnerability. • bring available knowledge beyond the current fragmented stage, and provide links between common, generically available knowledge about methods to assess climate change impacts, vulnerability and adaptation options, and the needs of regional or sectoral decision-making. • apply a systematic approach to developing a common methodological framework that integrates policy needs and the diversity in assessment approaches, both top-down and bottom-up. • increase the understanding, management and communication of pertinent uncertainties to allow for more harmonized approaches in European research to support robust decision-making.	2010-2013
CIRCLE CIRCLE-2	Climate Impact Research & Response Coordination for a Larger Europe	Coordinate European transnational research funding on Climate Change Impacts, Vulnerability and Adaptation (CCIVA) and facilitate the transfer of research outcomes that European and national decision makers need to design effective yet economically efficient Adaptation initiatives and strategies; Share experiences and lessons learnt on CCIVA research funding and management and on the development of national and regional Adaptation practices; Encourage international cooperation with non-European countries and organisations as well as the involvement of countries with less diverse CCIVA research programmes.	2005-2009 2010-2014

Acronym and Link	Project title	General aim	Duration
ClimateWater	Bridging the gap between adaptation strategies of climate change impacts and European water policies	The overall objective of the ClimateWater project is to study European and international adaptation measures and strategies related to climate change impacts and how these are taken into account in water policies. The project is formulating a coherent framework on adaptation strategies of climate change impacts on water resources, water cycling and water uses of the society and nature with special regard to those that water policy has to take into account when considering climate change impacts.	2008-2011
ESPON Climate	Climate Change and Territorial Effects on Regions and Local Economies in Europe	The ESPON project aims to develop a pan-European vulnerability assessment as a basis for identifying regional typologies of climate change exposure, sensitivity, impact and vulnerability. On this basis, tailor-made adaptation options can be derived which are able to cope with regionally specific patterns of climate change.	2009-2011
ACQWA	Assessing climatic change and impacts on the quality and quantity of water	The project uses advanced modelling techniques to quantify the influence of climatic change on the major determinants of river discharge at various time and space scales, and analyse their impact on society and economy, also accounting for feedback mechanisms. The focus will be on continuous transient scenarios from the 1960s up to 2050.	2008-2012
CIRCE	Climate Change and Impact Research: the Mediterranean Environment	The CIRCE project aimed at reducing vulnerability to climate change in the Mediterranean region. Its comprehensive assessment of climate change impacts in this region, the first ever produced, provides policy-makers and the public with information on current and potential impacts, including health, and with ways to modify services and infrastructure to respond to the climate change challenge.	2006-2011
Viroclime	Impact of Climate Change on the Transport, Fate and Risk Management of Viral Pathogens in Water	The use of hydrological models to determine the effects of climate change on the variation in viral flux, and therefore in risk associated with viral disease comprises a novel approach to the management of water-related disease. Tools developed in previous EU Projects will be used to conduct case studies on five selected sites (in Sweden, Spain, Hungary, Greece and Brazil) vulnerable to climate change (principally rainfall events), and the empirical baseline data accrued will be used in mathematical models constructed to estimate changes in exposure under defined conditions.	2011-2013
EDENext	Biology and control of vector-borne diseases in Europe	EDENext builds on the concepts, methods, tools and results of the earlier EDEN project (Emerging diseases in a changing European environment). It is using the same general approach of understanding and explaining biological, ecological and epidemiological processes in order to develop a set of state-of-the-art methods and tools to improve prevention, surveillance and control of vector	2011-2014

Acronym and Link	Project title	General aim	Duration
		populations and VBD.	
WEATHER	Weather Extremes – Impacts on Transport Systems and Hazards for European Regions	The WEATHER project aims at analysing the economic costs of climate change on transport systems in Europe and explores ways for reducing them in the context of sustainable policy design.	2010-2012
EWENT	Extreme weather events on EU networks of transport	The objective of the EWENT project is to assess the impacts and consequences of extreme weather events on EU transport system.	2010-2012
KULTURISK	Knowledge-based approach to develop a culture of risk prevention	Project objectives are a critical and comprehensive review of static and dynamic measures to prevent water-related hazards with special focus on the importance of risk communication techniques; the development of a risk-based methodology for the evaluation and accounting of risk prevention measures; the demonstration that prevention measures are more effective from a social and economic point of view than post-disaster recovery for different types of water-related risks characterised by different temporal and spatial scales and different socio-economic contexts within Europe and promotion of a culture of risk prevention by using the KULTURisk outcomes as examples.	2011-2013
BIOFRESH	Biodiversity of freshwater ecosystems: Status, trends, pressures, and conservation priorities	Biofresh aims to build a global information platform for scientists and ecosystem managers with access to all available databases describing the distribution, status and trends of global freshwater biodiversity.	2009-2014
CLIMSAVE	Climate change integrated assessment methodology for cross-sectoral adaptation and vulnerability in Europe	CLIMSAVE will develop and apply an integrated methodology for stakeholder-led, climate change impact and vulnerability assessment that explicitly evaluates regional and continental scale adaptation options, and cross-sectoral interactions between the key sectors driving landscape change in Europe (agriculture, forests, biodiversity, coasts/floodplains, water resources, urban development and transport).	2010-2013
CCTAME	Climate change - terrestrial adaption and mitigation in Europe	The project will assess the impacts of agricultural, climate, energy, forestry and other associated land-use policies, considering the resulting feed-backs on the climate system. Geographically explicit biophysical models together with an integrated cluster of economic land-use models will be coupled with regional climate models to assess and identify mitigation and adaptation strategies in European agriculture and forestry. The role of distribution and pressures from socio-economic drivers will be assessed in a geographically nested fashion.	2008-2011
IMPRINTS	Improving preparedness and risk management for flash floods and debris flow events	The aim of IMPRINTS is to contribute to reduce loss of life and economic damage through the improvement of the preparedness and the operational risk management for Flash Flood and Debris Flow [FF/DF] generating events, as well as to contribute to sustainable development through reducing damages to the environment. To achieve this ultimate objective the project is oriented to produce	2009-2012

Acronym and Link	Project title	General aim	Duration
		methods and tools to be used by emergency agencies and utility companies responsible for the management of FF/DF risks and associated effects.	
CLIWASEC	Cluster - Climate-Water-Security	The CLIWASEC Cluster, "Climate Change Impacts on Water and Security (in Southern Europe and neighbouring regions)" has been established among three FP7 Research Projects which were selected for funding through the 2009 FP7 Call for proposals: CLIMB and WASSERMed, which address Theme 6 ("Environment, including Climate Change), and CLICO, addressing Theme 8 ("Socioeconomic Sciences and Humanities"). The main objective of the Cluster, which brings together a critical mass of scientists from 44 partner institutions, is to identify and foster scientific synergies and to establish a more efficient policy outreach strategy, also forming a comprehensive representation of issues faced in the Mediterranean region.	since 2010
ArcRisk	Arctic health risks: Impacts on health in the Arctic and Europe owing to climate-induced changes in contaminant cycling	ArcRisk is looking at the linkages between environmental contaminants, climate change and human health – aimed at supporting European policy development in these areas. The Arctic setting provides unique opportunities for research in these fields.	2009-2013
CLEAR	Climate change, environmental contaminants and reproductive health	The key questions to be addressed are, firstly, how may climate change influence human exposure to widespread environmental contaminants and, secondly, how may contaminants impact occurrence of reproductive disorders as sensitive indicators of health? To provide affirmative answers to these questions the proposal will as a first step identify and describe mechanisms by which a changing climate may affect the exposure of Arctic and other human populations to contaminants through change in chemical use and emissions, delivery to the arctic ecosystem as well as processing within the arctic physical environment and human food chain..	2009-2013
DROUGHT-R&SPI	Fostering European Drought Research and Science-Policy Interfacing	Drought-R&SPI will enhance the understanding of the: 1.Drought as a natural hazard, incl. climate drivers, drought generating processes and occurrences 2.Environmental and socio-economic impacts, and 3. Vulnerabilities, risks and policy responses, incl. the further development of drought management plans in support of EU and other international policies, e.g. UN/ISDR-HFA. The project will address the past and future climate, link science and science policy dialogue across scales and across a range of affected sectors.	2011-2014
SOILSERVICE	Conflicting demands of land use, soil biodiversity and the sustainable delivery of ecosystem	European soil biodiversity is pivotal for delivering food, fibre and bio-fuels and carbon storage. However, the demand is greater than the amount of soil available, as production of bio-fuels competes	2008-2012

Acronym and Link	Project title	General aim	Duration
	goods and services in Europe	with areas for food production and nature. Moreover, intensified land use reduces soil biodiversity and the resulting ecosystem services. SOILSERVICE will value soil biodiversity through the impact on ecosystem services and propose how these values can be granted through payments.	
RAMSES	Reconciling Adaptation, Mitigation and Sustainable Development for Cities	RAMSES aims to develop methods, tools and case studies to design strategies, quantify costs and evaluate the impacts of adaptation to climate change in cities. In detail, it aims to (i) develop a high level climate risk assessment for European cities, (ii) extend existing urban integrated assessment modelling to include pluvial flooding, evaluation of impacts on the urban economy of extreme events, and air quality and health issues, (iii) apply (and adapt) our integrated assessment facility for new city case studies – including one international location, and (iv) test a range of adaptation strategies to identify how best to reduce risks in cities and inform the design of transitions to more sustainable urban environments.	2012-2017
TOPDAD	Tool-supported policy-development for regional adaptation	TOPDAD focuses on the development of state-of-the-art socio-economic methods and tools to support the integrated assessment of climate change impacts and adaptation decision-making. Emphasis is placed on the energy, transport, tourism sectors, but also on the health, environment and the socioeconomic domains. The toolset to be developed by the project will support the estimation of the multiplier effect of initial damage throughout an economy and the rate of recovery of that economy following a climate event or long term changes.	2012-2016
BASE	Bottom-up Climate Adaptation Strategies towards a Sustainable Europe	BASE focuses on reconciling the bottom-up nature of adaptation with top-down strategic policy making through novel combinations of models and qualitative analyses. Through the analysis of over 20 cases, the project will aim at improving adaptation knowledge availability, integration and utilisation, at the promotion and strengthening of stakeholder participation in adaptation decisions and policies, and at supporting coherent, multi-level and multi-sector adaptation policy development.	2012-2016

As of 2014 the new EU Framework Programme for Research and Innovation "Horizon 2020" will tackle 'societal challenges' – i.e. concerns of society/EU policy objectives (climate, environment, energy, transport, etc.) that cannot be addressed without innovation. It aims at bridging the gap between science and the market by coupling research to innovation. Climate-related expenditure, including adaptation and mitigation, should exceed 35 % of the overall Horizon 2020 budget (over € 70 billion). To achieve this, climate action will be integrated across the whole of Horizon 2020. Furthermore, two out of eight challenges identified will specifically address the needs emerging from climate challenges, from observation and modelling to climate services and adaptation tools and solutions.

The Joint Research Centre (JRC) is the scientific and technical arm of the European Commission. It is providing scientific advice and technical know-how to support a wide range of EU policies such as climate change adaptation. JRC has presented an overview on research carried out in order to support the EU climate change policy, taking into account support for mitigation and adaptation[130]. These include:

- Studies on the economic impacts of climate change in the EU (PESETA I and PESETA II[131]). The main purpose of the PESETA I study was to make a consistent physical and economic assessment of the impacts of climate change in Europe at the end of the 21st century for various sectors.
- Support to Climate-ADAPT by providing data and content from in-house sources such as the European Forest Data Centre, European Database of Vulnerabilities, etc.
- Report on Environment and human health with one chapter on climate change (joint JRC-EEA report)[132]

Finally, the European Environment Agency (EEA) also had a significant role in advancing the knowledge base on climate change impacts, vulnerability and adaptation in recent years. The EEA does not fund research projects but produces integrated environmental data and indicator sets, assessments and thematic analyses in order to provide a sound decision basis for environmental and climate change policies in the EU and Member States and for cooperation with candidate and potential candidate countries. Recent reports on the topic of climate change impacts, vulnerability and adaptation published by the EEA include, in chronological order:

- Regional climate change and adaptation: The Alps facing the challenge of changing water resources (2009)[133],
- SOER report 2010: Adapting to climate change (2010)[134],
- SOER report 2010: Understanding climate change (2010)[135],
- 10 messages for 2010: Climate change and biodiversity (2010)[136];
- Urban adaptation to climate change in Europe (2012)[137];
- Climate change, impacts and vulnerability in Europe (2012)[138];
- Adaptation in Europe: Addressing risks and opportunities from climate change in the context of socio-economic developments (2013)[139].

130 JRC – Joint research Centre (2011): Research at JRC in support of EU Climate change policy making. Luxembourg, 46pp.

131 http://ec.europa.eu/dgs/jrc/downloads/events/20120306-copenhagen/leen-hordjik.pdf

132 http://ies.jrc.ec.europa.eu/uploads/Environment%20and%20human%20health%20-%20joint%20EEA-JRC%20report.pdf

133 http://www.eea.europa.eu/publications/alps-climate-change-and-adaptation-2009

134 http://www.eea.europa.eu/soer/europe/adapting-to-climate-change

135 http://www.eea.europa.eu/soer/europe/understanding-climate-change

136 http://www.eea.europa.eu/publications/10-messages-for-2010-climate-change

137 http://www.eea.europa.eu/publications/urban-adaptation-to-climate-change

138 http://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012

139 http://www.eea.europa.eu/publications/adaptation-in-europe

7. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

Key developments

- The EUs provision of bilateral financial support has increased during the reporting period, peaking in 2012 at the level of USD 943 million (€734 million)[140]
- Total financial support provided by the EU in the years 2008 to 2012 amounted to USD 4 032 million (€2 967 million)
- Support to adaptation action has seen increased importance during the reporting period: in 2012, support to adaptation and mitigation are at similar levels
- Most of the climate change support provided by the EU is channelled through projects in which climate change is not the principle policy objective, thus demonstrating the success of the climate change mainstreaming efforts
- The EU has increased its focus in supporting the poorest and most vulnerable countries, which can be seen by the implementation of initiatives such as the Global Climate Change Alliance (GCCA) and the increased financial support to adaptation.

7.1. Introduction

This chapter of the EU's 6th National Communication includes information on financial resources and transfer of technology by the EU. Information on financial resources and transfer of technology by the EU's Member States can be found in their respective National Communications. However, some of the qualitative information reported also includes the Member States. In such circumstances there is a clear reference to the EU and its Member States.

Where similar information is required in NC6 and in BR1, the EU has opted to include such information in BR1 alone (the respective NC6 chapter shall refer to the relevant BR1 chapter).

7.2. Provision of new and additional resources

With the Lisbon Treaty putting the fight against poverty at the core of the EU's external and development cooperation policies, the EU is attaching increasing importance to climate finance. In this respect the EU has increased the amount of finance dedicated to mitigation and adaptation and is climate proofing its aid that is not directly climate-related.

EU climate and development actions are largely intertwined, contributing to inclusive growth for sustainable human development which cannot be thought of without limiting climate change. The EU promotes a common and comprehensive approach to financing for development, including climate change actions as part of the "Agenda for Change". We emphasise mutually reinforcing climate and development co-benefits. One Euro or one Dollar spent on climate or climate-related objectives should serve multiple

140 The Exchange rates used in this report are those published by the OECD Statistics service. EUR to USD in 2007: 0.73; 2008: 0.684; 2009: 0.72; 2010: 0.755; 2011: 0.719; 2012: 0.778.

purposes, such as energy, development and poverty eradication, biodiversity or resilience to climate impacts to take a few examples. The EU emphasises the catalytic role that ODA has in facilitating increased financing from other sources. Thus, the EU has strengthened efforts to create instruments and platforms that support leveraging of financing from multiple sources, in particular from the private sector.

The implementation of climate action at national and regional level is supported by geographical instruments. These mechanisms include the European Development Fund (in the ACP countries), the Development Cooperation Instrument (in Asia, Latin America and South Africa), and the European Neighborhood & Partnership Instrument (in the EU's neighbor regions). These are complemented by a specific thematic programme on environment and sustainable management of natural resources, including energy that addresses global environmental challenges as well as issues of common interest to groups of countries that do not belong to a single region. Further, the EU has established a number of innovative initiatives and facilities such as the Global Climate Change Alliance (GCCA), the Forest Law Enforcement, Governance and Trade (FLEGT), the Global Energy Efficiency and Renewable Energy Fund (GEEREF) and the EU water facility.

The EU has increased the amount of financial support to mitigation and adaptation action in developing countries. Between 2008 and 2012, the EU commitments to support climate relevant activities in developing country amounted to USD 4 032 million (€2 967 million). The support has been increasing from USD 435 million (€318 million) in 2007 (as reported in the previous NC) to USD 943 million (€734 million) in 2012. These resources are considered to be "new and additional resources"; meaning that they were committed after and not included in the 5th National Communication report.

Further, during the reporting period the EU and its Member States delivered on its commitments to provide fast start finance: EU and its Member States committed €7 300 million for fast-start finance for tackling climate change over the period 2010-2012, thus exceeding the goal of €7 200 million, despite a difficult economic situation and budgetary constraints.

7.3. Assistance to developing country Parties that are particularly vulnerable to climate change

The adaptation challenge is very unevenly distributed among countries and regions depending on their specific exposure, vulnerability and capacity to adapt. Developing countries, and in particular the least developed countries as well as SIDS and African countries will face the biggest challenge because poverty and low levels of development are major factors determining vulnerability and capacity to adapt. This is why the EU has taken steps to strengthen its support to adaptation in the field. This has happened by integrating adaptation considerations into existing and new development assistance programmes and through engagement in new areas of work such as combined adaptation and disaster risk reduction efforts. Further, the EU has increased its support to support those countries and regions that are most vulnerable to climate change by building the human and technical capacity needed to tackle it.

The assistance provided by the EU for the purpose of assisting developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting the costs of adaptation to those adverse effects has been increasing from USD 125 million (€86 million) in 2008 to USD 710 million (€553 million) in 2012, to reach a cumulative amount of USD 2 246 million (€1 670 million) in the period 2008-2012[141].

The Cancun Adaptation Framework adopted in 2010 under UNFCCC provides a framework for action on adaptation. The EU supports the work under UNFCC to accompany the Least Developed Countries to formulate and implement National Adaptation Planning processes that integrate adaptation into the countries national and sector development strategies and plans.

EU support to adaptation thus builds on available vulnerability assessments, and on the needs and priorities expressed by the developing countries in their national development and adaptation planning processes, including National Adaptation Programmes of Action (NAPAs).

The EU also strongly backs the UNFCCC Nairobi Work Programme (NWP) on adaptation, which aims to improve our knowledge of the impacts of climate change and of countries' vulnerabilities, adaptation needs and responses.

7.3.1. Focusing climate support on LDCs and SIDS: the Global Climate Change Alliance (GCCA)

In 2007, the EU pioneered the establishment of the Global Climate Change Alliance (GCCA). The GCCA is now a well-established mechanism and a reference for future actions. Back in 2008, the GCCA was working with four countries. By the end of 2012, over 45 GCCA programmes were either up and running or in preparation in more than 35 countries and 8 sub-regions within an envelope of € 290 million.

The GCCA works hard to support those poorer countries and regions which are the most vulnerable to climate change by building the human, technical and financial capacity needed to tackle it. This support particularly focuses on the Least Developed Countries (LDCs) and Small Island Developing States (SIDS).

Examples of actions are multiple and range from mangrove restoration in Guyana, to increased land tenure security in Rwanda to improved early warning and monitoring in Vanuatu, with a common leitmotiv of securing livelihoods and protecting communities at risk.

141 These figures include support projects that have climate change as their principal objective (100% of budget included) and projects that have climate change as a significant objective (40% of budget included). See section 7.4 below and the relevant section in the Biennial Report for further details on the methodology used to calculate overall support.

The GCCA's technical support focuses in five priority areas.

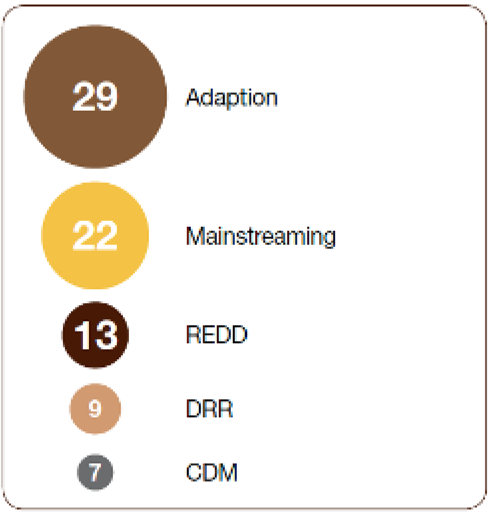
Figure 7-1 The five priority areas of the GCCA

1. **Mainstreaming climate change into poverty reduction and development efforts** The GCCA supports the systematic integration of climate change considerations into national development planning, from policymaking and budgeting to implementation and monitoring. This priority area, which focuses on institutional strengthening, is often combined with adaptation and DRR.
2. **Adaptation.** The GCCA aims to help improve knowledge about the effects of climate change and the design and implementation of appropriate adaptation actions, in particular in the water and agriculture sectors, which reduce the vulnerability of the population to the impacts of climate change. The GCCA builds on National Adaptation Programmes of Action (NAPAs) and other national plans.
3. **Reducing Emissions from Deforestation and Forest Degradation (REDD).** In LDCs 60 per cent of emissions originate from land use change, primarily deforestation. The GCCA supports solutions to reduce carbon dioxide (CO_2) emissions from deforestation and create incentives for forest protection, while preserving livelihoods and ecosystems depending on forests.
4. **Enhancing participation in the global carbon market.** The GCCA aims to promote a more equitable geographic distribution of financing opportunities linked to the carbon market by building the capacities of partner countries to access this source of funding, particularly in the field of energy.
5. **Disaster Risk Reduction** (DRR). The GCCA seeks to help developing countries to prepare for climate-related natural disasters, reduce their risks and limit their impacts.

Source: Paving the Way for Climate Compatible Development: Experiences from the GCCA

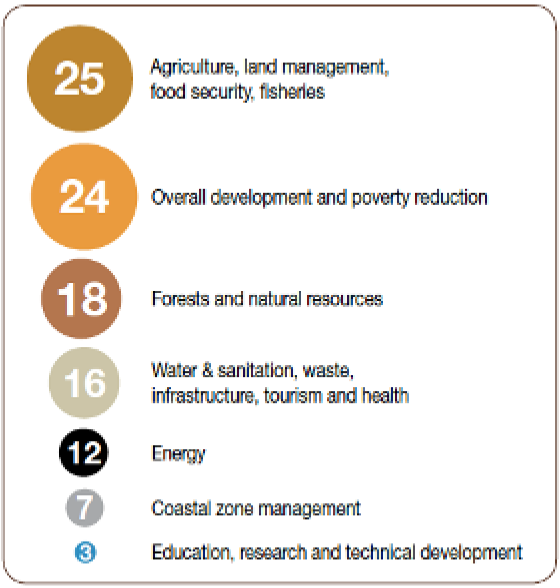
Although the scope of the GCCA is wider than solely adaptation, the figures below demonstrate a clear focus on adaptation and on those sectors of most relevance to LDCs and SIDS.

Figure 7-2 Distribution of priority areas supported by the GCCA to 2012 (number of interventions)



Source: Paving the Way for Climate Compatible Development: Experiences from the GCCA

Figure 7-3 Distribution of sectors supported by the GCCA to 2012 (number of interventions)



Source: Paving the Way for Climate Compatible Development: Experiences from the GCCA

7.4. Provision of financial resources through bilateral channels

For detailed information on the provision of support by the EU in 2011 and 2012, please refer to the relevant sections of the BR (chapter 6).

The approach used by the EU to track its bilateral provision of climate finance, technology and capacity building support is based on the OECD DAC system of Rio markers that has been integrated into the EUs own monitoring and reporting system.

According to the Rio marker methodology an activity is classified as climate change mitigation-related (either marked as 'Principal' or 'Significant') if it "contributes to the objective of stabilisation of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system by promoting efforts to reduce or limit GHG emissions or to enhance GHG sequestration."

As regards adaptation, an aid activity is marked as relevant if it "intends to reduce the vulnerability of human or natural systems to the impacts of climate change and climate-related risks, by maintaining or increasing adaptive capacity and resilience. This encompasses a range of activities from information and knowledge generation, to capacity development, planning and the implementation of climate change adaptation actions."

The Rio markers are policy makers, and were originally not intended for accurate quantification of flows to support policy goals. Therefore, an activity can have more than one principal or significant policy objective (i.e. it can be marked for several Rio markers; mitigation, adaptation and other Rio conventions such as Biodiversity and Desertification).

The EU has adopted the following approach to "translate" the Rio marked data into estimated climate finance flows:

- If an activity is marked as principal for mitigation or adaptation, 100% of the support is considered and reported as climate finance;
- If an aid activity is marked as significant for mitigation or adaptation, then only 40% of the support is considered and reported as climate finance.
- To avoid double counting, any activity can only count as 100%, 40% or 0%. If an activity is marked for both mitigation and adaptation, only the highest marking will count when calculating the total climate relevant financial contributing of the activity.

As can be seen in *Figure* 7-4 and *Figure 7-5*, the total support provided by the EU during the reporting period shows a clear increasing trend, peaking in 2009 and 2012 (at USD 1003 / € 722 million and USD 943 / €734 million respectively), with support provided more than doubling between the first and the last years of the reporting period (USD 460 / €315 million in 2009 and USD 943/ €734 million in 2012).

Figure 7-4 - *Total climate change relevant support provided by the EU between 2008 and 2012 (USD 1000)*

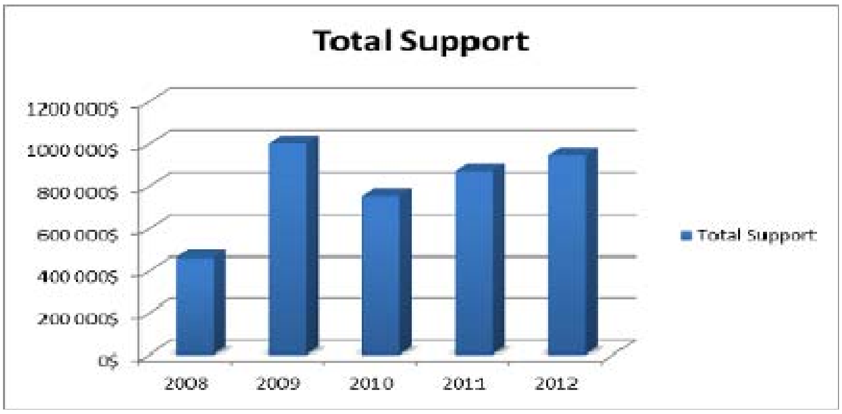


Figure 7-5- Total climate change relevant support provided by the EU between 2008 and 2012 (EUR 1000)

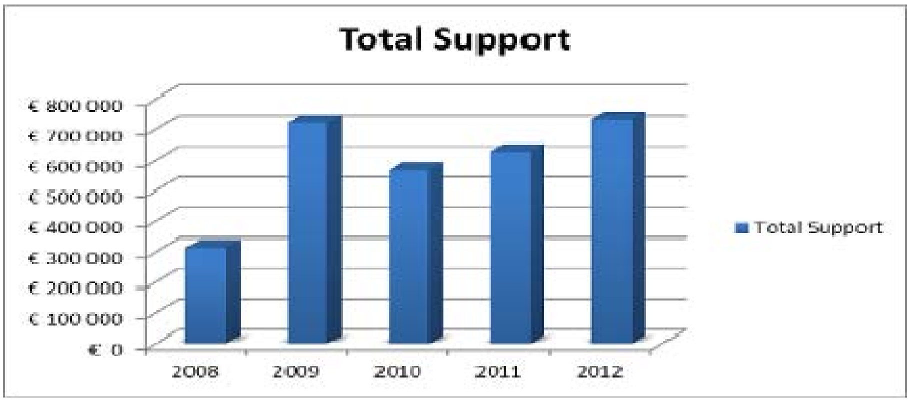


Figure 7-6 and *Figure 7-7* provide a graphic overview of the support to mitigation and adaptation relevant activities respectively (using the allocation methodology described above). Please note that the figures for mitigation and adaptation should not be added as some activities may contribute to both mitigation and adaptation. The figures

demonstrate that the EU has been successful in increasing the support to adaptation in both absolute and relative terms.

Support to adaptation and mitigation was in 2012,at a similar level (USD 713 / €554 million for mitigation and USD 711 / €553 million for adaptation), with the largest increase in the reporting period for adaptation (from USD 126 / €86 million in 2008 in relation to adaptation, and from USD 438 / €300 million for mitigation in the same year).

Figure 7-6 - Support to mitigation and to adaptation (USD 1000)

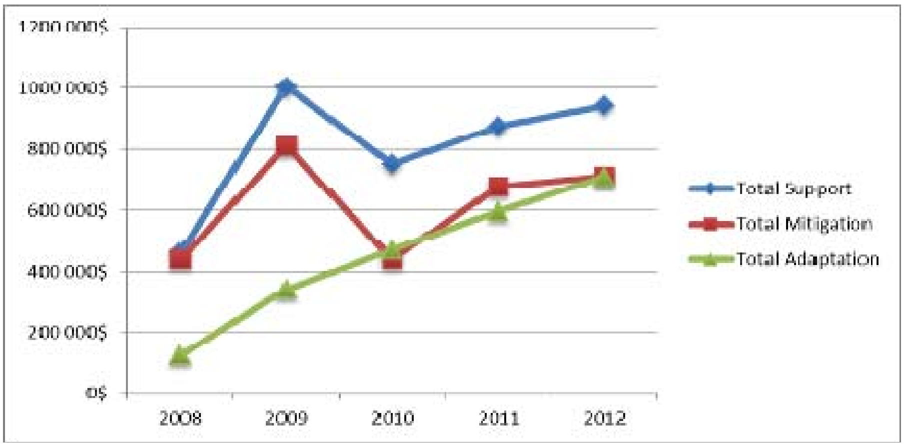


Figure 7-7- Support to mitigation and to adaptation (EUR 1000)

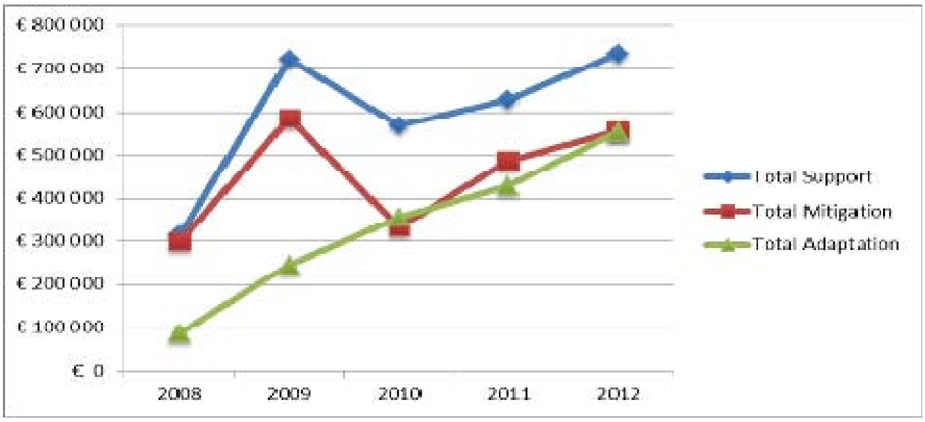


Figure 7-8 and *Figure 7-9* show that both with regards to mitigation and to adaptation, the climate change relevant support provided by the EU in the period 2008-2012 is integrated in projects and programmes that serve multiple objectives, i.e. projects in which climate change in Rio marker terms is a significant, but not a principal policy objective. These results are a clear demonstration of the EU and partner countries' efforts in mainstreaming climate change into other sectoral cooperation projects (figures for Mitigation 1 and 2 and Adaptation 1 and 2 have been derived through the application of the methodology explained above).

Figure 7-8 – Support provided through projects and initiatives where climate change is a principal (2) or significant (1) policy objective (2008-2012) (USD 1000).

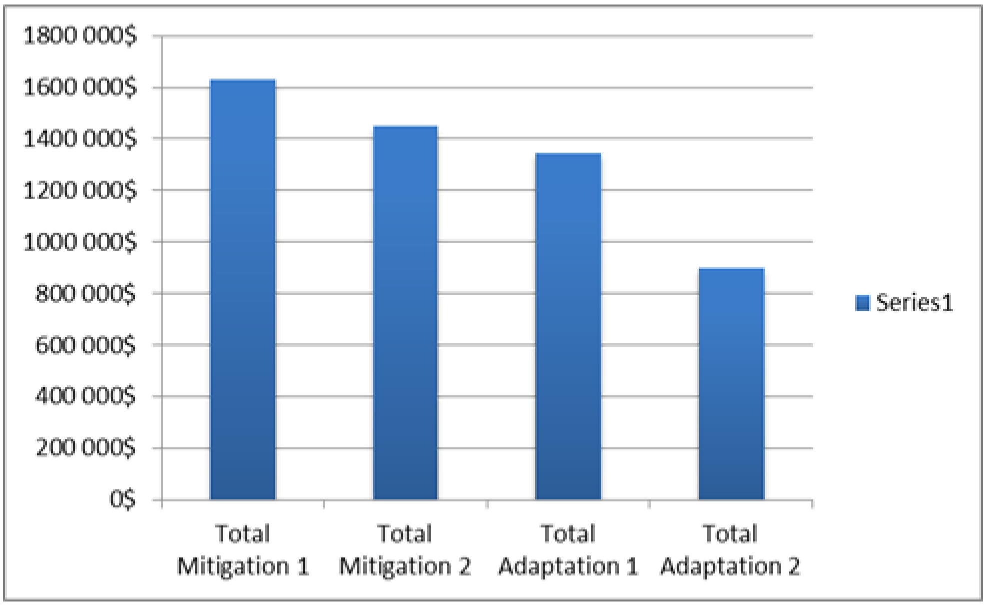
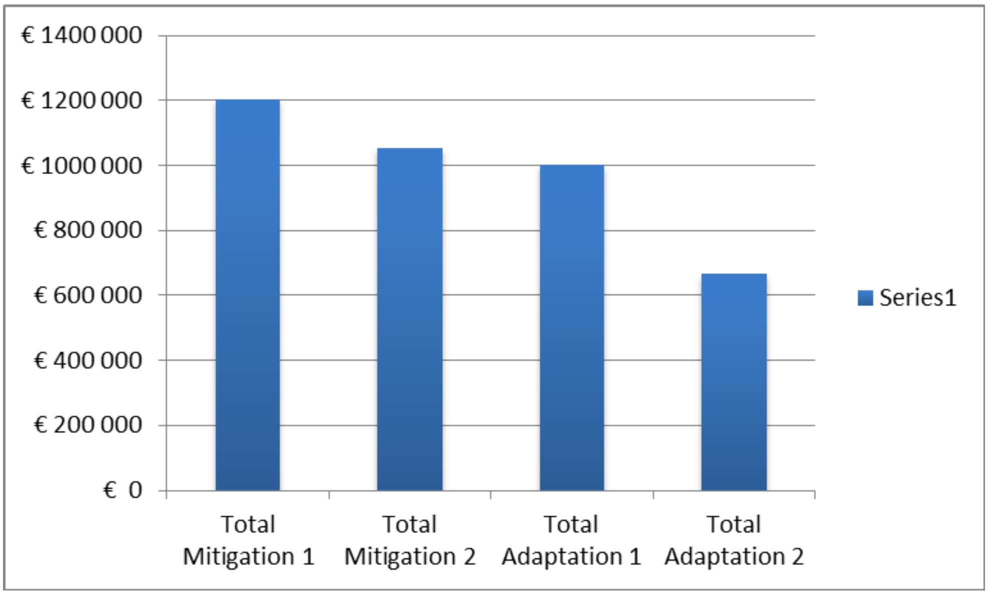


Figure 7-9 - Support provided through projects and initiatives where climate change is a principal (2) or significant (1) policy objective (2008-2012) (EUR 1000).



The EU has been making an important effort to ensure that its climate change mitigation and adaptation projects cover all the key sectors, namely those included in the reporting guidelines (Energy, Transport, Forestry, Agriculture, Waste Management/Water and Sanitation and Industry) and capacity building, coastal zone management and other vulnerability assessments specifically on what adaptation to climate change is concerned.

Table *7-1*(for the years 2008 to 2010) and Table *7-2* (for the years 2011 and 2012)[142] show, that the highest level of support goes for cross-cutting projects (those projects which impact more than one sector) and to the energy sector (in Table *7-3*, the energy sector includes also cross-cutting projects). It may also be noted that while the forestry sector has maintained a relatively high level of support, the support provided to the agriculture sector has shown an increasing trend throughout the reporting period.

142 Data for 2008 to 2010 and for 2011 and 2012 are presented differently due to the different reporting formats used in the National Communication and in the Biennial Report – note that details in relation to support provided in 2011 and 2012 are reported in the Biennial Report alone.

Table *7-1* - Provision of mitigation support by sectors for the years 2008-2010 (EUR and USD 1000)

	Mitigation											
	Energy		Transport		Forestry		Agriculture		Waste Management		Industry	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
2008	€ 150 985	220 738$	€ 0	0$	€ 110 361	161 347$	€ 9 049	13 230$	€ 12 350	18 056$	€ 17 150	25 074$
2009	€ 508 558	706 331$	€ 0	0$	€ 64 066	88 981$	€ 8 994	12 492$	€ 0	0$	€ 2 000	2 778$
2010	€ 220 638	292 236$	€ 600	795$	€ 96 345	127 609$	€ 15 200	20 132$	€ 0	0$	€ 0	0$
TOTAL	€ 880 181		€ 600	795$	€ 270 772	377 937$	€ 33 243	45 854$	€ 12 350	18 056$	€ 19 150	27 851$

* Energy includes cross cutting/multi-sector or other

Table *7-2*- Provision of adaptation support by sectors for the years 2008-2010 (EUR and USD 1000)

	Adaptation					
	Capacity Building		Coastal Zone Management		Other Vulnerability Assessments	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
2008	€ 16 164	23 632$	€ 120	175$	€ 69 797	102 043$
2009	€ 35 806	49 731$	€ 36 821	51 140$	€ 172 990	240 263$
2010	€ 45 260	59 947$	€ 0	0$	€ 311 033	411 964$
TOTAL	€ 97 230	133 310$	€ 36 941	51 315$	€ 553 820	754 270$

Table *7-3* - Provision of support by sectors for the years 2011 and 2012

	Mitigation															
	Energy		Transport		Industry		Agriculture		Forestry		Water and sanitation		Cross-cutting		Other	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
2011	€ 40 709	56 620$							€ 9 280	12 907$			€ 35 861	49 876$		
2012	€ 148 138	190 409$	€ 13 600	17 481$			€ 2 702	3 472$			€ 12 200	15 681$			€ 8 000	10 283$
	Adaptation															
	Energy		Transport		Industry		Agriculture		Forestry		Water and sanitation		Cross-cutting		Other	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
2011			€ 8 990	12 503$			€ 64 079	89 123$			€ 7 800	10 848$	€ 4 600	6 398$	€ 3 200	4 451$
2012							€ 44 940	57 763$			€ 17 962	23 088$	€ 8 000	10 283$	€ 8 132	10 452$
	Cross-cutting															
	Energy		Transport		Industry		Agriculture		Forestry		Water and sanitation		Cross-cutting		Other	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
2011							€ 16 520	22 976$	€ 34 000	47 288$	€ 12 800	17 803$	€ 390 532	543 160$		
2012	€ 3 595	4 621$					€ 56 036	72 026$	€ 79 800	102 571$	€ 69 684	89 568$	€ 242 473	311 662$	€ 18 480	23 753$
TOTAL	€ 192 443	251 650$	€ 22 590	29 984$	€ 0	0$	€ 184 277	245 361$	€ 123 080	162 765$	€ 120 446	156 988$	€ 681 466	921 379$	€ 37 812	48 939$

Table *7-4* shows the EU's climate finance by regions As can be seen, Africa attracts most of the support provided by the EU, summing a total of USD 1 698 / €1 252 million in the reporting period.

Table *7-4*- Provision of support by region

	ACP		Africa		Asia		Caribbean		Eastern Europe and Central Asia		Latin America		Oceania		Unspecified LDCs		Global	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
2008			€ 185 720	271 521$	€ 82 443	120 531$			€ 38 156	55 784$	€ 16 401	23 979$	€ 4 509	6 592$			€ 58 747	85 888$
2009	€ 348 800	484 444$	€ 185 191	257 209$	€ 50 784	70 533$	€ 16 867	23 426$	€ 34 438	47 830$	€ 64 218	89 192$	€ 40 770	56 625$			€ 88 168	122 455$
2010	€ 81 600	108 079$	€ 303 215	401 609$	€ 132 008	174 845$	€ 4 300	5 695$	€ 15 600	20 662$	€ 49 445	65 490$	€ 28 928	38 315$			€ 73 980	97 987$
2011			€ 231 639	322 168$	€ 100 880	140 306$	€ 28 034	38 990$	€ 80 600	112 100$	€ 27 755	38 602$	€ 5 090	7 079$	€ 154 374	214 707$		
2012	€ 27 706	35 611$	€ 346 730	445 668$	€ 88 900	114 267$	€ 42 112	54 129$	€ 42 680	54 859$	€ 82 840	106 478$	€ 26 908	34 586$	€ 14 825	19 055$	€ 61 043	78 461$
TOTAL	€ 458 106	628 135$	€ 1 252 495	1 698 176$	€ 455 015	620 482$	€ 91 313	122 240$	€ 211 474	291 235$	€ 240 659	323 741$	€ 106 205	143 197$	€ 169 199	233 762$	€ 281 938	384 791$

Table *7-5* and Table *7-6* below illustrate the key figures of the support provided by the EU during the reporting period. It should be noted that figures for "Total Mitigation" and "Total Adaptation" cannot be added, as they have been derived using the methodology explained above. Summing these two figures will result in a figure higher than the Total support provided (however, summing Mitigation 1 and Mitigation 2 shall be equal to Total Mitigation, likewise for Adaptation 1 and Adaptation 2).

Table *7-5*- Key figures of support provided (USD 1000)

	2008	2009	2010	*2011*	2012	TOTAL
Total Support	459 937$	1 002 904$	752 074$	*873 953$*	*943 114$*	4 031 982$
Total Mitigation	438 444$	810 581$	440 772$	*677 676$*	*712 725$*	3 080 198$
Total Adaptation	125 850$	341 134$	471 911$	*596 205$*	*710 682$*	2 245 783$
Total Mitigation 1	126 905$	349 582$	175 633$	*432 891$*	*543 413$*	1 628 423$
Total Mitigation 2	311 539$	461 000$	265 139$	*244 784$*	*169 312$*	1 451 775$
Total Adaptation 1	91 242$	159 398$	271 865$	*367 610$*	*455 763$*	1 345 878$
Total Adaptation 2	34 609$	181 735$	200 046$	*228 595$*	*254 920$*	899 905$

Table *7-6* - Key figures of support provided (EUR 1000)

	2008	2009	2010	*2011*	2012	TOTAL
Total Support	€ 314 597	€ 722 091	€ 567 816	*€ 628 372*	€ 733 743	€ 2 966 618
Total Mitigation	€ 299 896	€ 583 619	€ 332 783	*€ 487 249*	€ 554 500	€ 2 258 046
Total Adaptation	€ 86 082	€ 245 616	€ 356 293	*€ 428 672*	€ 552 911	€ 1 669 573
Total Mitigation 1	€ 86 803	€ 251 699	€ 132 603	*€ 311 249*	€ 422 775	€ 1 205 128
Total Mitigation 2	€ 213 093	€ 331 920	€ 200 180	*€ 176 000*	€ 131 725	€ 1 052 918
Total Adaptation 1	€ 62 409	€ 114 767	€ 205 258	*€ 264 312*	€ 354 583	€ 1 001 329
Total Adaptation 2	€ 23 672	€ 130 849	€ 151 035	*€ 164 360*	€ 198 328	€ 668 244

The tables below are a detailed description of the support provided to each of our developing country partners for the years 2008 to 2010. Such detailed reporting for the years 2011 and 2012 is included in the Biennial Report and the CTF Appendix

Table *7-7*- Bilateral and regional financial contributions related to the implementation of the convention, 2008 (EUR and USD 1000)

	Mitigation												Adaptation					
Recipient Country / Region	Energy*		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coastal Zone Management		Other Vulnerability Assessments	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
Azerbaijan	€ 100	146$											€ 100	146$				
Bolivia					€ 920	1 345$	€ 206	301$									€ 368	538$
Brazil					€ 2 499	3 653$											€ 999	1 461$
Burkina Faso	€ 500	731$					€ 1 048	1 532$	€ 980	1 433$			€ 200	292$			€ 292	427$
Burma/Myanmar	€ 140	205$											€ 140	205$				
Cambodia	€ 1 082	1 581$											€ 2 205	3 224$				
Cameroon	€ 141	205$			€ 8 857	12 949 $							€ 3 599	5 262$				
Chad					€ 4 500	6 579$											€ 1 800	2 632$
China	€ 27 590	40 337 $			€ 2 169	3 171$												
Congo					€ 2 000	2 924$											€ 800	1 170$
Costa Rica					€ 1 800	2 632$												
Democratic Republic of Congo					€ 24 286	35 506 $			€ 170								€ 7 100	10 380$
Ecuador	€ 78	114$																
Ethiopia					€ 12 688	18 550 $	€ 1 994	2 915$									€ 5 873	8 586$
Georgia	€ 62	90$					€ 890	1 302$					€ 62	90$			€ 356	521$
Ghana	€ 1 917	2 802$																

Recipient Country / Region	Mitigation												Adaptation					
	Energy*		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coastal Zone Management		Other Vulnerability Assessments	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
Guatemala					€ 946	1 383$											€ 378	553$
Guinea Bissau	€ 1 692	2 473$													€ 120	175$		
Guyana					€ 116	170$							€ 116	170$				
India	€ 337	492$																
Indonesia					€ 1 797	2 627$							€ 719	1 051$				
Kazakhstan	€ 199	291$											€ 199	291$				
Kenya					€ 611	893$											€ 244	357$
Kyrgyzstan	€ 604	883$																
Lebanon									€ 7 200								€ 7 200	10 526$
Lesotho	€ 90	132$															€ 90	132$
Madagascar					€ 2 280	3 333$											€ 912	1 333$
Maldives	€ 1 520	2 222$															€ 3 800	5 556$
Morocco	€ 30 664	44 830 $																
Mozambique	€ 1 400	2 047$																
Nepal					€ 200	292$											€ 200	292$
Nicaragua					€ 614	898$											€ 246	359$
Nigeria	€ 2 298	3 360$			€ 1 119	1 637$											€ 448	655$
Pakistan	€ 25 000	36 550 $																
Palestine	€ 1 309	1 914$																
Paraguay	€ 19	28$			€ 48	70$											€ 67	98$
Samoa					€ 29	42$												

	Mitigation												Adaptation					
Recipient Country / Region	Energy*		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coastal Zone Management		Other Vulnerability Assessments	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
Sierra Leone					€ 2 400	3 509$											€ 960	1 404$
Sudan							€ 540	789$									€ 540	789$
Tajikistan	€ 644	942$																
Tanzania	€ 882	1 290$			€ 1 231	1 799$											€ 2 698	3 944$
Togo	€ 2 000	2 924$															€ 2 000	2 924$
Turks and Caicos Islands	€ 210	307$															€ 210	307$
Uganda					€ 10 000	14 620 $											€ 4 000	5 848$
Uruguay	€ 163	238$			€ 545	797$					€ 150	219,77$					€ 218	319$
Vanuatu	€ 1 280	1 871$															€ 3 200	4 678$
Regional Africa	€ 3 710	5 423$			€ 8 447	12 350 $			€ 400								€ 4 171	6 098$
Regional Asia	€ 6 305	9 217$			€ 1 000	1 462$					€ 10 000	14 619,88 $					€ 3 561	5 207$
Regional Latin America	€ 500	731$			€ 3 784	5 532$											€ 1 200	1 754$
Unspecified LDCs																		
Regional Eastern Europe and Central Asia	€ 10 801	15 791 $			€ 1 828	2 672$	€ 1 571	2 296$	€ 3 600		€ 7 000	10 233,92 $					€ 10 141	14 827$
Regional Oceania																		
Global	€ 27 750	40 571 $			€ 13 648	19 953 $	€ 2 800	4 094$					€ 8 825	12 902$			€ 5 724	8 368$

* Energy includes cross cutting/multi-sector or other

Table *7-8* - Bilateral and regional financial contributions related to the implementation of the convention, 2009 (EUR and USD 1000)

	Mitigation												Adaptation					
Recipient Country / Region	Energy		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coastal Zone Management		Other Vulnerability Assessments	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
Bangladesh	€ 3 400	4 722$			€ 10 000	13 889$											€ 25 500	35 417$
Bolivia																	€ 4 374	6 075$
Brazil					€ 4 910	6 819$												
Central African Republic					€ 1 600	2 222$											€ 1 600	2 222$
Chad																	€ 10 800	15 000$
Cuba	€ 3 000	4 167$			€ 3 000	4 167$											€ 1 200	1 667$
Ecuador					€ 960	1 333$											€ 384	533$
Ghana					€ 8 000	11 111$												
Guyana					€ 4 165	5 785$									€ 18 965	26 340$		
India											€ 2 000	2 778$						
Jamaica	€ 1 652	2 294$															€ 4 130	5 736$
Jordan	€ 10 000	13 889$																
Kiribati	€ 4 100	5 694$																
Malawi					€ 3 880	5 389$											€ 3 880	5 389$
Maldives	€ 2 700	3 750$															€ 2 700	3 750$
Mali					€ 5 650	7 847$											€ 2 260	3 139$
Marshal Islands	€ 7 576	10 522$											€ 5 776	8 022$				
Mauritius	€	69 479$															€ 3 000	4 167$

	Mitigation												Adaptation					
Recipient Country / Region	Energy		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coastal Zone Management		Other Vulnerability Assessments	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
	50 025																	
Micronesia	€ 2 988	4 150$																
Nauru	€ 2 300	3 194$																
Niue	€ 1 020	1 417$																
Palau	€ 988	1 372$																
Rwanda	€ 1 822	2 531$															€ 4 555	6 326$
Senegal	€ 1 600	2 222$															€ 4 000	5 556$
Seychelles	€ 800	1 111$															€ 2 000	2 778$
Tanzania	€ 3 200	4 444$																
Thailand	€ 1 800	2 500$																
Tuvalu	€ 1 760	2 444$															€ 1 760	2 444$
Uganda																	€ 6 000	8 333$
Vanuatu																	€ 640	889$
Venezuela																	€ 1 920	2 667$
ACP	€ 296 000	411 111 $					€ 6 400	8 889$									€ 46 400	64 444$
Africa	€ 35 505	49 313$													€ 5 993	8 324$	€ 13 620	18 917$
Asia	€ 1 600	2 222$															€ 6 484	9 005$
Caribbean					€ 2 775	3 854$											€ 1 110	1 542$
Eastern Europe and Central Asia	€ 20 175	28 021$			€ 4 400	6 111$							€ 2 053	2 851$			€ 7 810	10 847$
Latin America	€	36 028$															€ 2 600	3 611$

	Mitigation												Adaptation					
Recipient Country / Region	Energy		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coastal Zone Management		Other Vulnerability Assessments	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
	25 940																	
Oceania															€ 11 862	16 475$		
All Other	€ 28 607	39 732$			€ 14 726	20 453$	€ 2 594	3 603$					€ 27 977	38 857$			€ 14 264	19 811$

* Energy includes cross cutting/multi-sector or other

Table 7-9 - Bilateral and regional financial contributions related to the implementation of the convention, 2010 (EUR and USD 1000)

	Mitigation												Adaptation					
Recipient Country / Region	Energy		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coastal Zone Management		Other Vulnerability Assessments	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
Belize	€ 1 160	1 536 $											€ 2 900	3 841 $				
Bhutan	€ 2 240	2 967 $																
Bolivia																	€ 8 000	10 596 $
Brazil					€ 6 985	9 252 $												
Burkina Faso																	€ 5 400	7 152 $
Chad							€ 5 600	7 417 $									€ 17 800	23 576 $
China	€ 4 243	5 620 $															€ 2 400	3 179 $
Congo					€ 2 000	2 649 $												
Egypt	€ 20 000	26 490 $																
Ethiopia	€ 13 700	18 146 $											€ 13 700	18 146 $				
Guyana					€ 1 500	1 987 $											€ 600	795 $
Honduras					€ 8 400	11 126 $											€ 8 400	11 126 $
India	€ 23 400	30 993 $																
Indonesia	€ 5 125	6 788 $															€ 1 700	2 252 $
Jordan																	€ 4 000	5 298 $
Kenya					€ 920	1 219 $											€ 26 560	35 179 $
Kiribati																	€ 1 360	1 801 $
Laos																	€ 3 200	4 238 $

	Mitigation												Adaptation					
Recipient Country / Region	Energy		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coastal Zone Management		Other Vulnerability Assessments	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
Lebanon							€ 5 600	7 417 $										
Lesotho																	€ 12 800	16 954 $
Malawi																	€ 16 800	22 252 $
Malaysia	€ 600	795 $			€ 1 600	2 119 $											€ 2 200	2 914 $
Morocco	€ 20 000	26 490 $																
Mozambique	€ 6 080	8 053 $															€ 15 200	20 132 $
Namibia																	€ 7 200	9 536 $
Nepal	€ 3 200	4 238 $															€ 8 000	10 596 $
Papua New Guinea																	€ 3 688	4 885 $
Philippines	€ 1 400	1 854 $															€ 1 400	1 854 $
Solomon Islands	€ 1 120	1 483 $											€ 2 800	3 709 $				
Thailand	€ 800	1 060 $															€ 800	1 060 $
Timor Leste																	€ 9 200	12 185 $
Turkmenistan	€ 1 200	1 589 $															€ 1 200	1 589 $
Turks and Caicos Islands																	€ 4 300	5 695 $
Vietnam	€ 4 400	5 828 $																
ACP					€ 13 600	18 013 $											€ 68 000	90 066 $
Africa	€ 12 200	16 159 $			€ 51 140	67 735 $	€ 4 000	5 298 $									€ 42 515	56 311 $
Asia	€ 45 700	60 530 $															€ 10 400	13 775 $

	Mitigation												Adaptation					
Recipient Country / Region	Energy		Transport		Forestry		Agriculture		Waste Management		Industry		Capacity Building		Coastal Zone Management		Other Vulnerability Assessments	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
Eastern Europe and Central Asia	€ 7 600	10 066 $															€ 5 600	7 417 $
Latin America	€ 6 500	8 609 $											€ 5 000	6 623 $				
Oceania	€ 4 560	6 040 $															€ 15 400	20 397 $
Global	€ 35 410	46 901 $	€ 600 000	794 702 $	€ 10 200	13 510 $							€ 20 860	27 629 $			€ 6 910	9 152 $

* Energy includes cross cutting/multi-sector or other

7.5. Provision of financial resources through multilateral channels

All the cooperation by the EU is considered to be bilateral, even when the EU partners with a multilateral organization as a delivery instruments (e.g. UNEP)[143]. In that regard, the only relevant figures to be reported are those referring to the EU contributions to the UNFCCC and Kyoto Protocol, which can be seen in Table *7-10* (for ease of reference, data for the whole reporting period is included in this chapter).

Table *7-10* - Contributions to multilateral organizations

Institution or programme	Contribution (US dollars)				
	2008	2009	2010	2011	2012
Multilateral institutions:					
1. World Bank					
2. International Finance Corporation					
3. African Development Bank					
4. Asian Development Bank					
5. European Bank for Reconstruction and Development					
6. Inter-American Development Bank					
7. United Nations Development Programme					
- specific programmes					
8. United Nations Environment Programme					
- specific programmes					
9. UNFCCC	617 775$	668 231$	690 756$	709 506$	730 144$
- Supplementary Fund	75 267$	128 509$	101 891$	106 993$	95 228$
10. Other					

7.6. Activities related to transfer of technology

7.6.1. Promotion of transfer of technology and support of endogenous capacities and technologies of developing countries

For a description of steps taken to promote, facilitate and finance transfer of technology, and to support development and enhancement of endogenous capacities and technologies of developing countries, please refer to section [BR1] 6.4. of Annex 1: EU 1st Biennial Report.

7.7. Information under Article 10 of the Kyoto Protocol

For information on steps taken to promote, facilitate and finance transfer of technology, and to support development and enhancement of endogenous capacities and technologies of developing countries, please refer to section [BR1] 6.5 in EU's 1st Biennial Report.

143 For additional information, please consult the relevant section of the Biennial Report.

8. RESEARCH AND SYSTEMIC OBSERVATION

Key developments

Research is a shared competence of the EU and its Member States. Only actions coordinated at EU level are reported in the EU National Communication.

The EU contributes to Research and Systematic Observation (RSO) through the involvement of multiple actors and through a suite of instruments, tools and programmes and across multiple sectorial policies including:

- Past EU Framework Programmes (FP) for Research and Technological Development and in the present EU Framework Programmes for Innovation (Horizon 2020)
- LIFE+ (EU's funding instrument for the environment)
- Competitiveness and Innovation Framework Programme
- International Development Cooperation
- Contribution to and/or financial support for major international institutions, research initiatives and programmes such as the UNFCCC, the Intergovernmental Panel on Climate Change (IPCC) and the Global Climate Observing System (GCOS), among others.

The new EU Framework Programme for Research and Innovation (Horizon 2020), set up for the period 2014-2020, contains the objective of reaching 35% climate relevant expenditures.

8.1. Introduction

Research on climate change processes and impacts on natural resources and humankind helps us to identify and assess key drivers and improves our understanding of their interactions. The EU contributes to Research and Systematic Observation (RSO) through the involvement of multiple actors (see section 8.2.1.1), through a suite of instruments, tools and programmes and across multiple sectorial policies (see section 8.2.1.2).

The research aims to better understand the climate evolution (past, present future), identify and quantify its impact on ecosystems and humans (from local to global scales) and facilitate the design and development of cost-efficient response strategies and measures. The EU is a world leader in research and innovation, responsible for 24 % of global expenditure on research, 32 % of high impact publications and 32 % of patent applications while representing only 7 % of the population[144].

Climate change research has been carried out during previous Framework Programmes and continued during the 7th Framework Programme for Research and Technological Development (FP7), which was the EU's main instrument for funding research in Europe for the period 2007-2013. Climate research will be central in Horizon 2020, new EU Framework Programme for Research and Innovation.

144 http://ec.europa.eu/research/iscp/pdf/com_2012_497_communication_from_commission_to_inst_en.pdf

Climate change research in FP7 aimed to support projects that analyse the pressures on the environment (atmosphere, ocean, land, and cryosystems) to improve understanding of the complex climate system, also through Earth System modelling. Another key research area was assessing impacts, vulnerabilities and solutions for adapting to climate change, developing strategies for disaster risk reduction and to support a transition to a low-carbon society.

FP7's total budget exceeded €50 billion over 7 years, with an additional €2.75 billion directed to the European Atomic Energy Community (EURATOM[145]) (increased by 65% when compared to FP6 in average annual terms), distributed through grants to co-finance research activities in priority areas. In FP7 it is estimated that 15% to 20% of the whole budget (approximately € 7.5 billion to € 10 billion) was dedicated to actions supporting directly or indirectly climate change objectives.[146].

EU research programmes are open to participation from across the globe. FP7 was the multiannual regional programme for funding research in Europe and beyond – in principle all parts were open to international cooperation. It was managed by the European Commission and relied on contributions from 27 EU Member States and 14 Associated Countries[147]. All these countries could participate in the FP7, as could the countries that have an international agreement with the EU on Science & Technology[148] and those covered by the European Neighbourhood Policy[149]. Currently, 6% of participants in the FP7 come from third countries[150]. The Marie Skłodowska-Curie actions, that fund mobility and training for researchers, support participants from 80 different countries. The European Research Council (ERC), which funds researchers from anywhere in the world to do cutting-edge research in Europe, has begun a campaign to attract more participants from third countries. The Commission's in-house science service, the Joint Research Centre (JRC), also maintains close research links to organisations around the world.

In what regards the financing of RSO and while some calls are still open and a final figure cannot yet be given, a rough estimation indicates that from 2007 to 2013 in FP7 over € 800 million have been spent to support dedicated climate change research actions[151], through the Cooperation Programme[152] which provides support for research projects carried out by consortia with participants from different countries and through the funding of investigator-driven 'frontier' research awarded by the European Research Council[153] (ERC). These dedicated climate research activities are complemented by

145 http://ec.europa.eu/energy/nuclear/euratom/euratom_en.htm

146 http://ec.europa.eu/dgs/jrc/downloads/events/20120306-copenhagen/andrea-tilche.pdf

147 Albania, Bosnia & Herzegovina, Croatia, Faroe Islands, Former Yugoslav Republic of Macedonia, Iceland, Israel, Liechtenstein, Moldova, Montenegro, Norway, Serbia, Switzerland, Turkey

148 Argentina, Australia, Brazil, Canada, China, Egypt, India, Japan, Republic of Korea, Mexico, Morocco, New Zealand, Russia, South Africa, Tunisia, Ukraine and the United State of America

149 Algeria, Armenia, Azerbaijan, Belarus, Georgia, Jordan, Palestinian-administrated areas and Syrian Arab Republic

150 For the purpose of this document Third Country Participants are all those participants who are established in a non EU country, which is not associated to the Seventh Framework Programme of the European Community for Research, Technological Development and Demonstration Activities (FP7) ftp://ftp.cordis.europa.eu/pub/fp7/docs/guideline-third-country-participants_en.pdf

151 European Research on Climate Change Funded by the Seventh Framework Programme
http://bookshop.europa.eu/en/research-on-climate-change-pbKI0313365ISBN 978-92-79-31251-9
doi 10.2777/30474

152 http://cordis.europa.eu/fp7/cooperation/

153 http://erc.europa.eu/

other activities funded by the Framework Programme, notably on energy and transport, which contribute to the identification and development of mitigation technologies and options through energy efficiency, renewable energy, carbon capture and storage and more environmentally friendly transport systems.

In the scope of Horizon 2020 European researchers will be free to cooperate with their third country counterparts on topics of their own choice. This will be complemented by targeted activities in which cooperation will be sought on particular topics and with well-identified partners. The strategy will also promote common international principles in research and innovation, such as that on research integrity, gender awareness and open access, in order to provide the global research and innovation community with a level playing field in international cooperation. The strategy also aims at having research and innovation contribute more strongly to the Union's external policies. The Commission will report on progress every two years[154].

Considering the crucial role of research and innovation in tackling climate change[155], ‘climate action, resource efficiency and raw materials' has been identified as one of the societal challenges that will drive the activities from research to market in Horizon 2020. Low-carbon solutions in the energy system, mobility and transport will be the focus of two other societal challenges. The programme marks a new emphasis on innovation-related solutions and it is expected that around 35% of the Horizon 2020 budget of around €70 billion will be climate related expenditure.

Research is a shared competence with the Member States. A strong partnership will be ensured by building on the work of the Strategic Forum for International Science and Technology Cooperation (SFIC)[156]. SFIC is a strategic forum and an advisory body to the Council and the Commission with a view to implementing a European Partnership in the field of international scientific and technological cooperation (S&T cooperation). Member States and the Commission are members of the Forum while countries associated to the FP7 have an observer's status. SFIC's objective is to facilitate the further development, implementation and monitoring of the international dimension of the European Research Area (ERA) by the sharing of information and consultation between the partners with a view to identifying common priorities which could lead to coordinated or joint initiatives, and coordinating activities and positions vis-à-vis third countries and within international fora[157].

There are two types of RSO actions that can be distinguished: those that are implemented by MS and others that are coordinated at EU level. The latter form the scope of this chapter which begins by describing in general terms the policy and funding of RSO, the EU’s participation in GCOS’s activities and finally presents some of most emblematic RSO projects.

154 http://europa.eu/rapid/press-release_IP-12-967_en.htm

155 COMMISSION STAFF WORKING PAPER, IMPACT ASSESSMENT Accompanying the Communication from the Commission 'Horizon 2020 - The Framework Programme for Research and Innovation'; COM(2011) 808 final

156 http://europa.eu/rapid/press-release_IP-12-967_en.htm?locale=en

157 http://ec.europa.eu/research/iscp/pdf/st01352.en13.pdf

8.2. General policy on and funding of research and systematic observation

8.2.1. General policy on RSO

Research on climate change has an illustrious European history. In the late 19th century, Swedish Svante Arrhenius proposed a theory to explain ice ages and developed the first arguments to describe what is now widely known as the greenhouse effect. Germany's Wladimir Köppen subsequently laid the foundations for climatology, while in the late 1930s it was the British scientist Guy Stewart Callendar who confirmed the link between rising carbon dioxide levels and global temperature. Climate change research has been present in the EU's FP since the 1980s – FP1 (1984–1988). In the 1990s, research concentrated on the carbon cycle and ecosystem functioning. Since then climate change research has proliferated in size and complexity. FP5 (1998-2002) supported projects in the action "Global Change, Climate and Biodiversity", while FP6 (2003-2006) backed many integrated projects on climate change, with research areas ranging from atmospheric pollutants to the prediction of climate change and its impacts. In FP7, climate relevant research is conducted with across various themes such as 'Environment (including Climate Change)', 'Energy' and 'Food, Agriculture, Fisheries and Biotechnology'. Targeted climate change research falls under the theme 'Environment (including climate change)', 'Activity 6.1 Climate Change, Pollution and Risks'.

Climate change research findings and IPCC's assessments have provided the scientific basis for global policy actions, such as the UNFCCC, the Kyoto Protocol and the international post-2012 process launched at the UNFCCC conference in Bali (December 2007). The EU – together with its international partners – now aims to forge at a new comprehensive global agreement tackling climate change which will set priorities, commitments and goals for the near- to long-term.

Research and innovation contribute to a package of external policies covering, for example, trade, enlargement, development and the Common Foreign and Security Policy (CFSP). In its 2012 Communication on 'Enhancing and focusing EU international co-operation in research and innovation'[158], the European Commission emphasised the importance of adequate "scale and scope" in international co-operation activities which will allow us to make a real difference.

Different countries are developing different scientific and research strengths. By combining research teams from all over the world, access to new data and scientific results and innovative solutions can be enhanced. For Europe, cooperation means accessing new sources of knowledge, attracting fresh scientific talent and investment, agreeing on common procedures for conducting research and developing common standards.

Article 189 of the TFEU, conferring on the Union a shared space competence which it pursues alongside that of the Member States, needs to be seen in this context. The Union thus has a specific mandate to draw up a European space policy, and, "to this end, it may promote joint initiatives, support research and technological development and coordinate the efforts needed for the exploration and exploitation of space". To this end, "...Parliament and the Council shall establish the necessary measures, which may take the form of a European space programme".

158 COM(2012) 497 final

In this new framework, Europe's space policy is aimed at achieving the following objectives: promoting technological and scientific progress, stimulating industrial innovation and competitiveness, enabling European citizens to reap the benefits of space applications and raising Europe's profile on the international stage in the area of space. In order to achieve those goals, Europe needs to keep independent access to space.

The first priorities for this policy set out at the fourth Space Council meeting are the flagship Galileo and Copernicus projects. The 5th Space Council meeting approved those projects and identified further priorities. Climate change, security, competitiveness and space exploration have ever since been reaffirmed as priority areas where specific action continues to be required[159].

Finally, in what concerns the support for developing countries to establish and maintain observing systems, related data and monitoring systems some of the relevant activities are the African Monitoring of Environment for Sustainable Development (AMESD[160]) programme and its successor Monitoring of Environment and Security in Africa (MESA) and natural resources in Africa and a tripartite collaboration[161] between the JRC, NASA and the South African National Space Agency (SANSA) has been in place since 2011 around the exploitation of data generated by the Multi-angle Imaging Spectro Radiometer (MISR) instrument on-board the NASA Terra platform.

8.2.1.1. Institutional mapping, actors and roles and responsibilities

In the EU there two sets of RSO actions that can be distinguished: those that are implemented by MS and others that are coordinated at the EU level. The latter make up are the scope of this chapter and a complex myriad of institutions contributes to it. A brief description of the roles and responsibilities of the main RSO actors at the EU level is provided below.

Directorate-General for Research and Innovation[162]

The mission of the DG Research and Innovation is to develop and implement the European research and innovation policy with a view to achieving the goals of Europe 2020 and the Innovation Union.

As such, the DG contributes to making Europe a better place in which to live and work, improving Europe's competitiveness, growth and job creation while tackling the main current and future societal challenges. To do so, DG Research and Innovation supports relevant activities through European FPs, coordinates and supports national and regional R&D programmes, contributes to the ERA by developing the conditions for researchers and knowledge to circulate freely, and supports European organisations and researchers in their cooperation at international level.

Joint Research Centre (JRC)

As the Commission's in-house science service, the JRC's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout

159 http://ec.europa.eu/enterprise/policies/space/files/policy/comm_pdf_com_2011_0152_f_communication_en.pdf

160 http://au.int/amesd/home/144-mesa-a-leap-forward-for-earth-observation-applications-in-africa-.html

161 http://www-misr.jpl.nasa.gov/index.cfm http://www.jpl.nasa.gov/news/news.php?release=2010-325
http://ec.europa.eu/dgs/jrc/index.cfm?id=1410&obj_id=11780&dt_code=NWS&lang=en
http://earthdata.nasa.gov/featured-stories/featured-research/new-angles

162 http://ec.europa.eu/research/index.cfm?pg=dg

the whole policy cycle. The JRC is a Directorate-General of the European Commission under the European Commissioner for Research, Innovation and Science. The Headquarters of the Directorate-General[163] are located in Brussels, while the seven JRC institutes are located on five separate sites in Belgium, Germany, Italy, the Netherlands and Spain.

Especially relevant to the issue of climate change is the *Institute for Environment and* Sustainability (IES) [164]. Its mission is to provide scientific and technical support to EU policies for the protection of the European and global environment, and to carryout research to understand the complex interactions between human activity and the physical environment, in particular the climate system, and how to manage strategic resources (water, land, forests, food, minerals, etc.) in a more sustainable manner or evaluate risks. Together with other JRC institutes, the IES provides the scientific basis for the conception, development, implementation and evaluation of EU policies that promote the greening of Europe and the global sustainable management of natural resources. It also works in partnership with other Directorates General to support the strategic priorities of the Commission.

JRC has been actively involved in GCOS (see section 8.3) for many years, both through its participation in its governing body and panels, including:

- the Steering Committee
- the Atmospheric Observation Panel for Climate (AOPC)[165] and
- the Terrestrial Observation Panel for Climate (TOPC)[166].
- as well as its contributions to the drafting of key documents for the systematic observation of the Earth, such as the Adequacy Reports and the Implementation Plans.

Similarly, JRC staff members regularly contribute to the work of Committee on Earth Observation Satellites (CEOS)[167], in particular through its panels dedicated to climate, calibration and validation, as well as land surface processes. CEOS coordinates, in particular, the responses of all Space Agencies to the recommendations issued by GCOS as part of the Implementation Plans and associated documents.

JRC also contributes directly to the IPCC activities, both in terms of writing or reviewing the various chapters of the successive assessments. While GCOS deals with the observational component of the climate, IPCC provides modelling and prediction support to UNFCCC.

Directorate-General Enterprise and Industry[168]

The European Commission's Directorate-General for Enterprise and Industry has the mission to promote a growth-friendly framework for European enterprises. It has a key role in the Europe 2020 agenda of smart, sustainable and inclusive growth. It is responsible for the product legislation in a number of sectors to ensure a well-

163 http://ec.europa.eu/dgs/jrc/index.cfm?id=1490&lang=en

164 http://ies.jrc.ec.europa.eu/

165 http://www.wmo.int/pages/prog/gcos/index.php?name=AOPC

166 http://www.wmo.int/pages/prog/gcos/index.php?name=TOPC

167 http://www.ceos.org/

168 http://ec.europa.eu/enterprise/dg/

functioning internal market, manages large industrial programmes in space and satellite navigation (GALILEO and Copernicus), and is the voice of SMEs in European policy-making. In this context, the Copernicus's Climate Change Service will become relevant (see section 8.5.2).

Directorate-General for Climate Action [169]

DG Climate Action was established in February 2010, climate change being previously included in the remit of DG Environment of the European Commission. It leads international negotiations on climate, helps the EU to deal with the consequences of climate change and to meet its targets for 2020 and develops and implements the EU Emissions Trading Scheme (EU ETS). It also promotes the development and demonstration of low carbon[170] and adaptation technologies, especially through the development and implementation of cost effective regulatory frameworks for their deployment (e.g., carbon capture and storage[171], fluorinated gases[172], the control of ozone depleting substances, vehicle efficiency standards[173], fuel quality standards) as well as through the development of appropriate financial support schemes.

European Research Council (ERC)[174]

The ERC is the European Union funding body that implements the Specific FP7 Programme 'Ideas'. This Programme supports "investigator-driven" research carried out across all fields by individual national or transnational teams in competition at the European level. The ERC consists of independent Scientific Council, responsible for scientific strategy, and an administrative arm, the European Research Council Executive Agency (ERCEA).

European Environment Agency (EEA)[175]*and* European Environment Information and Observation Network *(EIONET)*[176]

The EEA is an agency of the European Union. Its task is to provide sound, independent information on the environment as a major information source for those involved in developing, adopting, implementing and evaluating environmental policy, as well as the general public. The EEA does not fund research projects but produces European, pan-European and regional integrated environmental data and indicator sets, assessments and thematic analyses in order to provide a sound decision basis for environmental policies in the EU and Member countries and for cooperation with candidate and potential candidate countries.[177] Currently, the EEA has 32 member countries.

Relevant EEA products and services, which make use of results from a range of EU funded research projects on climate change and climate change impacts, include:

169 http://ec.europa.eu/dgs/clima/mission/index_en.htm

170 http://ec.europa.eu/clima/policies/lowcarbon/index_en.htm

171 http://ec.europa.eu/clima/policies/lowcarbon/ccs/index_en.htm

172 http://ec.europa.eu/clima/policies/f-gas/index_en.htm

173 http://ec.europa.eu/clima/policies/transport/vehicles/index_en.htm

174 http://erc.europa.eu/about-erc/mission

175 http://www.eea.europa.eu/about-us/who

176 http://eionet.europa.eu/. Eionet was set up in 1994 in accordance with the Council Regulation (EEC) No 1210/90 of 7 May 1990 on the establishment of the EEA and has grown as the EEA has enlarged

177 http://www.eea.europa.eu/about-us/what

- assessment reports published in 2012 and 2013 on ‘Urban adaptation to climate change in Europe[178]’, ‘Climate change, impacts and vulnerability in Europe 2012[179]’ and on ‘Adaptation in Europe - Addressing risks and opportunities from climate change in the context of socio-economic developments[180]’
- Climate-ADAPT, the European Climate Adaptation Platform[181] (see section 6.4)

EEA's mandate is to:

- help the Community and member countries[182] make informed decisions about improving the environment, integrating environmental considerations into economic policies and moving towards sustainability
- coordinate the European environment information and observation network (Eionet)
- coordinate in-situ observations and contribute to the development of the services, in particular to the technical coordination of the Land Monitoring Service. Use of the Copernicus services is an integrated part of EEA’s strategy to improve environmental information. Copernicus also plays an important role in the implementation of the principles of the Shared Environmental Information System (SEIS), and has the potential to make effective use of existing infrastructures in accordance with the INSPIRE directive. In the global context, Copernicus is an integral part of the Global Earth Observation System of Systems (GEOSS) (see section 8.3).

Eionet is a partnership network of the EEA and its member and cooperating countries. The EEA is responsible for developing the network and coordinating its activities. To do this, the EEA works closely together with the National Focal Points (NFPs), typically national environment agencies or environment ministries in the member countries. Eionet has become a model for the provision of high quality data, information and assessments on the state of the environment and the pressures and driving forces acting upon it.

The European topic Centres (ETCs)[183] are a consortium of organisations from EEA member countries with expertise in a specific environmental area and contracted by the EEA to support its work programme. These centres of thematic expertise carry out specific tasks identified in the EEA strategy (five-year work programme) and the annual work programmes. They are designated by the EEA Management Board following a Europe-wide competitive selection process and work as extensions of the EEA in specific topic areas.

Each ETC consists of a lead organisation and specialist partner organisations from the environmental research and information community, which combine their resources in their particular areas of expertise. The ETCs, working together with Eionet countries,

178 http://www.eea.europa.eu/publications/urban-adaptation-to-climate-change

179 http://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012

180 http://www.eea.europa.eu/publications/adaptation-in-europe

181 http://climate-adapt.eea.europa.eu/

182 http://www.eea.europa.eu/about-us/countries-and-eionet/intro

183 http://acm.eionet.europa.eu/

facilitate the provision of data and information from the countries and deliver reports and other services to the EEA and Eionet. There are currently 6 ETCs, one of which concerns Air Pollution and Climate Change Mitigation (ETC/ACM[184]) and another Climate Change Impacts, Vulnerability and Adaptation (ETC/CCA[185]) (see section 6.5).

European Space Agency (ESA)[186]

ESA is Europe's gateway to space. Its mission is to shape the development of Europe's space capability and ensure that investment in space continues to deliver benefits to the citizens of Europe and the world. ESA is an international organisation with 20 Member States. By coordinating the financial and intellectual resources of its members, it can undertake programmes and activities far beyond the scope of any single European country. ESA's job is to draw up the European space programme and implement it. ESA's programmes are designed to find out more about Earth, its immediate space environment, our solar system and the Universe, as well as to develop satellite-based technologies and services, and to promote European industries. ESA also works closely with space organisations outside of Europe. ESA has 20 Member States[187]. In recent years the ties between the Commission and ESA have been reinforced by the increasing role that space plays in supporting Europe's social, political and economic policies, in line with Article 189 of the TFEU.

The legal basis for the EU/ESA cooperation is provided by a Framework Agreement which entered into force in May 2004. Under this agreement the European Commission and ESA coordinate their actions through the Joint Secretariat, a small team of the European Commission's administrators and the ESA executive. The Member States of the two organisations meet at ministerial level in the Space Council, which is a concomitant meeting of the EU and ESA Councils, prepared by Member States representatives in the High-level Space Policy Group (HSPG).

One of ESA's activities is observing the state and evolution of Planet Earth, which encompasses two programmes: the Living Planet and Copernicus, in addition to Earthnet, financed through ESA's General Budget, enabling access to EO data. .

Also, to respond to the need for climate-quality satellite data, ESA has set up a new programme, the ESA Climate Change Initiative. A € 75 million programme, it will run from 2009 to 2016 and consist of three stages: requirement analysis, algorithm development and prototype ECV building; ECV production and system development; and user analysis and feedback[188] (see also section 8.3).

In addition to ESA's CCI, ESA's Living Planet programme supports through dedicated scientific missions, the Earth Explorers, and its exploitation programme components, increasing the knowledge base of processes and their interactions underlining climate.

184 http://acm.eionet.europa.eu/

185 http://cca.eionet.europa.eu/

186 http://www.esa.int/About_Us/Welcome_to_ESA/What_is_ESA

187 Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Romania, Spain, Sweden, Switzerland and the United Kingdom. Canada takes part in some projects under a Cooperation agreement. Poland exchanged Accession Agreements with ESA in September 2012 to become the 20th Member State. Hungary, Estonia and Slovenia are 'European Cooperating States'. Other countries have signed cooperation agreements with ESA.

188 http://www.esa-cci.org/

European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT[189])

The main purpose of EUMETSAT is to deliver weather and climate-related satellite data, images and products 24 hours a day, 365 days a year. This information is supplied to the National Meteorological Services of the organisation's Member, the European Centre for Medium range Weather Forecasting (ECMWF) and Cooperating States in Europe, as well as other users world-wide. EUMETSAT is an international organisation and was founded in 1986.

EUMETSAT contributes to the global effort to meet the climate challenge. Its Meteosat and Metop satellites, as well as data and products from the Jason satellites already provide a wealth of environmental and climate data. The latter are further analysed by its network of Satellite Application Facilities (SAFs) and distributed rapidly to the global user community. The organisation also possesses a unique archive of relevant long-term satellite data dating back to 1981.

EUMETSAT and its partners are contributing to the overall European-scale efforts to define a comprehensive, global, space-based climate monitoring system to address the challenges posed by global climate change.

The Satellite Application Facility on Climate Monitoring (CM SAF) aims at the provision of satellite-derived geophysical parameter data sets suitable for climate monitoring. CM SAF provides climatologies for ECVs, as required by the GCOS implementation plan in support of the UNFCCC.

The CM SAF data products are categorized in monitoring data obtained in near real time and data sets based on carefully intersensor calibrated radiances. The products are derived from several instruments on-board meteorological operational satellites in geostationary and polar orbit as the Meteosat and EUMETSAT Polar System satellites, respectively[190].

European Institute of Innovation & Technology (EIT)[191]

The EIT is a body of the European Union that aims to promote sustainable growth and competitiveness by reinforcing the innovation capacity of the EU. To do so, EIT integrates higher education, research and business in areas of high societal need through the Knowledge and Innovation Communities (KICs). Climate-KIC[192] aims to significantly accelerate the innovation required for a transformation to a low-carbon economy, and to ensure Europe benefits from new technologies, company growth and jobs.

189 http://www.eumetsat.int/Home/Main/AboutEUMETSAT/index.htm?l=en

190 http://www.cmsaf.eu/bvbw/appmanager/bvbw/cmsafInternet

191 http://eit.europa.eu/

192 www.climate-kic.org

Figure 8-1 EIT lines of action

8.2.1.2. Main instruments, policies and programmes

7th Framework Programme (FP7)

FP7 (2007-2013) was the EU's main instrument for funding research in Europe and beyond from 2007 to 2013. This multi-annual regional programme relied on contributions from 27 EU Member States and 14 Associated Countries[193]. In principle, all parts of FP7 were open to international cooperation, while many third countries (especially developing ones and economies in transition) were eligible for EU funding.

FP7was structured around five specific programmes:

- Cooperation – collaborative research: was the core of FP7, representing two thirds of the overall budget. It fostered collaborative research across Europe and other partner countries through projects by transnational consortia of industry and academia (for more details on RSO and International Cooperation see Section 8.3 below). Research was carried out in ten key thematic areas:
  - health
  - food, agriculture and fisheries, and biotechnology
  - information and communication technologies
  - nanosciences, nanotechnologies, materials and new production technologies
  - energy
  - environment (including climate change)
  - transport (including aeronautics)

193 Albania, Bosnia & Herzegovina, Croatia, Faroe Islands, Former Yugoslav Republic of Macedonia, Iceland, Israel, Liechtenstein, Moldova, Montenegro, Norway, Serbia, Switzerland, Turkey

- socio-economic sciences and the humanities
- space
- security

- Capacities – capacity building for research (network, research infrastructure, and others) in order to strengthen the research capacities that Europe needs if it is to become a thriving knowledge-based economy. It covered the following activities:
    - research infrastructures
    - research for the benefit of SMEs
    - regions of knowledge
    - research potential
    - science in society
    - specific activities of international cooperation.
- People – provided support for researcher mobility and career development, both for researchers inside the EU and internationally. It was implemented via a set of Marie Curie actions, providing fellowships and other measures to help researchers build their skills and competences throughout their careers:
    - initial training of researchers – Marie Curie Networks
    - industry-academia partnerships
    - co-funding of regional, national and international mobility programmes
    - intra-European fellowships
    - international dimension-outgoing and incoming fellowships, international cooperation scheme, reintegration grants
    - Marie Curie Awards
- Ideas: supported “frontier research” solely on the basis of scientific excellence. Research could be carried out in any area of science or technology, including engineering, socio-economic sciences and the humanities. In contrast with the Cooperation programme, there was no obligation for cross-border partnerships. Projects were implemented by “individual teams” around a “principal investigator”. The programme was implemented via the ERC.
- Euratom (nuclear research and training activities): comprises research, technological development, international cooperation, dissemination of technical information, and exploitation activities, as well as training. Two specific programmes are planned:
    - fusion energy research (in particular ITER), and nuclear fission and radiation protection;
    - activities of the JRC in the field of nuclear energy, including nuclear waste management and environmental impact, nuclear safety and nuclear

security. In addition to direct actions in the nuclear field, the JRC carries out research in a number of other areas to provide scientific and technological support to EU policy making.

In FP7, climate relevant research has been conducted across various themes such as 'Environment (including Climate Change)', 'Energy' and 'Food, Agriculture, Fisheries and Biotechnology'. Targeted climate change research falls under the theme 'Environment (including climate change)', 'Activity 6.1 Climate Change, Pollution and Risks', focusing in particular on the following issues:

- the earth system and climate, and related abrupt changes
- natural and anthropogenic emissions
- the global carbon cycle
- greenhouse gases
- future climate
- the natural, social and economic impacts of climate change
- mitigation and adaptation strategies, including novel responses to climate change
- natural climate-related hazards such as floods, droughts, storms or forest fires
- climate change impacts on health.

Progress has been – and continues to be – made in reducing fragmentation across the European Research Area and in strengthening coordination of national and regional research programmes. FP7 is supporting two main tools to achieve these goals – the ERA-NET scheme and actions under Article 185, as described below.

European research Area (ERA)

The European Commission's 2012 policy Communication on the European Research Area[194] led to a significant improvement in Europe's research performance to promote growth and job creation.

With the explicit objective of opening up and connecting EU research systems – important due to the increased cross-national nature – the ERA reform agenda focuses on five key priorities:

- more effective national research systems
- optimal transnational co-operation and competition on common research agendas, grand challenges and infrastructures
- an open labour market for researchers facilitating mobility, supporting training and ensuring attractive careers
- gender equality and gender mainstreaming in research encouraging gender diversity to foster science excellence and relevance
- optimal circulation and transfer of scientific knowledge to guarantee access to and uptake of knowledge by all .

194 COM(2012) 392 final

The objective of the ERA-NET scheme is to step up the cooperation and coordination of research activities carried out at national or regional level in the Member States and Associated States through:

- the networking of research activities conducted at national or regional level, and
- the mutual opening of national and regional research programmes.

The scheme will contribute to making a reality of the ERA by improving the coherence and coordination across Europe of such research programmes. The scheme will also enable national systems to take on tasks collectively that they would not have been able to tackle independently.

Both networking and mutual opening require a progressive approach. The ERA-NET scheme therefore has a long-term perspective that must also allow for the different way that research is organised in different Member States and Associated States[195].

The Joint Programming Initiatives (JPI) are also part of the ERA. Particularly relevant in this context are the JPI on Connecting Climate Knowledge for Europe (JPI-Climate) and on Agriculture, Food Security and Climate Change (FACCE-JPI). The concept of Joint Programming was introduced by the European Commission in July 2008. It is one of the five initiatives for implementing ERA.

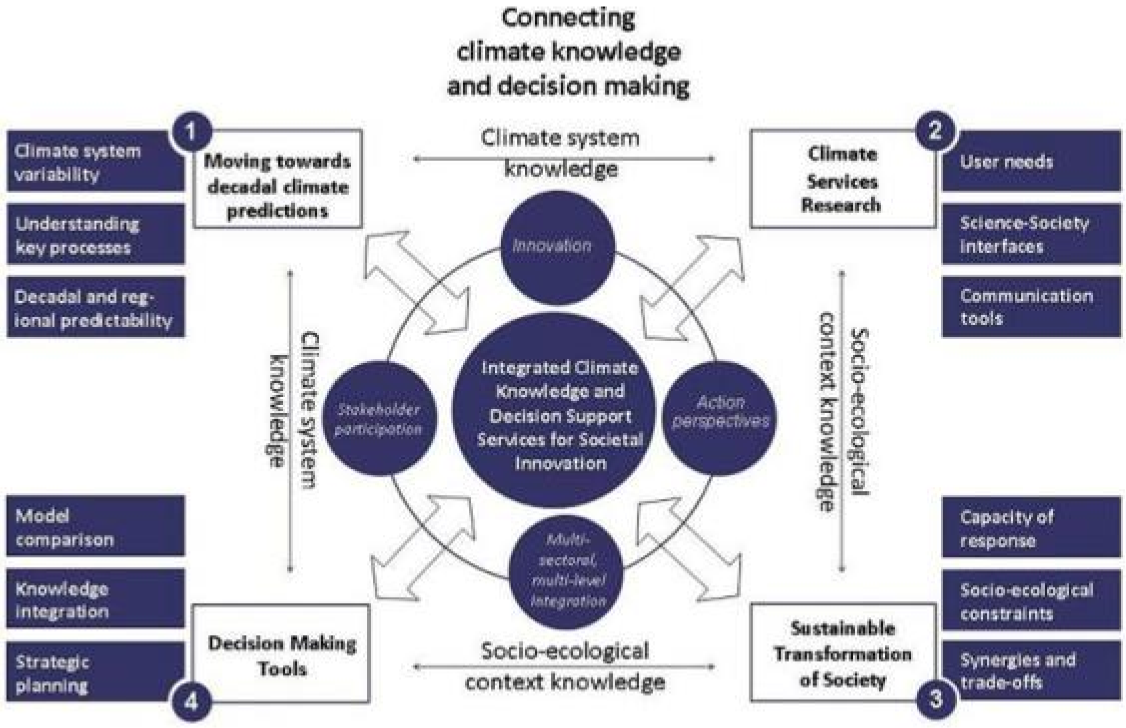
JPI-Climate[196] is a fundamental European initiative on the coordination of climate research funding. 'Climate knowledge' is understood in a rather broad sense, including all kinds of scientific knowledge on causes and consequences, on cost, risks and benefits of climate change as well as possible responses. JPI Climate aims to contribute to a highly coordinated knowledge development by not only improving the scientific expertise on climate change risks and adaptation options, but also by connecting that knowledge with decision-making on safety and major investments in climate-vulnerable sectors in Europe. The research agenda includes 4 modules:

- moving towards reliable Decadal Climate Predictions
- researching Climate Service Development and Deployment
- sustainable Transformations of Society in the face of Climate Change
- improving Tools for Decision Making under Climate Change.

195 http://www.cordis.europa.eu/coordination/era-net.htm

196 http://www.jpi-climate.eu/

Figure 8-2 JPI Climate conceptual framework



The FACCE-JPI brings together 21 countries that are committed to building an integrated European Research Area addressing the interconnected challenges of sustainable agriculture, food security and impacts of climate change.

The integrated FACCE-JPI strategic research agenda defines five core research themes:

- sustainable food security under climate change, based on an integrated food systems perspective: modelling, benchmarking and policy research perspective
- environmentally sustainable growth and intensification of agricultural systems under current and future climate and resource availability
- assessing and reducing trade-offs between food production, biodiversity and ecosystem services
- adaptation to climate change throughout the whole food chain, including market repercussions
- greenhouse gas mitigation: nitrous oxide and methane mitigation in the agriculture and forestry sector, carbon sequestration, fossil fuel substitution and mitigating GHG emissions induced by indirect land use change.

These core research themes are gradually taken into account by national research agendas with a view to aligning national programmes for which much research has already been undertaken, and inspire pilot joint actions[197] on topics for which research is lacking.

An implementation plan will be launched in the summer of 2013, which will set out short-term and mid-term priority actions to implement the FACCE-JPI strategic research agenda, in keeping with the first Work-Programme of Horizon 2020.

The JPI Urban Europe aims to respond to the grand challenge of urbanisation in Europe, and beyond. While doing so, it is sought at developing innovative R& D solutions, inter alia, in the area of environmental and ecosystem services to tackle the Climate Change challenge. The JPI is collaborating with cities, industry, and the European Commission in the context of the European Innovation Partnership on Smart Cities and Communities, which will set the pace for innovation path of European urban areas from 2014 to 2020, in partnership with countries and urbanised regions throughout the world, e.g. China, to share experiences and develop joint solutions[198].

Article 185[199]

Actions under Article 185 of the TFEU [ex Article 169 of the Treaty establishing the European Community (TEC)] aim to integrate parts of national and regional programmes for joint implementation, together with the Commission, of a real European research programme. The actions supported here may cover subjects not directly linked to the ten themes in as far as they have a sufficient EU added value. They will also be used to enhance the complementarity and synergy between FP7 and activities carried out under intergovernmental structures such as EUREKA[200] and COST[201].

Copernicus

The Copernicus Climate Change service capitalises on three main components: sustained network of in situ and satellite-based observations, re-analysis of the Earth climate with a variety of models driven by observations and modelling scenarios based on a variety of climate projections. These three components will allow a panoply of climate indicators (e.g., temperature increase, sea level rise, ice sheet melting, ocean acidification, warming up of the ocean, among others) and climate indices (e.g., based on records of temperature, precipitation, drought events) for both the identified climate drivers and the expected climate impacts. The pre-operational phase of the Copernicus climate change (CC) service started in earnest with the 2013 FP7 Space Call that identified five major domains of activities directly related to climate modelling and observation analyses.

The 6th FP7 space call for 2013 from DG Enterprise and Industry has prioritized developments relevant for a Climate Change service for a total budget of € 26 million : Global 20th century re-analysis and coupling methods, ensemble system of regional re-analyses, traceable quality assurance system for multi-decadal ECVs, provision of access to simulated & observed climate datasets and climate indicator toolbox and, attribution products. Proposals have been evaluated and are currently under negotiation.

197 http://www.faccejpi.com/FACCE-MACSUR

198 http://www.jpi-urbaneurope.eu/.

199 http://cordis.europa.eu/fp7/art185/home_en.html

200 http://www.eurekanetwork.org/about

201 http://www.cost.eu/about_cost

The Climate Change service is designed to provide information to increase the knowledge base to support adaptation and mitigation policies. It will in particular contribute to the provision of ECVs, climate analyses and projections at temporal and spatial scales relevant to adaptation and mitigation strategies for the various Union's sectoral policies. As an example the Climate Change service will deliver series of climate data records to monitor major climate drivers, e.g. Greenhouse Gases, and climate impacts, e.g. surface temperature and precipitation; it will also deliver information of direct relevance to sectors such as Agriculture and Forestry, Health, Infrastructure, Energy and Tourism to name but a few.

LIFE+

The LIFE programme is the EU's funding instrument for the environment. The general objective of LIFE is to contribute to the implementation, update and development of EU environmental policy and legislation by co-financing pilot or demonstration projects with European added value. It comprises:

- LIFE+ Nature & Biodiversity
- LIFE+ Environment Policy & Governance
- LIFE+ Information & Communication.

LIFE began in 1992 and to date there have been three complete phases of the programme (LIFE I: 1992-1995, LIFE II: 1996-1999 and LIFE III: 2000-2006). LIFE+, running from 2007-2013 had a budget of €2 143 billion. Climate change is an important priority for the LIFE+ programme.

The Commission launched a discussion process on the future of LIFE+ from 2014 onwards; with a view to designing a future EU financial instrument (a continuation of LIFE+) that would best address the needs of the environment and climate protection. The resulting Regulation on the establishment of a programme for the Environment and Climate action (LIFE) for the period 2014-2020 was adopted in December 2013.

In particular, the new LIFE programme will support public authorities, NGOs and private actors, especially small and medium enterprises, in testing small-scale low carbon and adaptation technologies, new approaches and methodologies to address climate issues. Specific local and regional climate mitigation or adaptation strategies or action plans will also be financed. Moreover, the sub-programme will support capacity building as well as awareness-raising actions involving stakeholders, in order to improve the implementation of the existing climate legislation.

Competitiveness and Innovation Framework Programme[202]

With small and medium-sized enterprises (SMEs) as its main target, the Competitiveness and Innovation Framework Programme (CIP) supported innovation activities (including eco-innovation), provided better access to finance and delivered business support services in the regions. It encouraged a better take-up and use of information and communication technologies (ICT) and helped to develop the

202 http://ec.europa.eu/cip/index_en.htm

information society. It also promoted the increased use of renewable energies and energy efficiency.

The CIP ran from 2007 to 2013 with an overall budget of € 3 621 million and was divided into three operational programmes. Each programme had its specific objectives, aimed at contributing to the competitiveness of enterprises and their innovative capacity in their own areas, such as ICT or sustainable energy:

- the Entrepreneurship and Innovation Programme (EIP)
- the Information Communication Technologies Policy Support Programme (ICT-PSP)
- the Intelligent Energy Europe Programme (IEE).

The new Programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME[203]) will run from 2014 to 2020, with a planned budget of € 2.5billion (current prices). COSME should start on 1 January 2014.

Its objectives are to:

- facilitate access to finance for Small and Medium-sized Enterprises (SMEs),
- create an environment favourable to business creation and growth
- encourage an entrepreneurial culture in Europe
- increase the sustainable competitiveness of EU companies and
- help small businesses operate outside their home countries and improving their access to markets.

COSME will:

- ensure continuity with initiatives and actions already undertaken under the Entrepreneurship and Innovation Programme (EIP), such as the Enterprise Europe Network, building on results and lessons learnt.
- continue the many successful features of the EIP, while simplifying management of the programme to make it easier for entrepreneurs and small businesses to benefit.
- support, complement and help coordinate actions by EU member countries. COSME will specifically tackle transnational issues that – thanks to economies of scale and the demonstration effect – can be more effectively addressed at European level.

COSME is expected to contribute to an annual increase of € 1.1 billion in the EU's GDP. The Enterprise Europe Network is expected to assist 40 000 companies with partnership agreements, resulting in:

- 1200 new business products, services or processes annually
- € 400 million annually in additional turnover for assisted companies.

203 http://ec.europa.eu/cip/cosme/index_en.htm

Access to finance will be easier for entrepreneurs, in particular those willing to launch cross-border activities, resulting in an expected annual increase of € 3.5 billion in additional lending and/or investment for EU companies.

Organising co-operation at different levels, co-ordinating national or European policies, networking teams and increasing the mobility of individuals and ideas is therefore a requirement resulting from the development of modern research in a global environment. Without determined actions at European level the present fragmentation of Europe's efforts cannot be overcome.

8.2.1.3. International Cooperation

International cooperation in research and innovation is not an end in itself. It is a means for the Union to achieve its higher-level objectives, in particular by:

- strengthening the Union's excellence and attractiveness in research and innovation and its economic and industrial competitiveness
- tackling global societal challenges, such as food and energy security and climate change and
- supporting the Union's external policies.

The impact of climate change in one country may depend on what happens thousands of kilometres away. Global business draws on diminishing natural resources around the world, and water and air pollution are not confined within national nor even regional borders. Food and energy security as well as water supply also depend on cross-border co-operation.

The only way to handle these issues effectively is for countries and regions to work together, pooling resources for research and innovation, to respond to common global challenges and move towards more sustainable livelihoods.

Considering the global character of environmental problems, international cooperation activities have become a top priority worldwide. This continues good previous practices and opens all the research themes and projects to international collaboration

Most of the instruments, policies and programmes of the EU, as stated above, are in general open to all while International Cooperation Partner Countries (ICPC[204]). A new element is that the 'Environment' theme under FP7 comprises Specific International Cooperation Actions (SICA), which addresses research problems of mutual interest and benefit between the EU and ICPC.

International cooperation activities have the following overall objectives:

- supporting European scientific and economic development through strategic partnerships with third countries in selected fields of science and by engaging the best third country scientists to work in and with Europe
- facilitating contacts with partners in third countries with the aim of providing better access to research carried out elsewhere in the world and
- addressing specific problems that third countries face or that have a global character.

204 http://ec.europa.eu/research/environment/pdf/icpc-list.pdf#view=fit&pagemode=none

Besides this general policy, there are some topics in the work programme in which specific reference is made to the need for international cooperation with specific countries or regions. A partner search service has been set up to facilitate new collaborations with researchers worldwide[205].

Established in 1984, the Committee on Earth Observation Satellites (CEOS) coordinates civil space-borne observations of the Earth. Participating agencies strive to enhance international coordination and data exchange and to optimize societal benefit. Currently, 53 members and associate members made up of space agencies, national, and international organizations participate in CEOS planning and activities. The European Commission is a full member of CEOS and through the JRC is actively involved in the CEOS Working Groups and Virtual Constellations (including acting as the Current Chair for the Working Group on Climate)

In addition to bilateral and regional co-operation, which was also envisaged in the scope of FP7 (above), the EU research contributes to international initiatives such as the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), United Nations Framework Convention on Climate Change (UNFCCC), United Nations Convention on Biological Diversity (UNCBD), United Nations Convention to Combat Desertification (UNCCD). The EU was also a leading player at the United Nations Rio+20 Sustainable Development Summit in June 2012, and is committed to implementing the measures agreed there.

The European Commission works closely with the Belmont Forum, which aims to improve coordination of research strategies and priorities in order to improve co-design, co-alignment, and co-funding of major research programmes.

In terms of Systematic Observation, the 2002 World Summit on Sustainable Development in Johannesburg, South Africa, highlighted the urgent need for coordinated observations relating to the state of the Earth. The June 2003 summit of the heads of states of the Group of Eight industrialised countries in France reinforced the importance of earth observation as a priority activity. Europe is a global leading player in the advancement of earth observation technologies and related environmental applications. European remote-sensing satellites cover all of the Earth's climatic zones, while European ground-, air- and ocean-based monitoring devices serve users by providing high-quality observation data for subjects as diverse as urban planning, adaptation to climate change, disaster reduction, disease control and humanitarian relief. The Group on Earth Observations (GEO) is a voluntary partnership involving 90 governments, the European Commission and 67 international and regional bodies. It is developing a Global Earth Observation System of Systems (GEOSS), which provides data and information for examining natural and human-induced disasters, as well as managing natural resources (see section 8.5.1). The EU also contributes to the work of GCOS (see 8.3) and COSPAR. The European institutions are particularly active in GEO, GCOS and CEOS, among others.

The EU Environmental Technologies Action Plan (ETAP)[206], which was adopted in 2004, is intended to make eco-innovation an everyday reality throughout Europe.

205 http://ec.europa.eu/research/environment/index_en.cfm?pg=coop

206 http://ec.europa.eu/environment/etap/index_en.htm

Covering a wide range of activities promoting eco-innovation and use of environmental technologies, its objective is to improve European competitiveness in this area and enable the EU to become the recognised world leader. The ETAP encompasses nine actions that the European Commission and some that other stakeholders, such national and regional governments should undertake for the plan to be successful. An integral part of the ETAP is getting from research to markets – in other words, to increase and focus research. It thus puts forward actions to attract more private and public investment for the development and demonstration of environmental technologies in line with the EU objective to raise overall R&D investment to 3% of GDP. The actions aim to improve the innovation process and to take inventions out of laboratories and onto the market.[207]

The proposal for a new EU International Strategy for Research and Innovation will be mainly implemented through Horizon 2020, as well as through joint initiatives with EU Member States. In addition to Horizon 2020 being fully open to international participation, targeted actions with key partners and regions will focus on societal challenges and enabling and industrial technologies.

Multi-annual programmes for cooperating with key partner countries and regions will be developed in order to enhance and focus international cooperation. The strategy also calls for improving the policy dialogue with our partners and for improved information gathering as part of a proposed Research and Innovation Observatory. In addition, the European Union will aim to increase its leverage in relevant international organisations[208].

8.2.2. Funding of RSO

The EU is among the world leaders in research and innovation and is regarded as an attractive partner for international cooperation. Environmental research is a particularly good example of EU efforts to provide a common reference framework and tackle global societal challenges – whether they relate to climate, disasters, water or pollution – together with international partners. FP7 supported competitiveness and excellence in research and innovation through strategic scientific partnerships with non-EU countries and regions. This broadens access to knowledge outside the Union and access to markets worldwide.

The EU's commitment to effective multilateral processes in international fora is central to the EU's external policies. At the same time sustainable development is an overarching objective of the EU with a clear external dimension. Environmental and development challenges are inextricably linked. The scale and scope of these challenges requires increased global collaboration.

Participants from developing countries and emerging economies, Mediterranean partner countries, Western Balkan countries, as well as Russia and the new independent states can be funded in the field of environmental research. Other third country participants can also participate in EU projects; however, funding is not available unless it is explicitly mentioned in the relevant topic of the work programme or it is clearly demonstrated that it is essential for carrying out the research activity[209].

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207 http://ec.europa.eu/research/environment/index_en.cfm?pg=policy

208 http://europa.eu/rapid/press-release_IP-12-967_en.htm?locale=en

209 http://ec.europa.eu/research/environment/index_en.cfm?pg=coop)

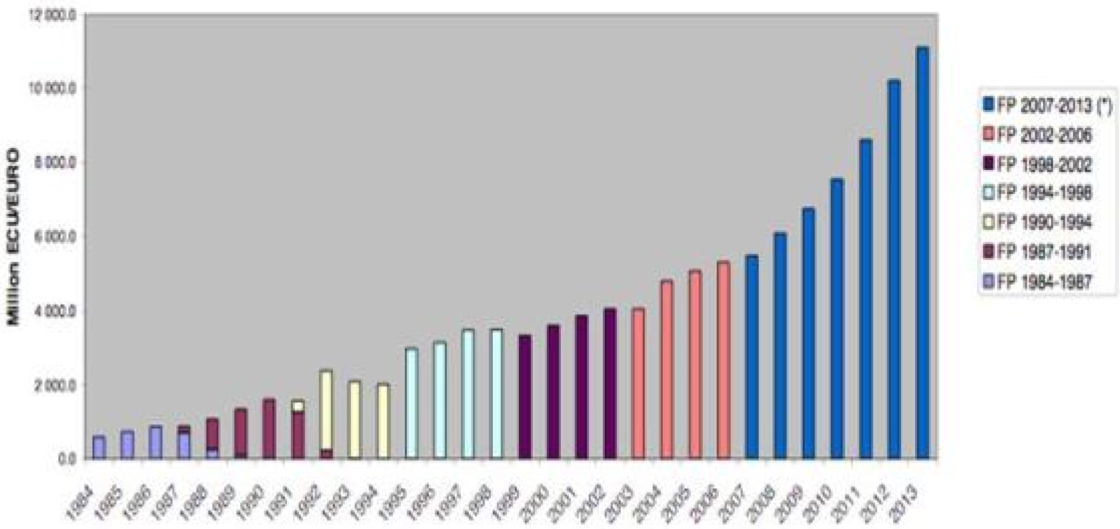
Considering the crucial role of research and innovation in tackling climate change[210], 'climate action, resource efficiency and raw materials' has been identified as one of the societal challenges that will drive the activities from research to market in Horizon 2020. Low-carbon solutions in the energy system, mobility and transport will be the focus of two other societal challenges. The programme marks a new emphasis on innovation-related solutions and it is expected that around 35% of the Horizon 2020 budget of around €70 billion will be climate related expenditure.

FP7

Climate research was one of the main research themes of the EU's FP7 (2007-2013) and will be central in Horizon 2020[211], the EU's new Framework Programme for Research and Innovation 2014-2020.

FP7's total budget exceeded € 50 billion over 7 years, with an additional of € 2.75 billion directed to EURATOM (increased by 65% when compared to FP6 in average annual terms), distributed through grants to co-finance research activities (in priority areas). The increase in the commitments towards the development of community research has been a trend since FP1 (1984) as shown in *Figure 8-3*.

Figure 8-3 Development of Community Research – Commitments (current prices).



Source: http://ec.europa.eu/research/fp7/pdf/fp-1984-2013_en.pdf

Note: the final numbers for 2012 and 2013 may change.

As part of a €10.8 billion budget for research and innovation agreed for 2013, the European Commission has announced an €8.1 billion euro package of calls for proposals under the FP7.

This was the final and largest ever package of FP7 calls, and is an important part of the Commission's commitment to work for growth and jobs in Europe:

- the budget and work programme were agreed in 2012 and funding awarded in 2013 – the closing dates for proposals were in September 2012. The calls

210 COMMISSION STAFF WORKING PAPER, IMPACT ASSESSMENT Accompanying the Communication from the Commission 'Horizon 2020 - The Framework Programme for Research and Innovation'; COM(2011) 808 final

211 http://ec.europa.eu/research/horizon2020/index_en.cfm

address key concerns faced by Europeans for which action at EU level is essential. € 4.8 billion will be invested in thematic areas, with specific priorities to preserve oceans and water, better use of raw materials, efficient energy, promote efficiency in the processing of biological resources, develop smart cities and tackle issues such as public sector reform, brain research and anti-microbial resistance

- making Europe a destination for world-class researchers is another key priority. The European Research Council will invest over € 1.7 billion in the best researchers and additional € 963 million will support mobility through “Marie Curie Actions”.
- small and medium-sized enterprises, recognised as vital for innovation, are given special incentives to participate with a total package of € 1.2 billion.

Figure 8-4 shows the work programme comparison among 2012 and 2013 and Figure 8-10 the budget execution by theme between 2007 and 2013.

Figure 8-4 Work programme comparison (2012 and 2013)

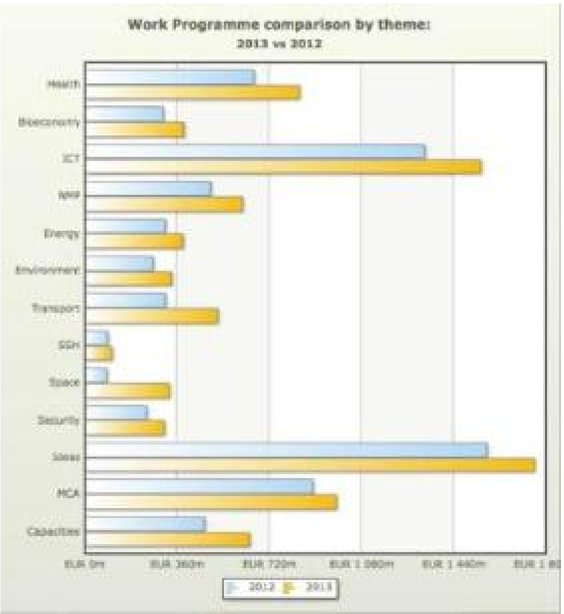
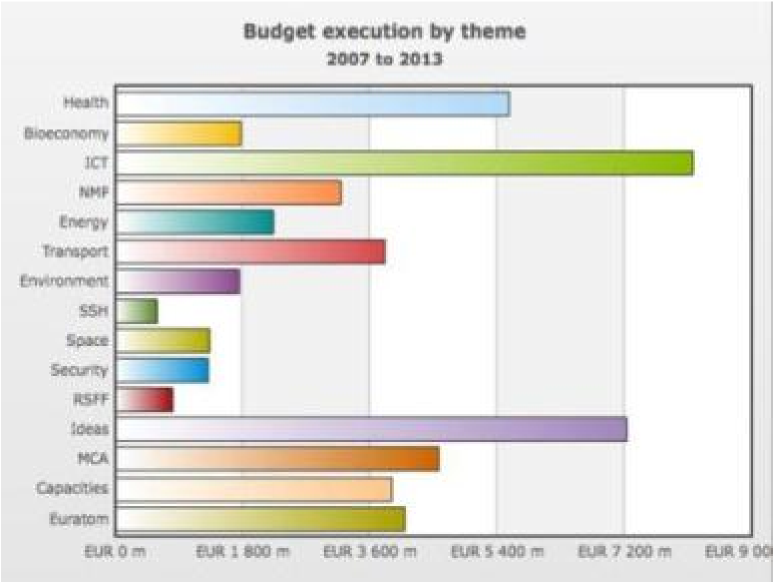


Figure 8-5 Budget execution by theme



Source: http://ec.europa.eu/research/fp7/index_en.cfm?pg=budget

Climate change research in FP7 aimed to support projects that analyse the pressures on the environment (oceans, land, atmosphere and ecosystems) and improved our understanding of the complex climate system, also through Earth System modelling. Another key research area is assessing impacts, vulnerabilities and solutions for adapting to climate change, developing strategies for disaster risk reduction and to stimulate a transition to a low-carbon climate-resilient society.

While some calls are still open and a final figure cannot yet be given, a rough estimation indicates that from 2007 to 2013 in FP7 over € 800 Million were spent on supporting climate change research[212]. The majority of the funding was provided for collaborative research projects within the 'Cooperation' programme, complemented by other funding for research infrastructures for climate observations and modelling and for investigator-driven 'frontier' research awarded by the European Research Council (ERC)[213]. These dedicated climate research activities are complemented by other activities funded by the Framework Programme, notably on energy and transport, which contribute to the identification and development of mitigation technologies and options through energy efficiency, renewable energy, carbon capture and storage and more environmentally friendly transport systems.

Horizon 2020, set up for the period 2014-2020, contains the objective of reaching 35% climate relevant expenditures.

LIFE+

The current phase of the programme, LIFE+, runs from 2007-2013 and has a budget of € 2.143 billion. LIFE+ covers both the operational expenditure of DG Environment and the co-financing of projects. According to Article 6 of the LIFE+ Regulation, at least 78% of the LIFE+ budgetary resources must be used for project action grants (i.e.

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213 http://erc.europa.eu/

LIFE+ projects). LIFE+ is open to public or private bodies, actors or institutions registered in the European Union. Project proposals can either be submitted by a single beneficiary or by a partnership, which includes a coordinating beneficiary and one or several associated beneficiaries. They can be either national or transnational, but the actions must exclusively take place within the territory of the 27 Member States of the European Union.

Under the next EU budget, the Commission wants to increase support for climate activities through all major EU funding programmes (e.g. European Agricultural Development Fund, European Regional Development Fund, Horizon 2020) to 20% of the overall EU budget. LIFE brings added value by addressing the specific needs of climate and environmental projects.

For the 2014-2020 period, the new LIFE Programme for Environment and Climate Action will have a budget of €3.46 billion, including a new €864 million sub-programme for climate action (LIFE Climate Action). This amounts to a tripling of the climate action budget compared to the LIFE+ programme, focussing on reducing greenhouse gas emissions; increasing resilience to climate change; and increasing awareness, communication, and exchange of information on climate actions.

Other

The EU is also largely supporting the Sentinel space programme, within the Copernicus programme through the funding of the procurement of a panoply of dedicated satellites and the associated operations.

8.3. Summary information on GCOS activities

GCOS is intended to be a long-term, user-driven operational system capable of providing the comprehensive observations required for:

- monitoring the climate system
- detecting and attributing climate change
- assessing impacts of, and supporting adaptation to, climate variability and change
- application to national economic development and
- research to improve understanding, modelling and prediction of the climate system.

As contributing to GCOS, the EU contributes to the collection of Atmospheric, Oceanic and Terrestrial Essential Climate Variables (ECVs) through Copernicus, the European system for monitoring the Earth.

On 26 September 2008, the 5th Space Council welcomed the progress made with the implementation of the European Space Policy and highlighted new priority areas in a Resolution adopted both by the Council of the EU (Competitiveness) and by the Ministerial Council of the European Space Agency (ESA).

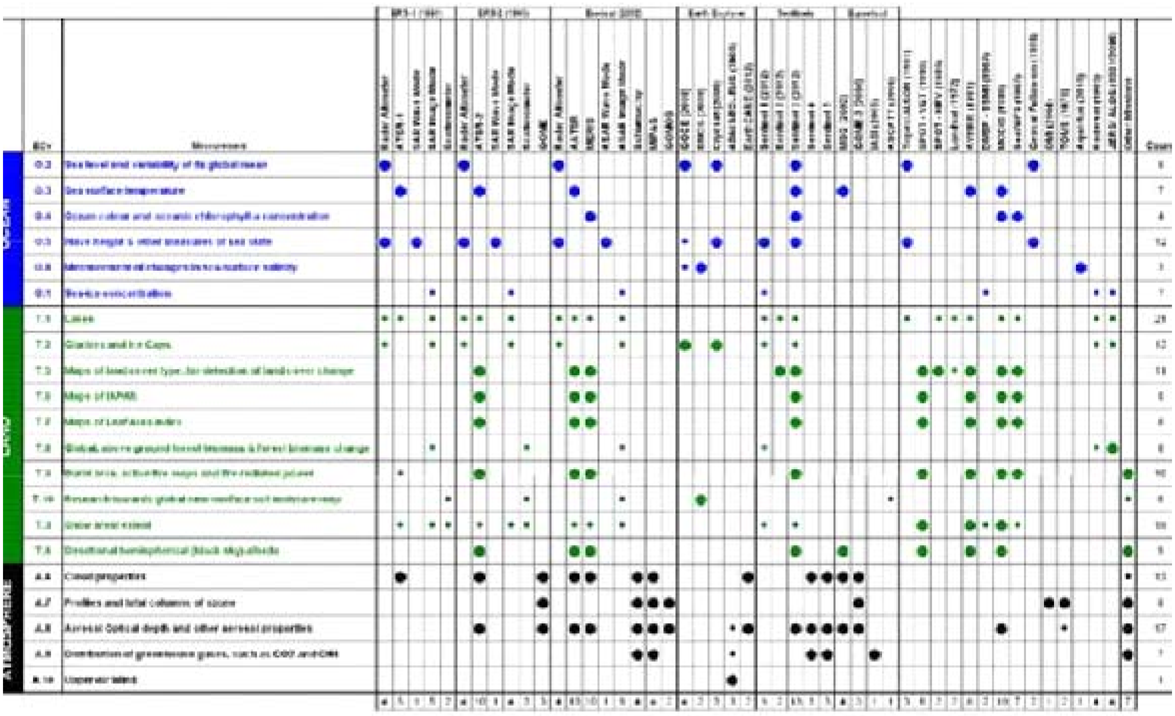
The Resolution also took stock of the progress made with the two European flagship programmes Galileo and Copernicus (formerly called GMES), and called for the scientific community, in conjunction with the European Commission, ESA and EUMETSAT, to define how the range of GMES (presently Copernicus) services and

European space observation archives can contribute most effectively to the provision of data including ECVs for scientific research.

The European Commission has undertaken to evaluate the status quo and future plans for the provision of climate data and identify what actions are required to build on existing and planned capacities to secure a dependable and comprehensive information source for climate data. The Copernicus' Climate Change service will in particular contribute to the provision of Essential Climate Variables (ECVs), climate analyses and projections at temporal and spatial scales relevant to adaptation and mitigation strategies for the various Union's sectoral policies.

Figure 8-6 shows how ESA and other European missions contribute to ECVs data collection.

Figure 8-6 How ESA and other European missions contribute to ECVs.



Source:
http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/13553/1/cc_and_space_final_report_100310_jrc_report.pdf

8.4. Research

The following sections present the main research projects related to:

- the climate process and climate system studies, including re-analysis and paleoclimate studies
- research on the impacts of climate change
- socio-economic analysis, including analysis of both the impacts of climate change and response options and

- research and development on mitigation and adaptation technologies.

These projects presented below provide examples of research projects undertaken; a full list is available in the European research on climate change catalogue[214].

8.4.1. Climate process and climate system studies, including paleoclimate studies

8.4.1.1. EU-WATCH[215]

Title	Water and Global Change
Instrument	Specific Targeted Research Project, FP6
Total Cost	€ 13 878 339
EU Contribution	€ 9 980 096
Duration	54 months
Start Date	1/2/2007
Consortium	25 partners, 14 countries
Project Coordinator	Centre for Ecology and Hydrology
Key Words	Water cycle, climate change, floods, droughts, feedbacks, water resources, landuse change, extremes, climate data

Main projects objectives include uniting the hydrological, water resources and climate communities to analyse, quantify and predict the components of the current and future global water cycles. To assess related water resources, evaluate their uncertainties and clarify the overall vulnerability of global water resources related to the main societal and economic sectors. WATCH has analysed and described the current global water cycle, especially changes in extremes (droughts and floods). It is also evaluating, in a consistent way, how the global water cycle and its extremes will respond to future drivers of global change (including increasing greenhouse gas concentrations and land cover change). An essential component of the analysis of the 20th and 21st century global water cycle will be a better understanding of feedbacks in the coupled system as they affect the global water cycle and the uncertainties in coupled climate-hydrological model predictions using a combination of model ensembles and observations. Finally WATCH will provide comprehensive quantitative and qualitative assessments and predictions of the vulnerability of the water resources and water-climate-related vulnerabilities and risks for the 21st century.

214 European Research on Climate Change Funded by the Seventh Framework Programme http://bookshop.europa.eu/en/research-on-climate-change-pbKI0313365/downloads/KI-03-13-365-EN-C/KI0313365ENC_002.pdf?FileName=KI0313365ENC_002.pdf&SKU=KI0313365ENC_PDF&CatalogueNumber=KI-03-13-365-EN-C

215 www.eu-watch.org

For the first time the global hydrological cycle has been assessed on a daily timeframe. The common methodologies developed between the climate and hydrology communities have enabled a coherent assessment of the global water cycle. These exemplar datasets and methodologies have led to substantial model development and greatly increased our understanding of the global water cycle.

A number of tools such as the drought and flood atlases have pushed forward our knowledge and provided useful mechanisms for assessing the frequency and severity of extremes. The location and extent of large scale droughts were satisfactorily reproduced by the model ensembles. The dividends of the close working relationship between the climate and water scientist should not be underestimated. The new consolidated data sets developed by WATCH are a strong legacy from the project which underpin its achievements and will provide a resource for environmental scientists for many years to come. In particular the 20th Century climatological data has generated much interest in the wider research community. The comparison of 13 model outputs all following the same protocol and using the same dataset have enabled many model developments. The multi-model outcomes of WATCH have also benefited the assessment of feedbacks and extremes. The quantification of uncertainties in our models of the global water cycle is leading to new ways of assessing impact and adaptation studies. Climate change, demographic and land-use change, and changing patterns of consumption all drive changes in river flow and water resources. Overall WATCH has delivered a new appreciation of the interaction between the drivers of past and future changes in water resources.

8.4.1.2. PAGE21[216]

Title	Changing Permafrost in the Arctic and its Global Effects in the 21st Century
Instrument	Large-scale integrating collaborative project under the ENV call topic "Vulnerability of Arctic permafrost to climate change and implications for global GHG emissions and future climate" (ENV.2011.1.1.3-1)
Total Cost	€ 9 269 927
EU Contribution	€ 6 951 895
Duration	48 months
Start Date	1/11/2011
Consortium	18 partners from 11 countries
Project Coordinator	The Alfred Wegener Institute for Polar and Marine Research (Germany)
Key Words	Permafrost, arctic, climate change, carbon

The key objectives of PAGE21 are:

- to improve our understanding of the processes affecting the size of the arctic permafrost carbon and nitrogen pools through detailed field studies and monitoring, in order to quantify their size and their vulnerability to climate change,
- to produce, assemble and assess high-quality datasets in order to develop and evaluate representations of permafrost and related processes in global models,
- to improve these models accordingly,
- to use these models to reduce the uncertainties in feedbacks from arctic permafrost to global change, thereby providing the means to assess the feasibility of stabilization scenarios, and
- to ensure widespread dissemination of our results in order to provide direct input into the ongoing debate on climate-change mitigation.

The timing of this project is such that the main scientific results from PAGE21, and in particular the model-based assessments will build entirely on new outputs and results from the CMIP5 Climate Model Intercomparison Project designed to inform the IPCC Fifth Assessment Report.

216 http://page21.eu

However, PAGE21 is designed to leave a legacy that will endure beyond the lifetime of the projections that it produces. This legacy will comprise

- an improved understanding of the key processes and parameters that determine the vulnerability of arctic permafrost to climate change,
- the production of a suite of major European coupled climate models including detailed and validated representations of permafrost-related processes, that will reduce uncertainties in future climate projections produced well beyond the lifetime of PAGE21, and
- the training of a new generation of permafrost scientists who will bridge the long-standing gap between permafrost field science and global climate modelling, for the long-term benefit of science and society.

8.4.1.3. ATP[217]

Title	Arctic Tipping Points
Instrument	FP7, Collaborative project
Total Cost	€ 6 545 464
EU Contribution	€ 4 998 098
Duration	2009-2012
Start Date	01/02/2009
Consortium	13 partners from 11 countries
Project Coordinator	Paul Wassmann UoT, Norway
Key Words	Climate change, Arctic marine ecosystems, time-series, ecological thresholds, regime shifts, early warning indicators, socio-economic impacts, EU policy integrated management.

The objectives of the project included to investigate the existence of climate-driven tipping points for key species and ecosystem processes through analysis of available time-series data and coordinated experimental evaluations. These experimental evaluations will be used to validate the thresholds identified from time-series analysis, and to postulate new climate-driven tipping points. Ecosystem models will test these, and help to formulate future trajectories of Arctic marine ecosystems under climate change scenarios that consider the possibilities of tipping points.

Main results of the project include:

217 www.eu-atp.org

- identified climate thresholds and tipping points for key Arctic marine ecosystem components and processes
- modelled future trajectories, tipping points and regime shifts through coupled physical/biological and regional climate models
- development of early-warning indicators of climatic thresholds for major phytoplankton taxa
- evaluation of expected changes in relationships between a) climate forcing and biological responses and b) ecosystem components and their inter-relationships during regime shifts
- assessments of the implications of changes in the Arctic for socio-economic activities and governance of Arctic resources
- white paper evaluating different policy options in avoiding exceeding tipping points for Arctic ecosystems.

8.4.1.4. ICE2SEA[218]

Title	Ice2sea – estimating the future contribution of continental ice to sea-level rise
Instrument	Collaborative project – Large-scale integrating project, FP7
Total Cost	€ 13 632 213
EU Contribution	€ 9 994 842
Duration	51 months
Start Date	1/03/2009
Consortium	24 partners from 13 countries
Project Coordinator	British Antarctic Survey, Natural Environment Research Council (United Kingdom)
Key Words	Sea-level rise, glaciers, IPCC, climate change

Ice2sea is a collaborative research programme involving 24 institutional partners. Ice2sea is specifically focussed on the contribution to sea-level rise that will arise from loss of continental glaciers and ice sheets and which give rise to the largest part of the uncertainty in the projections.

The ice2sea programme receives funding from FP7 and from the many national agencies funding the institutional partners.

218 http://www.ice2sea.eu

The programme ran for four years, (2009-2013) with a schedule designed to provide input to the next Intergovernmental Panel on Climate Change (IPCC) assessment of climate change and its impacts.

From its outset, ice2sea had twin goals of improving the science that underpins sea-level prediction, and of providing new sea-level projections based on the most up-to-date climate projections. These goals have been realised through:

- targeted studies of key processes in mountain glaciers, ice caps, and in the polar ice sheets (Greenland and Antarctica)
- improved satellite determinations of current changes in continental ice mass
- development of more reliable techniques for predicting the response of ice-sheets and glaciers to environmental change
- delivery of comprehensive projections of the contribution of continental ice to sea-level rise over the next 200 years.

The ice2sea projections based on simulations of physical processes suggest lower overall contributions from melting ice to sea-level rise than many studies published since IPCC fourth assessment report (AR4) (2007).

For the “business as usual” mid-range emissions scenario (A1B), the ice2sea projections based on simulations of physical process suggest a range of contributions to sea-level rise slightly higher than the ‘incomplete’ projections presented in the IPCC AR4 (2007). However, they are considerably lower than several high-end projections published since AR4. To obtain a projection of total global sea-level rise, other contributions, not explicitly addressed by ice2sea, must be added (e.g. thermal expansion of the oceans, and changes in terrestrial water storage).

For the period after 2100, sea levels will continue to rise, initially at an accelerating rate, for many centuries.

8.4.2. Modelling and prediction, including general circulation models

Understanding climate variability is of prime importance for assessing climate change projections and designing adaptation strategies accordingly. The Arctic is the most vulnerable region to climate change. During the last 100 years, the Arctic atmosphere has warmed up almost twice as fast as the global average. Arctic sea ice cover has rapidly thinned and decreased during at least three decades. For example September 2008 and 2009 had the second and third lowest summer sea ice extents in the Arctic ever observed; Arctic sea ice might completely disappear in summer by the end of this century.

8.4.2.1. AMAZALERT[219]

Title	AMAZALERT – Raising the alert about critical feedbacks between climate and long-tern land use change in the Amazon
Instrument	SP1-Cooperation; Collaborative project FP7, Funding Scheme: SICA
Total Cost	€ 4 757 920
EU Contribution	€ 3 494 420
Duration	36 months
Start Date	1/09/2011
Consortium	14 partners from 9 countries
Project Coordinator	• Stichting Dienst Landbouwkundig Onderzoek – ALTERRA (Netherlands)
Key Words	Amazonia, deforestation, climate change, REDD, tipping points, early warning system, climate feedbacks, CO_2, policy earth model, DGVM

AMAZALERT will:

- identify the most important ecosystem services represented by Amazonia
- analyse and improve coupled models of global climate and Amazon land use, vegetation and socio-economic drivers to quantify anthropogenic and climate induced land-use and land cover change and non-linear, irreversible feedbacks among these components
- assess the potential role of regional and global policies and societal responses in the Amazon region for altering the trajectory of land-use change in the face of climate change and other anthropogenic factors
- propose an Early Warning System (EWS) for detecting any imminent irreversible loss of Amazon ecosystem services
- propose policy response strategies to avoid such loss.

Halfway the project, first important results have been achieved:

- the most important ecosystem services of the Amazon: maintaining water cycling and climate, carbon storage, regional production and biodiversity
- multi-model projections for the Amazon basin from the state-of-the-art in climate and earth system modelling were presented. The simulations were

219 http://www.eu-amazalert.org

carried out according to different IPCC scenarios of greenhouse gas concentrations including land use change consistent with development pathway and policy decisions

- first simulations with vegetation and climate models show a challenge to correctly represent biomass, temperature and CO2 sensitivity of forest growth
- field work has addressed temperature and drought sensitivities
- a set of detailed land use change scenarios have been simulated
- the boundary conditions for an early warning system have been defined
- policy research identified both national and international policies and initiatives affecting land use in the Amazon – directly and indirectly.

In 3 years' time, the project should provide a set of greatly improved tools to evaluate, and assist in political decisions on, the future management of the Amazon region, including ways to monitor the functioning of the Amazon to avoid immanent, irreversible changes to its environment. This means:

- sets of scenarios that include both the response of the natural system to climate and land-use change, as well as the likely effects of policies and the possible response of the agriculture and society to Amazon degradation. These scenarios will aid in evaluating possible courses of action.
- a blueprint for an early warning system of irreversible change, based upon a monitoring network, including land surface cover, climate, rivers, and socio-economic indicators.

8.4.2.2. CARBOCHANGE[220]

Title	Changes in carbon uptake and emissions by oceans in a changing climate
Instrument	Collaborative Project (large-scale integrating project) FP7
Total Cost	€ 9 556 960
EU Contribution	€ 6 989 906
Duration	48 months
Start Date	01/03/2011
Consortium	28 partners from 15 countries
Project Coordinator	University of Bergen (Norway)
Key Words	Climate, Environment

CARBOCHANGE provides the best possible process-based quantification of net ocean carbon uptake under changing climate conditions using past and present ocean carbon cycle changes for a better prediction of future ocean carbon uptake. The consortium improves the quantitative understanding of key biogeochemical and physical processes through a combination of observations and models. New process understanding is up-scaled to large-scale integrative feedbacks of the ocean carbon cycle to climate change and rising carbon dioxide concentrations. The vulnerability of the ocean carbon sources and sinks are quantified in a probabilistic sense.

Results will be optimal process descriptions and most realistic error margins for future ocean carbon uptake quantifications with models under the presently available observational evidence. The project will deliver calibrated future evolutions of ocean pH and carbonate saturation as required by the research community on ocean acidification. The time history of atmosphere-ocean carbon fluxes past, present and future are synthesised globally as well as regionally. Observations and model results will merge into GEOSS/GEO through links with the European Research Infrastructure ICOS. The project is a key contributor to annual worldwide carbon budget updates. The results will be communicated to policy makers.

220 http://www.carbochange.eu

8.4.2.3. GHG EUROPE[221]

Title	Greenhouse gas management in European land use systems
Instrument	FP7 Large-scale Integrating Project
Total Cost	€ 8 925 737
EU Contribution	€ 6 648 703
Duration	45 months
Start Date	01/01/2010
Consortium	41 partners from 15 countries
Project Coordinator	Johann Heinrich von Thünen-Institut (Germany)
Key Words	greenhouse gas, land use management, climate change, carbon balance

GHG-Europe aims to improve our understanding and capacity for predicting the European terrestrial carbon and greenhouse gas (GHG) budget by applying a systematic, comprehensive and integrative approach. GHG-Europe quantifies the annual to decadal variability of the carbon and GHG budgets of terrestrial ecosystems via data-model integration, diagnostic and predictive modelling. Ultimately, the scientific challenge is to determine how, and to what degree, the carbon cycle and GHG emissions in terrestrial ecosystems can be managed.

An important finding for forests was that the stimulatory effect of nitrogen deposition in most European forests does not stem from increased photosynthesis, but from increased carbon allocation to wood. This could increase forest vulnerability to extreme events.

Although afforestation is thought to sequester carbon it turned out that afforested grasslands accumulate labile soil organic carbon but the stable fractions are depleted. This makes the soil carbon pool more vulnerable to future disturbance and loss.

Croplands are the largest N_2O source in Europe. Sensitivity analyses with models showed that there is some scope for mitigation by changes in the timing and forms of fertilizer applications.

221 www.ghg-europe.eu

8.4.2.4. COMBINE[222]

Title	Comprehensive Modelling of the Earth System for Better Climate Prediction and Projection
Instrument	Collaborative and large-scale Integrating Project
Total Cost	€ 11 423 157
EU Contribution	€ 7 922 679
Duration	48 months
Start Date	01/05/2009
Consortium	23 partners from 14 countries
Project Coordinator	Max Planck Institute for Meteorology, Max-Planck-Gesellschaft (Germany)
Key Words	Earth system model, processes, initialization, decadal climate prediction, climate projection, impacts, scenarios, climate policies

The overarching objectives of the COMBINE project are:

- to advance the prediction capabilities of ESMs by including critical physical and biogeochemical processes ("new components") into the models
- to represent more accurately the forcing mechanisms and the feedbacks determining the magnitude of climate change in the 21st century
- to assess, improve and implement new strategies of ocean and sea-ice initialization techniques for decadal climate prediction
- to combine ESMs and integrated assessment models to find revised CO2 emission scenarios, including those scenarios constructed on the basis of climate policy
- to assess climate change impacts on water availability and agriculture, globally and more specifically in three selected regions: The Arctic, the Eastern Mediterranean and the Amazon basin, where different feedbacks are important.

The COMBINE partners have advanced significantly on developing the scientific and technical foundations for incorporating new components in ESMs. The first phase of the COMBINE numerical experiments has been completed. The main results achieved so far are:

222 www.combine-project.eu

- implementation and testing of land use changes and wildfire impacts, processes for the terrestrial and oceanic nitrogen cycles, and processes related to methane emissions from permafrost and wetland changes
- evaluations of cloud-radiation and aerosol--cloud effects and land use impacts on tropospheric chemistry
- incorporation of tropical and polar stratospheric dynamical variability in ESMs
- improved understanding of processes regulating ice-sheet surface energy and mass balances; increased realism of the representation of surface snow processes in both ice-sheet and sea-ice models
- a new ocean re-analysis has been conducted using up-to-date quality-controlled ocean observation data sets and atmospheric forcing fluxes, with significant progress in sea-ice assimilation
- decadal prediction and centennial projection following the Coupled Model Inter-comparison Project phase 5 (CMIP5) protocols completed with the relevant COMBINE ESMs. The decadal experiments have been initialized using observation based ocean state estimates. The combined results of the new ESMs and integrated assessment models will provide new information to the policy makers on the necessary reduction in CO2 emissions for reaching defined targets in global warming, with implications for international climate negotiations. The results obtained will contribute not only to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, but also directly to European climate policies. Harmonisation and standardisation of climate simulations and model data will contribute to further strengthen the European climate modelling community and the European voice in international climate negotiations.

8.4.2.5. SPECS[223]

Title	Seasonal-to-decadal climate Prediction for the improvement of European Climate Services
Instrument	Collaborative Project large scale integrating project
Total Cost	€ 11 785 694
EU Contribution	€ 8 224 862
Duration	51 months
Start Date	1/11/2012
Consortium	20 partners, 9 countries
Project Coordinator	• Fundació Institut Català de Ciències del Clima (IC3), Spain
Key Words	Climate prediction, climate services, climate modelling, forecast reliability, forecast quality, initialisation, calibration, downscaling, impact assessment, operational prediction

The project's objectives include:

- evaluation of the forecast quality of current climate forecast systems
- test specific hypotheses for the improvement of s2d predictions
- integrate the best observational data of the climate system as initial conditions
- improve forecast quality by better initialization and by increasing the spatial resolution of the forecast systems
- achieve a best assessment of the uncertainties in climate prediction
- perform reliable and accurate local-to-regional predictions via the combination and calibration of the information from different sources and a range of state-of-the-art regionalisation tools
- illustrate the usefulness of the improvements for climate services and better communicate actionable climate information
- support the European contributions to WMO research initiatives on s2d climate prediction.

SPECS will be the origin of a new generation of European climate forecast systems, with improved forecast quality including better reliability, higher resolution, a simpler access to their data and an exhaustive documentation. This will result in more actionable

223 http://www.specs-fp7.eu/SPECS/Home.html

operational seasonal forecasts and the advancement towards a better understanding of the usefulness of decadal predictions.

The processes responsible for s2d climate predictability will be better understood, including those linked to the changes in both natural and anthropogenic forcings. This knowledge will be used to interpret an ambitious set of coordinated global forecast experiments that aim to assess the role of the appropriate initialization of different components of the climate system (sea ice, continental surfaces, atmospheric composition) and of the necessary model improvement (increased resolution, atmospheric chemistry, vegetation, ocean-atmosphere coupling).

A set of functions in the R language with standardized input-output will be created to perform statistical downscaling in a climate-prediction context. They will be merged with existing and new forecast verification functions to be publicly released as the first tool of its kind. This will provide a long-lasting response to the demand of local climate predictions for specific services.

SPECS will also provide a coordinated European response to and leadership in the different international initiatives in climate prediction, as well as a set of case studies illustrating the socio-economic benefits of climate prediction.

At the end of the SPECS project, climate predictions and climate-change projections will be brought closer together for the benefit of both climate services and the advancement of climate adaptation.

8.4.3. *Research on the impacts of climate change*

8.4.3.1. CLIMAFRICA[224]

Title	Climate change predictions in Sub-Saharan Africa: impacts and adaptations
Instrument	Collaborative Project
Total Cost	€ 4 662 503
EU Contribution	€ 3 496 232
Duration	48 months
Start Date	01/10/10
Consortium	The ClimAfrica consortium is formed by 18 institutions, 9 from Europe, 8 from Africa, and the Food and Agriculture Organization of the United Nations (FAO). African countries directly involved are: Burkina Faso, Congo, Ghana, Kenya, Malawi, South Africa, Sudan and Togo
Project Coordinator	Euro-Mediterranean Centre on Climate Change (CMCC), Italy
Key Words	Sub-Saharan Africa, Climate Predictions, Climate Impacts, Adaptation, Agriculture and Water Resources, Socio-economic Analysis

ClimAfrica aims at producing the most appropriate and up-to-date tools to better understand and predict climate change in Sub-Saharan Africa (SSA) for the next 10-20 years, analysing the expected impacts on water and agriculture and proposing adaptation strategies tailored to the African context. Specific objectives are:

Develop improved climate predictions for SSA on seasonal to decadal scale

Assess climate impacts in key sectors of SSA livelihood and economy, like water resources and agriculture

Evaluate the vulnerability of ecosystems and civil population to inter-annual variations and decadal trends in climate

Suggest and analyse new adaptation strategies suited to SSA

Develop a new concept of medium term monitoring and forecasting warning system for food security, risk management and civil protection

Analyse the economic impacts of climate change on agriculture and water resources in SSA and the cost-effectiveness of potential adaptation measures.

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224 www. climafrica.net

The results include state of the art data streams of remotely sensed land surface properties, harmonized meteorological reanalysis, and synergistic land use products are already available; among them a 30+ year (1979-2010) record of global daily soil moisture database, with 0.25 degree spatial resolution. ClimAfrica is already delivering improved climate predictions, ranging from 50 km to 25 km resolution, from the dynamical downscaling, and to point resolution, from statistical downscaling, for the specific field studies carried out in Burkina Faso, Congo, Ethiopia, Ghana, Kenya, Malawi, Sudan, Tanzania, and Togo. The resolution will be even higher for the impact models on water balance and main crop types, i.e. Sorghum, Maize, Millet, Rice, and Cassava. Other expected results are: new adaptation strategies suited to local needs; the assessment of economic implications of climate change impacts and adaptation options; a prototype of a medium term monitoring and forecasting warning system for food security, risk management and civil protection.

8.4.3.2. CLICO[225]

Title	Climate Change. Hydro-conflicts and Human Security
Instrument	Collaborative Project – Theme 8, Socio – Economic Sciences and Humanities (SSH)
Total Cost	€ 3.766.269
EU Contribution	€ 2.991.352
Duration	36 months
Start Date	01/01/2010
Consortium	14 partners from 11 countries
Project Coordinator	Unversitat Autonoma de Barcelona (Spain)
Key Words	Water, droughts, floods, climate change, conflict, security, vulnerability, adaptation, transboundary management, institutions, Middle East, Sahel, socio-economic sciences and humanities

CLICO explored the social dimensions of climate change and in particular the conditions under which hydro-climatic hazards, such as drought or floods, may infringe upon the security of human populations. The project focused on the geographical areas of the Mediterranean, Middle East and the Sahel, and on water-related stresses such as droughts, floods and sea-level rise, expected to intensify with climate change. More concretely, the project pursued the following objectives:

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To understand relationships between hydro-climatic hazards, climate change vulnerability, human security and conflict, through theoretically-informed, comparative, empirical, quantitative and qualitative social science research.

To map international and national policies for security and adaptation in water resources and hazard management, and develop policy priorities as regards hydro-climatic hazards ("hydro-security") in the region, applicable to the UN, EU and national states.

Key findings:

- climate change is one among many factors affecting human security
- climate change is less influential than political, economic and social factors in causing or exacerbating water-related conflicts (for majority of CLICO studies)
- states are important actors in adaptation, but not the only ones; civil society and self-adaptation are also relevant
- climate change adaptation can increase human insecurity and conflict, e.g. via divergent or mal-adaptations

Recommendations for policy-makers:

- address root causes of vulnerability, such as poverty, lack of knowledge and institutions plagued by corruption
- strengthen social security systems is an effective way for improving human security
- affected groups should be empowered to influence adaptation decisions
- integrating policies, e.g. link adaptation to policy agendas such as human development and poverty reduction
- implementing some existing policies could improve human security
- avoiding simplistic explanations on the impact of climate change on conflict.

8.4.3.3. CLIMB[226]

Title	Climate Induced Changes on the Hydrology of Mediterranean Basins: Reducing Uncertainty and Quantifying Risk through an Integrated Monitoring and Modelling System
Instrument	CP-SICA
Total Cost	€ 4 157 348
EU Contribution	€ 3 148 945
Duration	48 months
Start Date	1st January 2010
Consortium	21 beneficiaries from 9 countries
Project Coordinator	Ludwig-Maximilians-Universitaet Muenchen, Department of Geography (DE)
Key Words	Mediterranean, climate change impacts, uncertainty, environmental monitoring, hydrological modelling, socio-economic factor assessment, risk assessment

CLIMB improves modelling capabilities and develops appropriate tools to advance the capacity to assess climate effects on water resources and uses. The project consortium employs a combination of novel field monitoring concepts, remote sensing techniques, integrated hydrologic (and biophysical) modelling and socioeconomic factor analyses to reduce existing uncertainties in cli-mate change impact analysis and to create an integrated quantitative risk and vulnerability assessment tool.

This tool will serve as a platform for the dissemination of scientific project results and the communication with and planning for local and regional stakeholders.

The analysis of climate change impacts on available water resources is targeted to selected mesoscale river or aquifer catchments, representing water management units for regional water authorities. Study sites are located in Sardinia, Northern Italy, Southern France, Turkey, Tunisia, Egypt and the Palestinian-administered area Gaza.

In its effort to grant easy-access to data and results from the project, CLIMB will develop a WebGIS-Server and Client architecture open to the public. It will disseminate the impacts of cli-mate change on selected hydrological indicators, including a rigorous assessment of related uncertainties, as determined from the multi-model ensembles employed in the seven case studies. Further, it will comprise a risk modelling tool, assessing the risk of income loss and out-migration due to water shortages in agriculture, forestry and the tourism sector, based on the identification of key socio-economic indicators. Site-specific adaptive measures will be proposed and

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recommendations for future water resources management will be given, taking into account a thorough diagnosis of climate change impacts on water uses and rivalries. Further, it is expected that CLIMB results can be regionalized in general for water-stressed areas, in which climate and socioeconomic conditions render water-related problems compelling and urgent. This can happen in various ways to:

- foster and intensify the dialogue between scientists, managers, water experts and stakeholders in addressing local impacts of climate changes and identifying means for their assessments
- raise awareness among stakeholders about climate change impacts on water resources and land uses, which will lead to adequate approaches and adaptation strategies for water resources management and for food security
- empower stakeholders and scientists by providing new tools of decisions making in assessing climate change impacts.

These science-management-policy links are indispensable to provide visibility of the research findings beyond the borders of the scientific community and will allow for an uptake of research results into policy and management practice. An important output of the research in the individual study sites will be the development of a set of recommendations for an improved monitoring and modelling strategy for climate change impact assessment, addressing in particular the minimum requirements towards data collection and model complexity to achieve sufficient predictive power for climate change impact assessment in the targeted regions and beyond.

8.4.3.4. WASSERMED[227]

Title	Water Availability and Security in Southern EuRope and the Mediterranean
Instrument	FP7 Collaborative Project
Total Cost	€ 3 669 943
EU Contribution	€ 2 933 973
Duration	39 months
Start Date	1 January 2010
Consortium	12 partners from 9 countries
Project Coordinator	Prof. Roberto Roson (CMCC, IT)
Key Words	Water scarcity, water security, climate change, Mediterranean region

WASSERMed is an interdisciplinary project, which overall aims at all three targets of the call through the integration of climate change scenarios, holistic water system modelling and interdisciplinary impact assessment.

The WASSERMed Project analyses, in a multi-disciplinary way, ongoing and future climate induced changes in hydrological budgets and extremes in southern Europe, North Africa and the Middle East under the frame of threats to national and human security. This includes the assessment of changes in mean flows, frequency and magnitude of extreme precipitation (intensity and duration), surface run-off, stream flows ground water balance, as well as social and economic factors.

Five case studies have been considered:

- Syros Island (Cyclades Complex, Greece), a region which is characterised by multiple water uses and experiences significant tourism development in recent years,
- Sardinia Island (Italy), with huge water demand and conflicting water uses between agricultural and tourism sectors,
- Merguellil watershed (Tunisia), a river basin which concentrates multiple and conflicting water uses,
- Jordan river basin, where the Case Study will focus mainly on trans-boundary water management and conflicting water demands, and

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- the Nile River system, focusing mainly on Egypt and issues related to inter-regional water supply-demand balances and allocation.

The impact of climate change on the Mediterranean agricultural sector will likely be affected by water availability and could be prevalently:

- positive for the Northern Mediterranean countries and areas characterized by relatively cold and humid climate, and
- negative for the Southern Mediterranean countries and the areas already characterized by arid and semi-arid conditions.

The extension of the areas suitable for cultivation toward the Northern latitudes and higher altitudes and the overall expansion of the cultivation season could bring benefits especially to the Northern Mediterranean countries.

Results of the macroeconomic analysis of the consequences of climate change on agricultural productivity and tourism attractiveness indicate that several Mediterranean countries will likely face water shortages with significant implications in terms of agricultural productivity, income and welfare. The analysis of climate change impacts on tourism indicates that conditions will remain favourable for outdoor activities in the Mediterranean basin; however a change in seasonality is foreseen. Particularly, negative impacts for summer tourism are foreseen in Southern Mediterranean countries, whereas the situation is different for northern countries.

Different policy and adaptation options have emerged in the five case studies. However, similarities and recurrent issues have also been noticed: solutions for increased water productivity, recycling, desalination, water harvesting.

8.4.3.5. IMPACT2C[228]

Title	Quantifying projected impacts under 2°C warming
Instrument	Collaborative project (large-scale integrating project), FP7
Total Cost	€ 8 447 372
EU Contribution	€ 6 499 999
Duration	48 months
Start Date	1/10/2011
Consortium	29 partners from 17 countries
Project Coordinator	Coordinator: Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung
Key Words	Climate change, 2°C warming, impacts, vulnerability, risks, adaptation, decision making, sector, floods, droughts, water availability, water management, agriculture, forestry, health, air pollution

The project aims at:

- providing detailed information based on an ensemble of climate change scenarios, plus statistics and derived indices, tailored to the needs of various sectors, for the time slice in which the global temperature is simulated to be 2oC above pre industrial levels
- giving a detailed assessment of risks, vulnerabilities, impacts and associated costs for a broad range of sectors against the background of socio-economic scenarios consistent with the development paths aimed at global warming being limited to 2oC
- developing an optimal mix of response strategies (technological, governance, capacity building) accounting for the regional differences in adaptive capacities, which are distinguished between those that can be accommodated autonomously and those that require additional policy interventions.

Expected results comprise:

- estimating the key impacts of a 2 ºC (1.5 ºC) climate change signal for different regions and sectors, both in Europe and outside, and suggesting appropriate response strategies;

228 http://www.impact2c.eu

- tailoring the scenarios to the needs of the sectoral impact modellers by providing bias corrections, downscaled products and derived statistics and associated uncertainties;
- developing integrated (climate – impact – cost) assessments of uncertainty in support of the (cross) sectoral climate change impact and adaptation projections, developing policy guidelines to deal with these uncertainties.

IMPACT2C draws this information together in a synthesis report that highlights the risks, trade-offs, synergies and costs. This will be particularly useful for European authorities who participate in international negotiations on climate change.

The project also includes an ambitious awareness-raising programme that will disseminate the findings effectively and provide easily accessible climate-related information to policy-makers, the media, and users in general.

8.4.4. Socio-economic analysis, including analysis of both the impacts of climate change and response options

8.4.4.1. CLIMATE-ADAPT[229]

The European Climate Adaptation Platform (CLIMATE-ADAPT) is a partnership between the European Commission (DG Climate Action, Joint Research Centre and other DGs) and the European Environment Agency.

CLIMATE-ADAPT aims to support Europe in adapting to climate change. It is an initiative of the European Commission and helps users to access and share data and information on:

- expected climate change in Europe
- current and future vulnerability of regions and sectors
- EU, national and transnational adaptation strategies and actions
- adaptation case studies and potential adaptation options
- tools that support adaptation planning.

CLIMATE-ADAPT organises information under the following main entry points:

- adaptation information (observations and scenarios, vulnerabilities and risks, adaptation measures, national adaptation strategies, research projects)
- EU sector policies (agriculture and forestry, biodiversity, coastal areas, disaster risk reduction, financial, health, infrastructure, marine and fisheries, water management)
- transnational regions, countries and urban areas
- tools (adaptation support tool, case study search tool, map viewer).

The platform includes a database that contains quality-checked information that can be easily searched.

229 http://climate-adapt.eea.europa.eu/about

8.4.4.2. ADAM[230]

Title	Adaptation and Mitigation Strategies: Supporting European climate policy
Instrument	FP6
Total Cost	€ 18 216 125
EU Contribution	€ 12 905 000
Duration	41 months
Start Date	01/03/2006
Consortium	27 partners from 15 countries
Project Coordinator	University of East Anglia, UK
Key Words	Mitigation and adaptation scenarios, climate governance, regional policy appraisal, energy technologies

The project objectives can be summarized as:

- to assess the extent to which existing and evolving EU (and world) mitigation and adaptation policies can achieve a tolerable transition to a world with a global climate no warmer than 2°C above pre-industrial levels, and to identify their associated costs and effectiveness, including assessment of the damages avoided compared to a scenario where climate change continues unchecked to 5°C
- to develop and appraise a portfolio of longer term strategic policy options addressing identified shortfalls between existing mitigation policies and the achievement of the EU's 2°C target, also between existing adaptation policy development and implied EU goals for adaptation.
- to develop a novel Policy-options Appraisal Framework, apply to existing and evolving policies, and new, long-term strategic policy options, so as to inform: European and international climate protection strategy in post-2012 Kyoto negotiations, a re-structuring of International Development Assistance, the EU electricity sector and regional spatial planning.

The emerging results include:

- effective climate policy involves portfolios of adaptation and mitigation activities;

230 www.adamproject.eu

- three conditions for 'achieving' 2^0C: technology innovation, global participation, 'Europeanisation';
- adaptation is about establishing process more than about delivering outcomes;
- substantial fragmentation of the global regime will reduce efficiency, effectiveness and equity;
- climate policy appraisal processes in Europe are weak and unreflexive.

The target audience for ADAM was policy-makers; the following project outputs were made available:

- policy briefings and dialogues
- a Cambridge University Press book series
- special journal issues
- journal papers.

8.4.4.3. REDD-ALERT[231]

Title	Reducing Emissions from Deforestation and Degradation through Alternative Landuses in Rainforests of the Tropics (REDD-ALERT)
Instrument	Collaborative Project (CP), FP7
Total Cost	€ 4 520 466
EU Contribution	€ 3 488 760
Duration	42 months
Start Date	1 May 2009
Consortium	12 partners from 11 countries
Project Coordinator	Dr Robin Matthews
Key Words	Climate change, REDD+, land use change, deforestation, carbon

The project's objectives are:

231 www.redd-alert.eu

- documenting the diversity in social, cultural, economic and ecological drivers of forest transition and conservation in selected case study areas in Indonesia, Vietnam, Cameroon, and Peru
- quantifying rates of forest conversion and change in forest carbon stocks using improved methods
- improving accounting of the consequences of land use change for GHG emissions in tropical forest margins including peatlands
- identifying and assessing viable policy options addressing the drivers of deforestation and their consistency with other policy approaches
- analysing scenarios of the local impacts of potential international REDD+ policies on GHG emission reductions, land use and livelihoods
- developing new negotiation support tools for stakeholders at international, national and local scales to explore options for incorporating REDD+ into post-2012 climate agreements.

Results showed that some developing tropical countries have recently been through a forest transition, thus shifting from declining to expanding forests at a national scale. However, in many of these (e.g. Vietnam), a significant part of the recent increase in national forest cover is associated with an increase in importation of food and timber products from aboard, representing leakage of carbon stocks across international borders. Avoiding deforestation and restoring forests will require a mixture of state-level command-and-control (regulatory) approaches, emerging market-based instruments (e.g. eco-certification of products, corporate environmental responsibility, stewardship agreements, and other demand-driven interventions), options, and management measures. Most of the available policy instruments tend to focus on local and proximate drivers with very few instruments that address global underlying (e.g. world demand) and national underlying drivers (e.g. population growth, the perceived need for economic growth).

Significant progress was made in the quantification of carbon and GHG fluxes following land use change in the tropics, contributing to narrower confidence intervals on peat-based emissions and their reporting standards. Specifically, it was found that net CO_2 emissions and removals contributed more than 90% to the soil net balance of all GHGs across all land-use categories on peat soils, that the overall decrease in CH_4 emissions from conversion of peat swamp forests does not offset the simultaneous increase in soil CO_2 emissions due to accelerated peat decomposition, and that forest conversion to agriculture and agroforestry significantly and highly increased soil N_2O emissions. For mineral soils, it was found that there was a strong geographic bias in the published literature, with most studies being skewed toward regions with higher precipitation and allophanic clay mineralogy, while areas with low precipitation and high activity clays were clearly underrepresented. It was also found that measurement of soil carbon stocks down to one metre was sufficient to capture changes following land use change.

Policy analysis and modelling work showed the high degree of complexity at local levels and highlighted the need to take this heterogeneity into account – it is unlikely that there will be a ‘one size fits all’ approach to make REDD+ work. It is important to see REDD+ as part of larger systems which also include arable agriculture, grasslands, wetlands, and human settlements, as these can often be a driver of deforestation (e.g. agriculture) or may represent leakage (alternative income opportunities. Dealing with any one land use component (such as forests) in isolation is likely to result in partial solutions at best as the Law of Unintended Consequences starts to operate.

There are indications that there is only a short and relatively small window of opportunity of making REDD+ work – these included the fact that forest-related emissions as a fraction of total global greenhouse gas emissions have been decreasing over time due to the increase in fossil fuel emissions, and that the cost efficiency of REDD+ may be much less than originally thought due to the need to factor in safeguard costs, transaction costs and monitoring costs.

8.4.4.4. RESPONSES[232]

Title	European responses to climate change: deep emissions reductions and mainstreaming of mitigation and adaptation (RESPONSES)
Instrument	Small or medium-scale focused research project
Total Cost	€ 4 117 787
EU Contribution	€ 3 149 659
Duration	40 months
Start Date	1 January 2010
Consortium	10 partners from 9 countries (7 EU Member States)
Project Coordinator	Institute for Environmental Studies, VU University, Amsterdam, The Netherlands
Key Words	Climate change, adaptation, EU sectoral policy, mainstreaming, low emissions scenarios

The RESPONSES project addressed policy challenges. Its overall objective was to assess integrated EU climate-change policy responses to achieve ambitious mitigation and environmental targets while at the same time reducing the Union's vulnerability to inevitable climate-change impacts. The empirical focus of the project was on five EU policy sectors: water and agriculture, biodiversity, regional and cohesion policy, health, and energy. Specifically, the project:

- developed a new set of low emission scenarios;
- developed and assessed strategies for integrating mitigation and adaptation to climate impacts into existing EU policies; and

232 www.responsesproject.eu

- identified synergies, trade-offs and conflicts between mitigation and adaptation, and identify opportunities for future EU strategies and policy measures.

Key results include:

- synergies can be achieved between greenhouse gas emissions reductions (mitigation) and increasing climate resilience (adaptation) in some areas of EU policy, such as land use management in agriculture. But for much EU policy mitigation and adaptation are likely to remain separate
- the electricity sector is critical to achieving deep emissions reductions in the EU. Under a new RESPONSES low emissions scenario for the EU, we find that a reduction of 34-43% in total EU emissions by 2050 could be achieved in the power generation sector alone, with wind generation playing a major role
- a key governance dilemma for climate adaptation mainstreaming exists between the need for central direction and the benefits of local discretion. The European Commission can play an important role in providing guidance, information and supporting capabilities on the ground. Especially for long-term investments, there will be growing benefits in opting for robust solutions that are resilient under different scenarios
- mainstreaming adaptation often involves linkages between different sectoral policies (for instance, between water and agriculture, or between cohesion and health policies). The RESPONSES project developed a way of mapping these interactions and linking them to climate vulnerabilities and adaptation strategies. There are many opportunities for cross-sectoral support for adaptation
- EU nature and biodiversity policy is implemented by providing protected areas for valuable and endangered species and ecosystem types. With changing climates, the suitability of localities for species and ecosystems will shift over time. The current policy of protecting particular species and habitats at particular places is untenable given climate change. Key adaptive responses, such as habitat restoration and ensuring coherence of reserve networks, are left to the discretion of EU Member States
- the distribution of climate vulnerabilities across the EU varies greatly by impact category (RESPONSES looked at fire, heat stress and river flooding). A new analysis, combining climate impacts with adaptive capacity, shows that climate risks, which currently exist mainly in southern Europe, will grow significantly in many parts of continental Europe by the 2040s. In contrast, for Ireland, Scandinavia, much of Poland, the Baltic countries, and most UK regions, overall impacts will remain relatively lower
- many new and emerging vector-borne diseases could potentially become endemic in Europe over the coming decades under climate change. However, based on modelling dengue fever risk in Europe, the scale of disease burden appears to be modest, even when looking at projections to the end of the century. Effective public health interventions exist for some diseases, as well as for reducing heat stress risk among vulnerable groups.

- appraising the eventual effect of policy interventions made today on mitigation and adaptation goals is fraught with problems. For adaptation, it often makes sense to focus efforts on correcting existing mal-adaptations, rather than trying to prepare for highly uncertain conditions in the far-future.

8.4.4.5. CLIMSAVE[233]

Title	Climate change integrated assessment methodology for cross-sectoral adaptation and vulnerability in Europe
Instrument	FP7 Collaborative Project FP7 Collaborative Project
Total Cost	€ 4 157 842
EU Contribution	€ 3 149 644
Duration	46 months
Start Date	01/01/2010
Consortium	18 partners from 13 countries
Project Coordinator	Chancellor, Master and Scholars of the University of Oxford (United Kingdom)
Key Words	Climate change, impacts, adaptation, vulnerability, cross-sectoral

The overall aim of the CLIMSAVE project is to deliver an integrated methodology to assess cross-sectoral climate change impacts, adaptation and vulnerability. It will put science in the service of stakeholders and policy-makers by providing a common platform for an improved integrated assessment of climate change impacts, vulnerability and related cost-effective adaptation measures covering key sectors in Europe. There are six specific objectives:

- to analyse the policy and governance context for adaptation
- to develop an Integrated Assessment Platform which includes linkages and feedbacks between key landscape sectors
- to apply the Integrated Assessment Platform to assess climate change impacts on, and adaptation options for, ecosystem services
- to integrate stakeholder input into climate change impacts and adaptation research through the development of participatory scenarios
- to identify vulnerability hotspots through metrics of impacts and adaptive capacity and

233 www.climsave.eu

- to analyse the cost-effectiveness of adaptation strategies and investigate sources of uncertainty to inform appropriate policy options.

CLIMSAVE's integrated assessment approach will enable stakeholders to explore and understand the interactions between different sectors, rather than viewing their own area in isolation. This contributes to the development of a well adapted Europe by building the capacity of decision-makers to understand cross-sectoral vulnerability to climate change and how it might be reduced by various adaptation options.

A number of CLIMSAVE outputs are already available from the project website (www.climsave.eu). These include reports on the stakeholder workshops, scenario development, adaptive capacity, vulnerability, adaptation policy and governance, and the specification of the Integrated Assessment Platform and the sectoral meta-models within it. The final output from CLIMSAVE will be the Integrated Assessment Platform which will allow stakeholders or interested citizens to analyse climate change impacts, vulnerability and adaptation options themselves. The Platform will be available from October 2013 from the CLIMSAVE website (www.climsave.eu) and the Climate-Adapt website (www.climate-adapt.eea.europa.eu).

8.4.4.6. CLIMATECOST[234]

Title	ClimateCost: The Full Costs of Climate Change
Instrument	FP7, Collaborative Project
Total Cost	€ 4 600 000
EU Contribution	€ 3 500 000
Duration	32 months
Start Date	December 2008
Consortium	22 partners from 14 countries
Project Coordinator	Stockholm Environment Institute Oxford, UK
Key Words	Climate change economics, cost of inaction, mitigation costs, social cost of carbon

The objectives were to advance knowledge across the areas outlined above, by:

- identifying and developing consistent climate and socio-economic scenarios, including for mitigation

234 www.climatecost.cc

- quantifying the effects of climate change in Europe, in physical terms and economic costs (for coastal zones, health, energy, agriculture and infrastructure), and identifying the costs and benefits of adaptation
- assessing the impacts and economic costs of major catastrophic and socially contingent events
- updating the costs of mitigation, including (induced) technological change, non-CO2 GHG and sinks, and recent abatement technologies
- quantifying and monetising the ancillary air-quality co-benefits of mitigation in Europe, China and India
- developing a number of existing global level economic Integrated Assessment Models (IAMs)
- providing policy relevant output, including analysis of policy scenarios

The project advanced multi-disciplinary research, developing integrated bottom-up and top-down analysis, and directly engaging policy makers to provide policy relevant outputs.

In what regards main results, the project provided a more complete, updated assessment of cost of mitigation, impacts and economic costs of climate change, and the costs and benefits of adaptation. The potential impact of the project has been primarily through the outputs and results (including a set of policy briefs), which are highly relevant for European Commission climate policy, as well as for Member States. Indeed, the results have already been included in policy discussion and deliberations.

The project has provided results on the future potential economic costs of climate change that are of high relevance to Commission Services and have been cited in the 2013 EU Strategy on adaptation to climate change (COM(2013) 216 final). This information, and analysis of the costs and benefits of adaptation, has been included in the European Climate Adaptation Platform (CLIMATE-ADAPT).

In addition, in relation to long-term targets and justification for mitigation, the study has provided final results and available models that are of high relevance for the Commission and others, in relation to the short- and long-term GHG emission reduction targets and stabilisation. This includes information on the cost of inaction for Europe under future scenarios – and the economic co-benefits of mitigation for Europe – which were both included in the European Commission's impact assessment for the Roadmap for moving to a competitive low carbon economy in 2050.

An updated suite of models that are used in European Commission mitigation cost and economic analyses (POLES, GEM-E3) has been produced, with new runs with these models. An updated suite of CGM and IAM models has been produced, for potential use in policy analysis, including the new PAGE09 model.

The results of the project also provide valuable research inputs, as measured through the publication of many academic papers. The project has produced a set of policy briefing notes that summarise sector results.

8.4.4.7. MEDIATION[235]

Title	Methodology for Effective Decision-making on Impacts and AdaptaTION
Instrument	Collaborative Project, FP7
Total Cost	€ 4 050 579
EU Contribution	€ 3 142 744
Duration	42 months
Start Date	1 January 2010
Consortium	11 partners from 8 countries
Project Coordinator	Alterra (The Netherlands)
Key Words	Climate change, adaptation strategies, methods and tools, decision-support

MEDIATION aims to provide a coherent framework for systematically identifying available methods and tools that can be meaningfully applied to address specific adaptation and vulnerability questions and support adaptation action. This is required to address the currently fragmented knowledge base supporting climate change adaptation decision-making in Europe, in particular in the area of methods and tools. To achieve this, firstly the knowledge requirements associated with the ongoing impact assessment and adaptation policy developments in Europe had to be mapped for various decision domains, in consultation with the appropriate decision- makers and stakeholders. Secondly, existing methods, tools and metrics had to be reviewed, linked and - where needed and feasible - improved or developed. A final objective was to make the framework and associated toolbox available, and disseminate the project results.

Rather than suggesting a one-size-fits-all solution, MEDIATION acknowledges that adaptation questions are diverse as they are determined by their regional and sectoral context. A diagnostic framework for problem-oriented adaptation research was developed that organizes adaptation questions into a logical structure, linking them to suitable methods and tools. The framework was used for UNEP PROVIA's Guidance for the Assessment of Impacts, Vulnerability and Adaptation and is made available via an interactive platform, which includes:

- the Adaptation Pathfinder that enables users to find the most appropriate methods and tools for their adaptation questions
- the MEDIATION Toolbox that provides detailed information about some 40 methods and tools with conditions for their applicability; and

235 http://mediation-project.eu

- the Case study search tool. The platform is intended to be used by experts with basic technical or scientific knowledge and skills, who engage in policy advice, policy analysis, or other research aiming at supporting climate change adaptation decision making.

8.4.5. Research and development on mitigation and adaptation technologies

As referred in the Section 7.6 addressing EU funded technology transfer initiatives and programmes, a number of other climate change activities involving technology transfer funded by the EU, most notably in the area of research are referred in the Biennial Report. Examples include FP7, the Strategic Energy Technology Plan (SET), the Near-zero Emissions Power Generation technology through Carbon Dioxide Capture and Storage, European Energy Technology Platforms and NER, among others. Below, some examples of projects are referred. Here only those that are not considered as Technology Transfer are referred.

8.4.5.1. PLANETS[236]

Title	Probabilistic Long-Term Assessment Of New Energy Technology Scenarios – PLANETS
Instrument	FP7, Integrated Project
Total Cost	€ 1 927 049
EU Contribution	€ 1 541 673
Duration	30 Months
Start Date	January 2008
Consortium	8 partners from 8 European countries
Project Coordinator	Mariaester CASSINELLI/FONDAZIONE ENI ENRICO MATTEI/ITALY
Key Words	Energy, Energy Technologies, Economy, Climate, Models, Modelling

The objective of the PLANETS project was to devise robust scenarios for the evolution of energy technologies in the next 50 years. It was foreseen to assess the impact of technology development and deployment at world and European levels, by means of an ensemble of analytical tools designed to foresee the best technological hedging policy in response to future environmental and energy policies.

A shift towards climate stabilisation can occur along different pathways. The PLANETS project analysed ten possible climate control scenarios with six different integrated

236 http://www.feem-project.net/planets/

assessment models. These scenarios combined long-term climate stabilisation targets of 500 and 530 ppm equivalent (ppm-e) – consistent with long-term equilibrium temperature increases of 2.3ºC and 2.5°C respectively, under a central value for the climate sensitivity – with different strategies regarding how to achieve these targets. Immediate and fully cooperative action starting from 2012 was compared with "second-best" scenarios characterised by different regional emission quotas.

Results indicate that emission reduction targets for 2050 are relevant for the economics of long-term climate stabilisation. Models find that several scenarios with a 500 ppm-e climate target are unreachable, in particular those in which some regions aim at initially mild reductions followed by more drastic reductions after 2050. Postponing abatement makes it impossible, or at least considerably more costly, to achieve climate stabilisation.

8.4.5.2. NER 300[237]

NER300 is one of the world's largest funding programmes for innovative low-carbon energy demonstration projects. The programme is conceived as a catalyst for the demonstration of environmentally safe carbon capture and storage (CCS) and innovative renewable energy (RES) technologies on a commercial scale within the European Union. The European Commission is responsible for the overall management and implementation of NER300. In this, the Commission draws on the unique expertise of the European Investment Bank (EIB) to evaluate proposals submitted by Member States, to sell NER allowances on its behalf, and to manage the revenues and the disbursement of funds to Member States during project implementation.

The aim of NER300 is to establish a demonstration programme comprising the best possible CCS and RES projects and involving all Member States. The programme intends to support a wide range of CCS technologies (pre-combustion, post-combustion, oxyfuel, and industrial applications) and RES technologies (bioenergy, concentrated solar power, photovoltaics, geothermal, wind, ocean, hydropower, and smart grids).

NER300 also seeks to leverage a considerable amount of private investment and/or national co-funding across the EU, boost the deployment of innovative low-carbon technologies and stimulate the creation of jobs in those technologies within the EU.

NER300 is so called because it is funded from the sale of 300 million emission allowances from the new entrants' reserve (NER) set up for the third phase of the EU emissions trading system (EU ETS). The funds from the sales are to be distributed to projects selected through two rounds of calls for proposals, covering 200 and 100 million allowances respectively.

Under the first call for proposals the European Commission in December 2012 made funding awards for a total value of €1.2 billion to 23 renewable energy projects. This amount is estimated to have leveraged additional funding of over €2 billion from private sources. The projects awarded funding are now moving towards implementation. They must reach their final investment decisions by December 2014, and enter into operation by December 2016.

237 http://ec.europa.eu/clima/policies/lowcarbon/ner300/index_en.htm

The second call for proposals was launched on 3 April 2013. Thirty-three projects were submitted by the 3 July deadline. Awards will be funded from the sale of the remaining 100 million allowances and unused funds from the first call.

8.5. Systematic observation

The EU contributes to Systematic Observation through various channels and various programmes and projects as, for example, GCOS, (see 8.3), GEOSS (see 8.5.1), Copernicus (see 8.5.2), IES' activities (see 8.5.3).

The following topics include the description of the most emblematic projects and programmes on systematic observation covering:

- atmospheric climate observing systems, including those measuring atmospheric constituents
- ocean climate observing systems
- terrestrial climate observing systems
- cryosphere
- paleoclimate
- support for developing countries to establish and maintain observing systems, related data and monitoring systems.

8.5.1. GEOSS[238]

Europe is a global leading player in the advancement of earth observation technologies and related environmental applications. European remote-sensing satellites cover all of the Earth's climatic zones, while European ground-, air- and ocean-based monitoring devices serve users by providing high-quality observation data for subjects as diverse as urban planning, adaptation to climate change, disaster reduction, disease control and humanitarian relief. Earth observation projects are increasingly being integrated into the GEOSS which brings together 89 partner countries from around the world, as well as the European Commission and 67 participating organisations.

Before 2015, GEO Climate Social Benefit Area (SBA) aims to:

- Achieve effective and sustained operation of the global climate observing system and reliable delivery of climate information of a quality needed for predicting, mitigating and adapting to climate variability and change, including for better understanding of the global carbon cycle

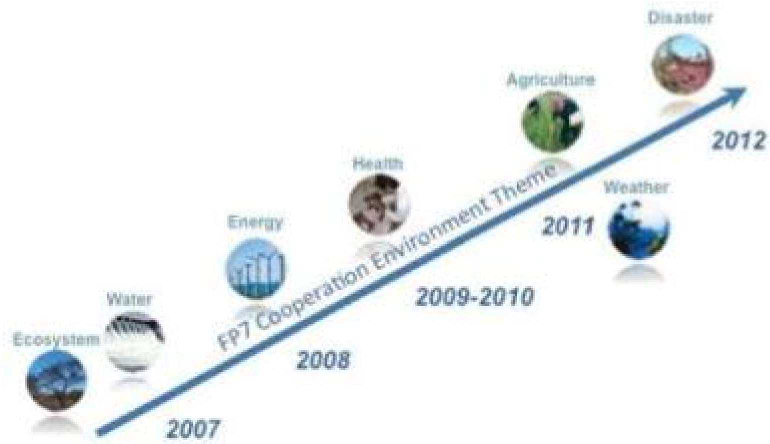
This will be demonstrated by:

- Improved scientific understanding, modelling & prediction of climate.
- Accessibility of all the observational data needed for climate monitoring and services in support of adaptation to climate variability and change.

238 http://ec.europa.eu/research/environment/index_en.cfm?pg=earth

- Development and facilitation of a comprehensive (atmosphere, ocean, land) global carbon observation and analysis system in support of monitoring based decision-making and related environmental treaty obligations
- Availability of all Essential Climate Variables defined by GCOS and needed by the WCRP, the IPCC and the UNFCCC.

Figure 8-7 Annual call addressing GEO[239] Societal benefit Areas specifically



In FP7, four blocks toward the establishment of GEOSS are emphasised:

- integration of European activities within the Group on Earth Observations (GEO), supporting European activities at global level
- cross-cutting research activities relevant to GEO understanding, modelling and predicting environmental phenomena
- emerging earth observation activities, supporting the development of European earth observation systems and activities in areas of environmental research needed for GEOSS
- developing capacity-building activities in the domain of earth observation, providing support to international research initiatives in which Europe would contribute to the development of observing systems.

Long term funding/resourcing in order to achieve sustained operation of the necessary Earth Observing (EO) infra-structure (space-based and in-situ) and improved access to and exchange of data and information is of paramount importance for all SBAs under consideration. Based on the work that has been conducted within the EUGENE[240] project, the European GEO approach should strive to achieve the following goals:

- implement Copernicus data and services and secure its further development and other European GEO systems, such as the European Meteorological Infrastructure (EMI), in close cooperation with GEOSS, where appropriate

239 http://earthobservations.org/about_geo.shtml

240 http://www.eugene-fp7.eu/docs/EUGENE_Report_web.pdf

- intensify contributions to GEO standardisation activities to promote INSPIRE and other European standards and specifications
- further invest in European scientific expertise and innovative capabilities and offer expertise within international collaboration frameworks, such as GEOSS
- offer cooperation to the developing world, with a focus in Africa
- participate more actively in GEOSS to better address European requirements
- take advantage of GEOSS and its political profile, especially as to the
    - sustainability and interoperability of systems
    - promotion and implementation of the Data Sharing Principles
    - strengthened in-situ systems
    - documented data quality and
    - user-driven recognition of information requirements for the benefit of decision-making
- improve coordination of European GEO actors on all levels[241].

8.5.2. Copernicus[242]

Copernicus is a European system for monitoring the Earth. Copernicus consists of a complex set of systems which collect data from multiple sources: earth observation satellites and in situ sensors such as ground stations, airborne and sea-borne sensors. It processes these data and provides users with reliable and up-to-date information through a set of services related to environmental and security issues.

The services address six thematic areas: land, marine, atmosphere, climate change, emergency management and security. They support a wide range of applications, including environment protection, management of urban areas, regional and local planning, agriculture, forestry, fisheries, health, transport, climate change, sustainable development, civil protection and tourism.

The main users of Copernicus services are policymakers and public authorities who need the information to develop environmental legislation and policies or to take critical decisions in the event of an emergency, such as a natural disaster or a humanitarian crisis.

Based on the Copernicus services, many other value-added services can be tailored to more specific public or commercial needs. This will create new business opportunities. In fact, several economic studies conducted to date have demonstrated a huge potential for job creation, innovation and growth.

The Copernicus programme is coordinated and managed by the European Commission. The development of the observation infrastructure is performed under the aegis of the ESA for the space component and of the EEA and the MS for the in situ component.

241 http://www.eugene-fp7.eu/docs/EUGENE_Report_web.pdf

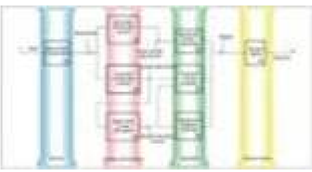
242 http://copernicus.eu/pages-principales/overview/copernicus-in-brief/

The services have reached different degrees of maturity. Some are already operational (land monitoring and emergency management) while others are still in a pre-operational mode (atmosphere monitoring and marine monitoring) or in a development phase (climate change monitoring and services for security applications).

The Copernicus Climate Change service will capitalise on three main components: sustained network of in situ and satellite-based observations, re-analysis of the Earth climate with a variety of models driven by observations, modelling scenarios based on a variety of climate projections. These three components will allow a panoply of climate indicators (e.g., temperature increase, sea level rise, ice sheet melting, ocean acidification, warming up of the ocean, among others) and climate indices (e.g. based on records of temperature, precipitation, drought events) for both the identified climate drivers and the expected climate impacts to be derived. The pre-operational phase of the Copernicus CC service started in earnest with the 2013 FP7 Space call that identified five major domains of activities directly related to climate modelling and observation analyses. The proposed strategy is to build upon the proposals resulting from this and other efforts (e.g., ESA Climate Change Initiative, EUMETSAT Climate Satellite Application Facility (SAF), EEA, WMO through the Global Framework for Climate Services (GFCS) initiative, among others). The enormous level of available information will then have to be harmonised, coordinated, and tailored to the users' needs and quality checked. All are provided free of charge to users. The provision of Copernicus services is based on the processing of environmental data collected from two main sources:

- A space component[243,] which consists of several Earth observation satellites;
- An in situ component[244], which consist of a multitude of sensors on the ground, at sea or in the air.

Examples of on-going projects[245] related to Climate Change include:



CORE-CLIMAX[246]

COordinating Earth observation data validation for RE-analysis for CLIMAte ServiceS

(FP7 / 2013 – 2015)

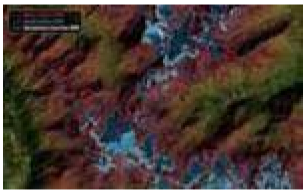
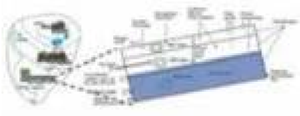
CORE-CLIMAX aims to coordinate the identification of essential climate change variables and the creation of long term climate data records. The project will help to substantiate how Copernicus observations and products can contribute to climate change analyses.

243 http://copernicus.eu/pages-principales/infrastructure/space-component/

244 http://copernicus.eu/pages-principales/infrastructure/in-situ-component/

245 http://copernicus.eu/pages-principales/projects/other-fp7-projects/climate-change/

246 http://coreclimax.itc.nl/

	CryoLand[247] (2011 - 2015 / EU FP7) Copernicus Service Snow and Land Ice CryoLand services assist European public authorities and affected industries in dealing more effectively with the climate change challenge by means of fast and cost effective remote sensing techniques for snow and ice monitoring. It provides a set of tools for spatially detailed observations of snow cover and glaciers based on satellite data, integrated with ground based measurements.
	MAIRES[248] (EU FP7) Monitoring Arctic Land and Sea Ice using Russian and European Satellites MAIRES will develop new methods for mapping of sea ice, icebergs and glaciers in the Arctic. By joint analysis of high-resolution images from European and Russian satellites obtained in the last decades, the project expects to obtain significant new knowledge about ice in the Arctic.
	OPERR[249] (2011 - 2013 / EU FP7) Operational Pan-European River Runoff OPERR will develop an operational real-time river discharge model covering all of Europe. The project will provide data for monitoring and warning of flooding events, as well as data on predicted high concentrations of nutrients in flood water and will validate and apply data for shelf sea models, supporting the performance of regional ocean models.
	CARBONES[250] (2010 - 2013 / EUEU FP7) 30-year re-analysis of CARBON fluxes and pools over Europe and the Globe CARBONES aims at establishing a first reanalysis of the carbon cycle in a long-term perspective (20-30 years). By integrating essential climate variables such as atmospheric

247 http://www.cryoland.eu/

248 http://%20http//www.nersc.no/project/maires

249 http://www.smhi.se/en/Research/Research-departments/Oceanography/operr-operational-pan-eurhttp://www.carbones.eu/opean-river-runoff-1.16820

250 http://www.carbones.eu/

	carbon dioxide, leaf area and biomass data, CARBONES will improve the ability to predict how the carbon cycle of ecosystems respond to greenhouse gas emissions and climate change.
	EURO4M[251] (2010 - 2014 / EUEU FP7) European Reanalysis and Observations for Monitoring EURO4M strengthens the Europe's capacity to monitor climate change over extended time periods. Thanks to the collection of regional observation datasets of Essential Climate Variables (ECV) and to the performance a comprehensive model-based regional reanalysis, EURO4M will help better understand and predict climate change.
	MONARCH-A[252] (2010 - 2013 / EUEU FP7) Monitoring and Assessing Regional Climate change in High latitudes and the Arctic MONARCH-A aims to generate a dedicated and comprehensive information package showcasing Arctic climate change in a 30-50 years perspective. This information package will consider a set of multidisciplinary Essential Climate Variables, their mutual forcing and feedback mechanisms associated with changes in terrestrial carbon and water fluxes, sea level and ocean circulation, and the marine carbon cycle.
	ReCover[253] (2010 - 2013 / EU FP7) Science-based remote sensing services to support REDD and sustainable forest management in tropical region ReCover supports the fight against deforestation and forest degradation in the tropical region by developing a state-of-the-art service capabilities for enhanced forest monitoring. Its main focus is to develop a sound statistical concept and accuracy assessment procedure that enables the generation of more reliable estimates for forest degradation and change.

251 http://www.euro4m.eu/

252 http://monarch-a.nersc.no/

253 http://www.vtt.fi/sites/recover/

	REDDAF[254] (2011 - 2014 / EU FP7) Reducing Emissions from Deforestation and Degradation in Africa REDDAF supports countries in the African Congo Basin in monitoring deforestation and forest degradation more effectively. REDDAF will establish innovative services based on EO and in-situ measurements which respond to the needs of the users in the Congo Basin Region. The services are related to the Monitoring, Reporting and Verification (MRV) requirements within the new REDD policy process.
	REDD-FLAME[255] (2011 - 2013 / EU FP7) REDD Fast Logging Assessment & Monitoring Environment REDD-FLAME will design and implement a satellite system for monitoring tropical and subtropical forests. This system will be able to identify quickly the first signs of illegal logging and thus allow earlier intervention by the authorities and better management of these fragile and valuable environments to prevent lasting damage.
	REDDINESS (2011 - 2013 / EU FP7) Support EO-driven forest and carbon monitoring in Central Africa for REDD The REDDINESS project aims to enhance the existing capabilities within national forest monitoring centres in Gabon and the Republic of Congo in undertaking forest assessments, forest mappings and carbon trend estimations. It will also undertake knowledge transfers and work to increase the readiness of the countries to join the carbon trade market.
	SIDARUS[256] (2011 - 2014 / EU FP7) Sea Ice Downstream Services for Arctic and Antarctic Users and Stakeholders Polar regions are strongly affected by climate change: temperature is increasing, sea ice is retreating during the

254 http://www.reddaf.info/

255 http://redd-flame.info/

256 http://sidarus.nersc.no/

	summer and land ice decreases. SIDARUS seeks to establish a set of sea ice services for climate research, marine safety and environmental monitoring in the Arctic and Antarctic regions.

8.5.3. JRC-IES activities

The activities of the JRC-IES are outlined in the Multiannual Work Programme[257], which is funded through the specific programme of the JRC within the FP7 of the European Union. The research activities of the Institute for Environment and Sustainability are presently divided into 20 Research Actions distributed amongst the Scientific Units. The most relevant for climate change are as follows:

- Water Resources Unit
    - Action 22001 - Monitoring across Policies and Environmental Media (MAPLE)
    - Action 22010 - European and Global Freshwaters (FRESHWATERS)
    - Action 22011 - Coastal and Marine Waters (SEACOAST)
- Air and Climate Unit
    - Action 24007 - Air and Climate Analysis (ACA)
    - Action 24009 - Air and Climate Foresight (ACF)
- Forest Resources and Climate Unit
    - Action 22003 - Forest Modelling and Information Systems (FORESTMOD)
    - Action 42003 - Global Forest Assessment and Monitoring (GLOBE-TREES)
- Climate Risk Management Unit
    - Action 24008 - Climate Risk - LESS Developed Countries (CR-LESS-DC)
    - Action 32004 - Climate Risk - MORE Developed Countries (CR-MORE-DC) .

JRC Actions are grouped under five Policy Themes, according to the European Union's Seventh Framework Programme (FP7) and the Seventh Framework Programme of the European Atomic Energy Community (EURATOM). Starting from 2011 Work Programme, Actions are developed around seven Thematic Areas:

- Towards an open and competitive economy
- Development of a low carbon society
- Sustainable management of natural resources
- Safety of food and consumer products

257 http://ec.europa.eu/dgs/jrc/downloads/mawp2007_2013.pdf

- Nuclear safety and security
- Security and crisis management
    - Reference materials and measurements[258].

IES's projects per year, covering the period 2010 to 2013, related to the development of a low carbon society thematic area can be accessed through JRC project browser[259].

8.5.4. Atmospheric climate observing systems, including those measuring atmospheric constituents

8.5.4.1. Copernicus Atmosphere Monitoring Service[260]

Copernicus Atmosphere monitoring service provides continuous data and information on atmospheric composition. The service describes the current situation, forecasts the situation a few days ahead, and analyses consistently retrospective data records for recent years.

The Copernicus atmosphere monitoring service supports many applications in a variety of domains including health, environmental monitoring, renewables energies, meteorology, and climatology.

It provides daily information on the global atmospheric composition by monitoring and forecasting constituents such as greenhouse gases (carbon dioxide and methane), reactive gases (e.g. carbon monoxide, oxidised nitrogen compounds, sulphur dioxide), ozone and aerosols.

It provides near-real-time analysis and 3-day forecasts, as well as reanalysis, of the European air quality, thus enabling a permanent assessment of the air we breathe.

The monitoring and reanalysis of greenhouse gases and aerosols contribute to climate change studies by describing climate forcing.

Thanks to daily analysis and forecasts of ultra violet (UV) radiation, solar energy and stratospheric ozone, the service supports public health policies (e.g. skin cancer prevention) and solar energy users.

The service is delivered in a pre-operational mode. The products delivered by the Copernicus atmosphere monitoring service are provided free of charge through the atmosphere.copernicus.eu webportal, which is operated by the EU-funded project MACC-II.

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258 http://projects.jrc.ec.europa.eu/jpb_public/mainMenu.html;jsessionid=kTLQR7VH2bGS5ysFRxv6xyXFdsrvzLNjQLJLRTKdLY0fxMBXBwrn!-1647626627

259 http://projects.jrc.ec.europa.eu/jpb_public/act/publicexportworkprogramme.html

260 http://www.copernicus.eu/pages-principales/services/atmosphere-monitoring/

8.5.4.2. RECONCILE[261]

Title	Reconciliation of essential process parameters for an enhanced predictability of arctic stratospheric ozone loss and its climate interactions
Instrument	FP7, Collaborative Project
Total Cost	€ 4 656 564
EU Contribution	€ 3 499 782
Duration	48 months
Start Date	1/03/2009
Consortium	16 partners from 8 countries
Project Coordinator	Forschungszentrum Jülich (Germany)
Key Words	Ozone Layer, Climate Change, Long Term Predictions

The issues where the lack of understanding is most palpable are the catalytic ClOx/BrOx chemistry, chlorine activation on cold stratospheric aerosol, NAT nucleation mechanisms, and mixing and transport of processed air to lower latitudes. A catalogue of open questions in all these areas has been defined including:

- Are there unknown additional mechanisms for O_3 destruction in polar winter?
- Does the cold binary aerosol suffice to activate chlorine or are plar stratospheric clouds (PSCs) required?
    - How does nitric acid trihydrate (NAT) nucleation leading to large denitrifying particles work?
    - How intense is the transport through the vortex edge in both directions and how does it influence estimates of ozone depletion?

These and other important questions will be addressed in RECONCILE with the aim to develop parameterisations that can be used in computer models simulating stratospheric chemistry and transport.

Key results from laboratory experiments and the field activities in the Arctic winter 2009/10 include:

- consistent quantification of the ClOOCl photolysis rate

261 https://www.fp7-reconcile.eu

- unambiguous demonstration of heterogeneous NAT nucleation in the absence of ice and detection of various possible „nuclei“, with implications for PSC formation and denitrification
- strong evidence for significant chlorine activation not only on PSCs but also on cold binary aerosol
- identification and quantification of discrepancies between observations and models with respect to transport and mixing (with ongoing work to refine the models).

Sophisticated process parameters and parameterisations have been implemented in the chemistry climate model (CCM) LMDZrepro. Improved CCM simulations better reproduce observed past Antarctic ozone losses, while in the Arctic, external processes determining the stability of the polar vortex drive the interannual variability. In both hemispheres, the new and more robust CCM simulations confirm our current estimates of 21st century ozone depletion and recovery date.

8.5.4.3. EUCLIPSE[262]

Title	EU Cloud Intercomparison, Process Study & Evaluation Project
Instrument	FP7 Collaborative Project
Total Cost	€ 4 985 600
EU Contribution	€ 3 500 000
Duration	48 months
Start Date	01/02/2010
Consortium	12 partners from 9 countries
Project Coordinator	KNMI (The Netherlands)
Key Words	Clouds, climate change

EUCLIPSE represents a focused multi-disciplinary effort to respond to this challenge by fostering coordinated research in the area of cloud feedbacks on climate change. The specific objectives of EUCLIPSE are:

- evaluation of cloud processes in Earth System Models.
- development of physical understanding of how cloud processes respond and feedback to climate change.

262 www.euclipse.eu

- development of a metric to measure the relative credibility of the cloud feedbacks by different Earth System Models.
- improvement the parameterization of cloud related processes in current Earth System Models.

Expected Results include:

- improvement of the representation of cloud related processes
- a metrics to quantify the ability of Earth System Models to represent clouds, radiation and precipitation
- reduction of the uncertainty of model-based estimates of climate change due to cloud related processes
- dissemination of new tools, analysis methods, simulations and observations that will provide a useful data base for the model development community at large.

8.5.4.4. COCOS[263]

Title	Coordination action Carbon Observing System
Instrument	Coordination action
Total Cost	€ 1 876 367
EU Contribution	€ 1 747 683
Duration	36 months
Start Date	1/05/2008
Consortium	11 partners from 6 countries
Project Coordinator	VU University Amsterdam, the Netherlands
Key Words	Carbon, observations, ocean, land, international coordination, GEO, environment, climate change

Project objectives include:

- assess the status, and update where required, the essential carbon cycle variables of the Integrated Global Carbon Observations (IGCO) list of core variables

263 http://www.cocos-carbon.org/

- improve the interoperability of a priori data sets that are used in global scale inversion studies through joint activities between ecosystem and ocean bottom-up observation communities
- perform integrated regional-scale multiple constraint assessments of the land and ocean carbon balance through the use of harmonized data sets
- identify, narrow down uncertainties and decrease differences in emerging global data sets that are aimed at providing constraints on the vulnerability of the global carbon cycle
- contribute to the implementation and improvement of the global observing systems by organizing a large international conference in light of monitoring requirements for the Group on Earth Observations (GEO)
- through executing these objectives, demonstrate and strengthen European leadership in designing and operating systematic long-term carbon observations in critical regions of the globe.

Scientists have been brought together to pool their expertise, and design and implement common procedures for data collection, quality control and storage. To achieve this objective, COCOS organised the series of workshops shown in the table. COCOS also organised a major international conference: “Carbon in a Changing World”.

The COCOS Data Portal provides access to the Carbon Cycle data. On the interpretation, particularly using so called inverse models, COCOS made significant progress. It has also evaluated the usefulness of a series of observations, including total column CO_2 retrievals from space and from the surface. COCOS has collaborated with the Global Carbon Project in a project to create regional-scale resolution maps of the world’s carbon budget over both land and ocean. The project is known as RECCAP (REgional Carbon Cycle Assessment and Processes). More than 150 scientists from all over the world are working on RECCAP. COCOS identified a number of emerging gaps in our knowledge of the carbon cycle, and provided new access for instance to ocean carbon data. Through collaborating with international scientist COCOS produced the GEO Carbon strategy report that is widely regarded as providing the blueprint for a Global Carbon Observing system, both in situ and from space. COCOS has put the European Carbon Cycle Community at the forefront of global carbon monitoring science.

8.5.4.5. GEOCARBON[264]

Title	Operational Global Carbon Observing System
Instrument	Collaborative project FP7
Total Cost	€ 8 672 736
EU Contribution	€ 6 648 530
Duration	36 months
Start Date	01/10/2011
Consortium	25 partners from 11 countries
Project Coordinator	CMCC – Euro-Mediterranean Centre on Climate Change (Italy)
Key Words	Climate change, carbon cycle, GHG budget, carbon observations, data assimilation, tropical forests, economic analysis

GEOCARBON aims at designing a coordinated and integrated Global Carbon Observation and Analysis System, addressing the climate targets of the Group on Earth Observations (GEO) toward building an operational Global Earth Observation System of Systems (GEOSS) for carbon. Specific objectives are:

- Provide an aggregated set of harmonized global carbon (CO_2 and CH_4) data and information (integrating the land, ocean, atmosphere and anthropogenic component)
- Develop improved Carbon Cycle Data Assimilation Systems (CCDAS)
- Provide global annual budgets of CO_2 and CH_4 with reduced uncertainty
- Provide improved regional carbon budgets, with a focus on tropics (Amazon and Central Africa)
- Define the specifications for an operational Global Carbon Observing System
- Provide an economic assessment of the value of an enhanced global carbon observing system
- Strengthen the effectiveness of the global carbon contribution to the GEO system.

GEOCARBON is conceived to support the implementation of the GEO 2012-2015 Work Plan and the achievements of the GEOSS 2015 Strategic Targets on climate, and it is already contributing to these results. The ultimate expected outcome of the project is the provision of an aggregated and harmonized set of data and information on carbon

264 http://www.geocarbon.net/

pools, sources and sinks, ranging from regional to the global scale and with an increased resolution and accuracy, and a reduced uncertainty. This will improve the global understanding of carbon cycle, and its role in the climate change system, both from a scientific and policy perspective, and help scientists and policy makers better define the future targets on greenhouse gases reduction and the actions needed to mitigate and adapt to climate change. Finally, a strategy for a continued and sustained Global Carbon Observing and Analysis System will be delivered.

8.5.5. Ocean climate observing systems

8.5.5.1. MyCopernicus Marine Monitoring Service[265]

The Copernicus marine monitoring service provides regular and systematic reference information on the state of the physical oceans and regional seas. The observations and forecasts produced by the service support all marine applications.

For instance, the provision of data on currents, winds and sea ice help to improve ship routing services, offshore operations or search and rescue operations, thus contributing to marine safety.

The service also contributes to the protection and the sustainable management of living marine resources in particular for aquaculture, fishery research or regional fishery organisations.

Physical and marine biogeochemical components are useful for water quality monitoring and pollution control. Sea level rise helps to assess coastal erosion. Sea surface temperature is one of the primary physical impacts of climate change and has direct consequences on marine ecosystems. As a result of this, the service supports a wide range of coastal and marine environment applications.

Many of the data delivered by the service (e.g. temperature, salinity, sea level, currents, wind and sea ice) also play a crucial role in the domain of weather, climate and seasonal forecasting.

The service is currently delivered in a pre-operational mode.

The products delivered by the Copernicus marine environment monitoring service today are provided free of charge to registered users through an Interactive Catalogue available on the marine.copernicus.eu web portal. The pre-operational marine service of Copernicus is currently provided through the EU-funded project MyOcean2 (see below).

8.5.5.2. myOcean[266]

The main objective of the MyOcean2 project is to deliver and operate a rigorous, robust and sustainable Ocean Monitoring and Forecasting system of the GMES Marine Service (OMF/GMS) to users for all marine applications: maritime safety, marine resources, marine and coastal environment and climate, seasonal and weather forecasting.

In the period from April 2012 to September 2014, MyOcean2 is ensuring a controlled continuation and extension of the services and systems already implemented in

265 http://www.copernicus.eu/pages-principales/services/marine-monitoring/

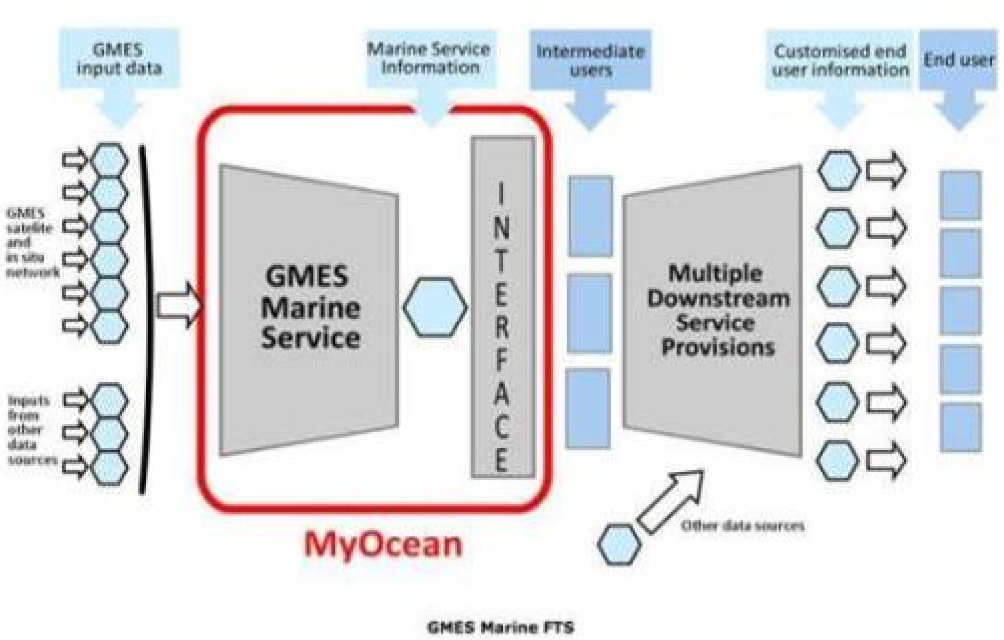
266 http://www.myocean.eu/web/3-objective.php

MyOcean, a previous FP7-funded project (April 2009- March 2012) that has advanced the pre-operational marine service capabilities by conducting the necessary research and development.

The MyOcean2 marine service consists of the following activities:

- data acquisition from the ground segment of the space-based observation systems and in situ networks
- acquisition of atmospheric forcing data (winds, temperatures, fluxes) from National Meteorological Services and ECMWF
- compilation of these data into quality-controlled datasets at Thematic Data Assembly Centres (sea surface temperature, ocean colour, sea level, sea ice, surface winds and fluxes, and in-situ data) suitable for the generation of more extensive data sets for subsequent use, analytical products and assimilation by ocean models
- running numerical ocean models in near real time to assimilate thematic data and generate analyses and forecasts to an agreed and generally perpetually repeating cycle. The monitoring and Forecasting Centres operate regional (Arctic, Baltic, North West shelf, Irish-Bay of Biscay and Iberian Coast, Mediterranean Sea and Black Sea) and global models. The centres will also operate offline to produce reanalysis /hindcasts
- preparation and delivery of products suitable for external service provision and
- preparation phase for a fully operational service by the end of 2014.

Figure 8-8 The COPERNICUS Marine Fast-Track Service chain and its Ocean Monitoring & Forecasting (OMF) component.



8.5.5.3. NACLIM[267]

Title	North Atlantic Climate – Predictability of the climate in the North Atlantic/European sector related to North Atlantic/Arctic sea surface temperature and sea ice variability and change
Instrument	FP7, Funding Scheme SP1-Cooperation
Total Cost	€ 11 046 614
EU Contribution	€ 8 598 407
Duration	48 months
Start Date	01/11/2012
Consortium	18 partners from 10 countries
Project Coordinator	University of Hamburg
Key Words	Climate change, Environment and Health, Marine Environment

The project aims at investigating and quantifying the predictability of the climate in the North Atlantic/European sector related to North Atlantic/Arctic sea surface temperature and sea ice variability on seasonal to decadal time scales. SST and sea-ice forcing have a crucial impact on weather and climate in Europe. It will analyse the multi-model decadal prediction experiments currently performed as part of the CMIP5 Project and assess the quality of predictions of the near-future state of key oceanic and atmospheric quantities relevant to the SST and sea-ice distribution and the related climate. Long-term observations of relevant ocean parameters will be carried out, for assessing the forecast skill of the model-based prediction results. We will identify observations that are key to the quality of the prediction and optimize the present observing system. The project will quantify the impact of North Atlantic/European climate change on oceanic ecosystems and urban societies.

The project's results include:

- quantify the uncertainty of state-of-the-art climate forecasts by evaluating the ability to model the most important oceanic and atmospheric processes in the North Atlantic and Arctic Oceans, and by comparing key quantities with observations
- optimize the present North Atlantic observation system by evaluating the impact of its components on the quality and quality control of model forecasts, and their value in determining the present ocean state and its past variability

267 www.naclim.eu

- quantify the impact on oceanic ecosystems and on European urban societies of predicted North Atlantic/Arctic Ocean variability
- critically assess the use of climate forecast parameters for use by stakeholders in society, politics and industry.

8.5.5.4. THOR[268]

Title	Thermohaline Overturning – at Risk? – THOR
Instrument	FP7 Environment (Climate Change, Policy and Risks)
Total Cost	€ 12 948 295
EU Contribution	€ 9 274 427
Duration	48 months
Start Date	December 2008
Consortium	20 higher educational and research institutions of 9 European countries
Project Coordinator	Hamburg University

THOR will establish an operational system that monitors and forecasts development of the North Atlantic thermohaline circulation (THC) on decadal time scales and assess its stability and risk of a breakdown in a changing climate. Together with pre-existing data sets, ongoing observations within the project will -for the first time - allow precise quantitative monitoring of the THC and its sources.

By identifying key processes manifested in paleo observations, THOR' models will be able to provide early identification of any systematic changes occurring.

The combined effect of various global warming scenarios and melting of the Greenland ice sheet will be thoroughly assessed in a coupled climate model. Through these studies and the assimilation of systematic observations at key locations into ocean models, THOR will be able to forecast the development of the Atlantic THC with emphasis on the European/North Atlantic region and its variability until 2025.

Expected Results

- quantifying THC variability on time scales up to centennial and identification of the key processes and feed-back mechanisms responsible for this variability
- quantifying ocean state uncertainties derived from combined model and data analysis

268 www.eu-thor.eu, http://vimeo.com/54353956, http://cordis.europa.eu/projects/rcn/88858_en.html

- quantifying Atlantic THC flux variability on time scales up to decadal, providing benchmarks for model tests
- quantifying the strength of the Nordic sources to the deep limb of the THC
- quantifying the skill of coupled forecast models on decadal time scales
- forecasting the THC variability on decadal time scales
- near real time data transfer from deep sea moorings
- assimilation techniques for coupled ocean-atmosphere general circulation models.

Parties outside the consortium that will benefit from the dissemination of the results of THOR, and that will be able to exploit them, fall into a number of categories: other scientists, instrument manufacturers, meteorological organizations, policy makers, end users in general, and the general public.

8.5.5.5. ACOBAR[269]

Title	Acoustic Technology for Observing the interior of the Arctic Ocean
Instrument	Small – medium scale focussed research project
Total Cost	€ 4 090 000
EU Contribution	€ 3 000 000
Duration	48 months
Start Date	01/10/2008
Consortium	9 partners from 5 countries
Project Coordinator	Nansen Environmental and Remote Sensing Centre – NERSC (Norway)
Key Words	ocean observing system, Arctic, underwater acoustics, climate change, oceanography, climate, acoustic tomography, gliders, data assimilation, acoustic navigation

The main objective of ACOBAR is to develop an acoustic system for monitoring of the interior of the Arctic Ocean. The project will collect 3-D observations of properties and transport of water masses in the Fram Strait using an acoustic tomography array, consisting of source and receivers, in combination with acoustic ice-tethered profilers (AITPs), oceanographic moorings and profiling gliders. Navigation of gliders under the ice by use of acoustic signals from the tomography sources will be developed and tested. Data transmission by acoustic modems from underwater platforms to the surface

269 http://acobar.nersc.no/

for downloading to ships will be demonstrated. The AITPs are deployed on ice floes with underwater sound source, hydrophones, modems and satellite communication, allowing near real time data transmission via satellite. ACOBAR will contribute to establish a future Arctic Ocean Observing System.

The expected results of ACOBAR will consist of new acoustic technology for observing the interior of the ocean, new observational data of the deep ocean from tomography as well as from gliders, use of acoustics for underwater communication and navigation, and data transmission from underwater platforms and vehicles that can operate under ice. Results of ACOBAR will be used to improve the ocean observing capability in the polar oceans, and will thus contribute to build the Arctic Regional Ocean Observing System (Arctic ROOS), a component of the Global Ocean Observing System (GOOS).

The project will strengthen European expertise in underwater acoustic navigation, communication, data transmission and tomography. The project will promote the use of underwater acoustic technology for monitoring the ocean. The technology will be used to build a long-term ocean monitoring system for the polar oceans.

8.5.5.6. EuroSITES[270]

Title	European Network of Deep Ocean Observatories
Instrument	Collaborative Project FP7
Total Cost	€ 4 700 000
EU Contribution	**€** 3 500 000
Duration	36 months
Start Date	1/04/2008
Consortium	13 partners from 8 countries (1 ICPC)
Project Coordinator	National Oceanography Centre, Southampton – NOCS (UK)
Key Words	EuroSITES, Deep sea, open ocean, Ocean Observatories, Eulerian, time-series, ocean interior, seafloor, subseafloor, COPERNICUS, GEO, GEOSS

EuroSITES will integrate and enhance the existing in situ infrastructure of 9 European deep ocean observatories. Integration will be carried out regionally across Europe and vertically through the ocean environment to include monitoring of the ocean interior, seafloor and subseafloor. Specific science missions will be conducted to develop the sustained monitoring capabilities of key environmental features e.g. pH, dissolved oxygen.

270 http://www.eurosites.info/

EuroSITES will focus on scientific excellence, best practice, common data management and effective communication to industry, policy makers and the general public. This will be achieved through close interaction with relevant European initiatives including ESONET (FP6 NoE), and EMSO PP (FP7). EuroSITES will contribute to the sub-sea component of COPERNICUS and to the GEOSS.

EuroSITES is expected to have the following results: the establishment of an integrated European network of 9 existing deep ocean observatories; a major advance in the way the European community monitors the ocean interior, seafloor and sub-seafloor; improvement of ocean data management and sensor/data accuracy; increase in effective communication of ocean science, ocean observation and outputs.

EuroSITES will also form an essential component of European and International Ocean Observation programmes including GOOS and GEOSS.

8.5.5.7. HYPOX[271]

Title	In situ monitoring of oxygen depletion in hypoxic ecosystems of coastal and open seas, and land-locked water bodies
Instrument	FP7 collaborative project / small or medium-scale focused research project (Grant #226213)
Total Cost	€ 4 665 281
EU Contribution	€ 3 499 711
Duration	36 months
Start Date	1/04/2009
Consortium	16 partners plus 4 affiliated partners from 13 countries
Project Coordinator	Prof. Antje Boetius, Dr. Felix Janssen, Dr. Christoph Waldmann
Key Words	Oxygen depletion, climate change, in situ water cycle monitoring, GEOSS, aquatic ecosystems, marine, freshwater, global ocean observation, eutrophication, biodiversity

A better understanding of global changes in oxy-gen depletion requires a global observation sys-tem. Oxygen and associated parameters need to be monitored at high resolution, including the assessment of physical mixing and of the role of the seafloor in controlling ecosystem sensitivity and recovery. Within HYPOX, oxygen depletion and associated processes were monitored in a broad range of aquatic systems that differ in oxygen status and sensitivity towards change: oxygen-rich open ocean with high sensitivity to global warming (Arctic), semi-enclosed basins with permanent anoxia (Black Sea, Baltic Sea) and land-locked systems with seasonal or local oxygen

271 http://www.hypox.net/

depletion (fjords, lagoons, lakes). The results were combined with information on past hypoxia and state-of-the-art numerical modelling to predict future hypoxia and its effect on aquatic ecosystems and to decide on appropriate oxygen monitoring efforts in the future.

HYPOX carried out pioneering work to build capacities for state-of-the-art oxygen monitoring. An increased demand for oxygen observations is foreseen in the context of the Marine Strategy Framework Directive and in response to the expected increase in the use of marine resources. HYPOX knowledge contributes to a conclusive oxygen observation strategy to monitor global change effects and to ensure sustainability of the envisaged maritime activities. This represents a major impact generated by the project that will extend into the future. HYPOX deployed stand-alone or cabled observatories that are able to perform long-term continuous measurements of oxygen and associated parameters. The adopted monitoring strategies account for temporal and spatial scales of oxygen depletion that are inadequately addressed by previous oxygen observation approaches. Ecosystem responses with a special focus on biogeochemical processes and element cycling were included as well as the investigation of past hypoxic conditions based on faunal patterns and organic as well as inorganic proxies from the sediment record. Based on generalized findings achieved by careful analysis of the data from observatories and field campaigns as well as application of data assimilation and modelling techniques, hypoxia ecosystems were classified and recommendations for future oxygen monitoring defined.

The results obtained in HYPOX are highly relevant to GEOSS objectives from ecosystem, water management, and climate points of view. Four HYPOX services compliant with GEOSS accepted standards have been registered at the GEOSS registry. A standardized and GEOSS compliant da-ta flow from the observatories to the end users was established. Through these activities HYPOX substantially improved the interoperability of observation systems for oxygen depletion in different systems. All observations and measurements obtained by observatories and during targeted field campaigns are disseminated through the HYPOX data portal. The project web site (www.hypox.net) provides access to the data portal as well as to reports, presentations and public outreach material including brochures, policy briefs, posters, images, and video footage.

8.5.5.8. GEOWOW[272]

Title	GEOSS interoperability for Weather, Ocean and Water
Instrument	FP7, Collaborative Project
Total Cost	€ 9 168 704
EUEU Contribution	€ 6 399 098
Duration	36 months
Start Date	01/09/2011
Consortium	15 partners from 7 countries
Project Coordinator	ESA (FR)
Key Words	GEO, GEOSS, GCI, Multidisciplinary Interoperability

GEOWOW will propose and validate an architectural model federating Earth Observation and other Earth Science data holdings at global, regional and local scale; allow easy and harmonized access to heterogeneous data; contribute to the GCI interoperability, standardisation and operability; develop services for data dissemination, access and use for the selected SBAs; establish and promote data sharing and usage procedures consistent with the GEOSS Data Sharing Implementation Guidelines and contribute to the development of the GEOSS Data CORE (Collection of Open Resources for Everyone).

Moreover, the project will support users of the SBAs by: providing harmonized and fast data access for meteorological hazard application development (Weather SBA); deploying an e-infrastructure giving access to in-situ and satellite data for hydrological application and Run-off process (Water SBA); enhancing the access to in-situ and satellite ocean observations, to information on threats to ocean ecosystems, and to key ocean forecasts and projections (Ecosystem SBA).

GEOWOW will facilitate discovery, access and use of resources (data, products, models) for different communities by revising the GEOSS architecture and evolving the GCI.

Moreover, the project will contribute to support Earth Science Research, to develop new Earth Science applications and to promote GEOSS, by putting in practice the Data Sharing Action Plan, and to the development of the GEOSS Data CORE.

Besides the impacts related to increased interoperability, significant benefits are expected from the GEOWOW achievements in the targeted thematic areas, a specific

272 http://www.geowow.eu/

aim of the project being to respond to the needs in terms of data, tools and services in the Weather, Water and Ocean Ecosystem research and management.

GEOWOW will also support innovation and foster the creation of research-led jobs in SMEs (Small Medium Enterprises), with a specific activity aimed at identifying opportunities and needs of SMEs in Europe in the Earth Observation and Geographic Information-related sector.

8.5.6. Terrestrial climate observing systems

8.5.6.1. Copernicus Land Monitoring Service [273]

The Copernicus land monitoring service provides geographical information on land cover and on variables related, for instance, to the vegetation state or the water cycle. It supports applications in a variety of domains such as spatial planning, forest management, water management, agriculture and food security, etc.

The service became operational in 2012. It consists of three main components: a Pan-European component, a global component and a local component.

The Pan-European component is coordinated by the European Environment Agency and will produce 5 high resolution data sets describing the main land cover types: artificial surfaces (e.g. roads and paved areas), forest areas, agricultural areas (grasslands), wetlands, and small water bodies. The pan-European component is also updating the Corine Land Cover dataset to the reference year 2012.

The global component is coordinated by the European Commission JRC. It will produce data across a wide range of biophysical variables at a global scale (i.e. worldwide), which will describe the state of vegetation (e.g. leaf area index), the energy budget (e.g. albedo) and the water cycle (e.g. soil moisture index).

The local component is coordinated by the European Environment Agency and aims to provide specific and more detailed information that is complementary to the information obtained through the Pan-European component. Besides an update of the Urban Atlas, the next local component will address biodiversity in areas around rivers.

8.5.6.2. CARBOEUROPE[274]

Title	Assessment of the European Terrestrial Carbon Balance
Instrument	FP6, Integrated Project
Total Cost	€ 23 656 645
EU Contribution	€ 16 310 000
Duration	60 months
Start Date	1/1/2004

273 http://www.copernicus.eu/pages-principales/services/land-monitoring/

274 www.carboeurope.org

Title	Assessment of the European Terrestrial Carbon Balance
Consortium	61 partners from 17 countries
Project Coordinator	• Max Planck Gesellschaft zur Förderung der Wissenschaften E.V. (Germany)
Key Words	European Carbon Balance, mechanism controlling carbon cycle in European terrestrial ecosystems, atmospheric CO_2 concentration

CarboEurope-IP aimed to understand and quantify the terrestrial carbon balance of Europe and the associated uncertainty at local, regional and continental scale. In order to achieve this strategic objective, the project addresses the following topics and associated questions:

"The European Carbon Balance" What is the carbon balance of the European continent and its geographical pattern, and how does it change over time?

"Processes and Modelling" What are the controlling mechanisms of carbon cycling in European ecosystems? How do external parameters such as climate change and variability, and changing land management affect the European carbon balance?

"Detection of Kyoto" Can the effective CO_2 reduction in the atmosphere in response to fossil fuel emission reduction and enhanced carbon sequestration on land be detected in the context of the Kyoto commitments of Europe?

The key innovation of the CARBOEUROPE-IP was solving the scientific challenge of quantifying the terrestrial carbon balance at different scales and with known, acceptable uncertainties. The increase in spatial and temporal resolution of the observational and modelling program will allow for the first time a consistent application of a multiple constraint approach of bottom-up and top-down estimates to determine the terrestrial carbon balance of Europe with the geographical patterns and variability of sources and sinks. CARBOEUROPE-IP aims at providing a system for carbon accounting for the European continent, and it will further investigate the main controlling mechanisms of carbon cycling in European ecosystems. CARBOEUROPE-IP integrates and expands the research efforts of 95 European institutes. Finally, it addresses basic scientific questions of high political relevance.

8.5.6.3. NITROEUROPE[275]

Title	The nitrogen cycle and its influence on the European greenhouse gas balance
Instrument	FP6, Integrated Project
Total Cost	€ 26 943 227
EU Contribution	€ 16 600 000
Duration	63 months
Start Date	01/02/2006
Consortium	62 partners from 24 countries
Project Coordinator	Natural Environment Research Council (NERC, UK)
Key Words	• Nitrogen, agriculture, climate change, air quality

NitroEurope addresses the major question: What is the effect of reactive nitrogen (N) supply on net greenhouse gas budgets for Europe?

Objectives:

- establish robust datasets of N fluxes and net greenhouse-gas exchange (NGE) in relation to C-N cycling of European ecosystems,
- quantify the effects of past and present global changes on C-N cycling and NGE,
- simulate observed fluxes of N and NGE, their interactions and responses to global change/land-management decisions, applying refined plot-scale models,
- quantify multiple N and C fluxes for European landscapes, including interactions between farm-scale management, atmospheric and water dispersion,
- up-scaling Nr and NGE fluxes for terrestrial ecosystems to regional/European levels, considering spatial variability, allowing assessment of past, present and future changes,
- assess uncertainties in European model results and use these together with independent measurement/inverse modelling approaches for verification of European Nitrous Oxide (N2O) and Methane (CH4) inventories and refinement of IPCC approaches.

275 http://www.nitroeurope.eu/

NitroEurope delivers results to a wide range of users and stakeholders. The substantial amount of new measurements of Nr fluxes and NGE on a large network of sites create a unique dataset, which is compiled and stored in a sophisticated database. Researchers within NitroEurope and a wider research community can access these datasets for in-depth analyses. In addition to that, a network of manipulation sites provides insight into the effects of future climate conditions on agricultural land and semi-natural and natural ecosystems. These are of vital importance for gaining a better understanding of the contribution of Nr to biogeochemical cycles. Modelling activities on different spatial scales – from plot to landscape to European – generate results for the assessment of management options for a better management of the nitrogen cycle. Supported by verification activities and uncertainty assessments, these results provide a direct evidence base for the design of agricultural and environmental policies.

8.5.6.4. Carbo-Extreme[276]

Title	The terrestrial Carbon cycle under Climate Variability and Extremes – a Pan-European Synthesis
Instrument	FP7-ENV-2008-1; Collaborative project
Total Cost	€ 4 677 523
EU Contribution	€ 3 312 754
Duration	48 months
Start Date	01/06/2009
Consortium	25 partners from 12 countries
Project Coordinator	Dr.Markus Reichstein, Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V. (Germany)
Key Words	Climate change, extreme events, climate variability, terrestrial carbon cycle, carbon sink, carbon pools and fluxes, ecosystem manipulation experiments, long-term observations, process studies, carbon cycle modelling, model-data integration, model scenarios, carbon vulnerability analysis, policy interaction, drought, heat wave, heavy precipitation, forest ecosystems, agriculture, grasslands, soil process studies, tree-ring analysis, tree mortality, primary production, respiration, climate model, eddy covariance measurements, flux measurements, remote sensing, database, spatio-temporal patterns, uncertainty analysis.

The overall objective is to obtain a better and more predictive understanding of European terrestrial carbon cycle responses to climate variability and extreme weather

276 www.carbo-extreme.eu

events. In particular the aim is to identify the most sensitive and vulnerable carbon pools and processes under different scenarios and to map the most likely trajectory of carbon pools in Europe over the 21st century, including uncertainties.

By building a consistent harmonized multi-source database on the European carbon cycle components for studying climate variability and extreme events and, performing a Bayesian model calibration and comparison, we aim to improve terrestrial carbon cycle predictions and their uncertainties in scenario analyses, giving advice to the European Commission and other stakeholders.

Climate extremes strongly influence terrestrial ecosystems and their carbon cycle. Multiple evidence indicates that water-cycle extremes, in particular droughts, are a dominant threat to carbon cycle related ecosystem services. All land use types in Europe are vulnerable to climate extremes to some degree. Taken together, with both their large carbon stocks and long generation time, forests are expected to experience the largest, most diverse, and longest lasting consequences for carbon cycling from climate extremes compared to other land-cover types.

8.5.6.5. GHGEUROPE[277]

Title	Greenhouse gas management in European land use systems
Instrument	FP7 Large-scale Integrating Project
Total Cost	€ 8 925 737
EUEU Contribution	€ 6 648 704
Duration	45 months
Start Date	01/01/2010
Consortium	41 partners from 15 countries
Project Coordinator	Johann Heinrich von Thünen-Institut (Germany)
Key Words	Greenhouse gas, land use management, climate change, carbon balance

GHG-Europe aims to improve our understanding and capacity for predicting the European terrestrial carbon and greenhouse gas (GHG) budget by applying a systematic, comprehensive and integrative approach. GHG-Europe quantifies the annual to decadal variability of the carbon and GHG budgets of terrestrial ecosystems via data-model integration, diagnostic and predictive modelling. Ultimately, the scientific challenge is to determine how, and to what degree, the carbon cycle and GHG emissions in terrestrial ecosystems can be managed.

277 www.ghg-europe.eu

An important finding for forests was that the stimulatory effect of nitrogen deposition in most European forests does not stem from increased photosynthesis, but from increased carbon allocation to wood. This could increase forest vulnerability to extreme events.

Although afforestation is thought to sequester carbon it turned out that afforested grasslands accumulate labile soil organic carbon but the stable fractions are depleted. This makes the soil carbon pool more vulnerable to future disturbance and loss.

Croplands are the largest N_2O source in Europe. Sensitivity analyses with models showed that there is some scope for mitigation by changes in the timing and forms of fertilizer applications.

8.5.7. Paleoclimate

8.5.7.1. PAST4FUTURE[278]

Title	Climate change – Learning from the past climate
Instrument	FP7. SP1-Cooperation. Collaborative project. Large-scale integrating project. FP7-ENV-2009-1
Total Cost	€ 9 233 878
EU Contribution	€ 6 647 909
Duration	60 months
Start Date	1/1/2010
Consortium	22 partners from 12 countries
Project Coordinator	University of Copenhagen
Key Words	Climate change, abrupt change, interglacial, sea level, sea ice, ocean circulation, thresholds, greenhouse gases, solar insolation, volcanic forcing, ice sheets

The key objective for Past4Future is to provide the answers to the following key questions:

- what are the dynamics of the climate over interglacial periods?
- what causes climate changes and abrupt changes over the course of interglacial periods?
- what causes climate changes and abrupt changes over the course of interglacial periods?
- can we understand the greenhouse gas records of the interglacial periods?

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- what can the past tell us about risks for climate changes/threats in the future?

The programme results will strengthen our understanding the responses of the Earth system in warmer climate, and will improve predictions of climate change risks and possible abrupt changes in the coming centuries. Past4Future will deliver knowledge that is of particular relevance from a European perspective. The need to predict future climate change strongly influences the prospects of both citizens and policy makers of the European Union. The program will inform the international debate on climate system stability and the dissemination of results will be targeted to both citizens and governmental and non-governmental stakeholders. Past4Future will leave a legacy of improved understanding of past drivers of sea level and sea ice changes as well as of greenhouse gas concentrations.

8.5.8. Support for developing countries to establish and maintain observing systems, related data and monitoring systems

The following activities are relevant in this context:

- as mentioned above, the African Monitoring of Environment for Sustainable Development (AMESD[279]) programme and its successor Monitoring of Environment and Security in Africa (MESA) are activities jointly supported and managed by the European Commission and EUMETSAT, which aim at monitoring the state and evolution of the environment and natural resources in Africa, encouraging the use of remote sensing data (in particular from the MSG instruments of EUMETSAT) in a wide range of applications, from policy making to resource management, and widely distributing products and services to current and prospective users and
- a tripartite collaboration[280] between the JRC, NASA and the South African National Space Agency (SANSA) has been in place since 2011 around the exploitation of data generated by the Multi-angle Imaging Spectro Radiometer (MISR) instrument on-board the NASA Terra platform.

8.6. Research Infrastructures

Research Infrastructures (RI) are facilities, resources, organisational systems and services that are used by the research communities to conduct research and innovation in their fields. This includes:

- major scientific equipment (or sets of instruments)
- knowledge-based resources such as collections, archives or scientific data
- e-infrastructures, such as data, computing and software systems
- any other infrastructure of a unique nature essential to achieve excellence in research and innovation

279 http://au.int/amesd/home/144-mesa-a-leap-forward-for-earth-observation-applications-in-africa-.html

280 http://www-misr.jpl.nasa.gov/index.cfm http://www.jpl.nasa.gov/news/news.php?release=2010-325
http://ec.europa.eu/dgs/jrc/index.cfm?id=1410&obj_id=11780&dt_code=NWS&lang=en
http://earthdata.nasa.gov/featured-stories/featured-research/new-angles

The objectives of the RI projects are:

- to open access to the research infrastructures existing in the individual Member State to all European researchers
- to avoid duplication of effort and to coordinate and rationalise the use of these research infrastructures
- to trigger the exchange of best practice, develop interoperability of facilities and resources, develop the training of the next generation of researchers
- to connect national research communities and increase the overall quality of the research and innovation.

8.6.1. Atmospheric research

8.6.1.1. ICOS[281]

Title	Integrated Carbon Observing System
Instrument	Collaborative project and coordination and support action
Total Cost	€ 5 742 042
EU Contribution	€ 4299 996
Duration	60 months
Start Date	1/04/2008
Consortium	20 partners from 15 countries
Project Coordinator	Alternative Energies and Atomic Energy Commission, FR
Key Words	Carbon, climate change, greenhouse gases

ICOS is designed to provide the long-term observations required to understand the present state and predict future behavior of the carbon cycle and greenhouse gas emissions over Europe.

The huge uncertainty associated with the behavior of future natural CO_2 sources and sinks, future anthropogenic emissions and the mitigation efforts creates the need to monitor CO_2 with a substantially improved observing, analysis and forecast system.

The first objective of ICOS is to monitor greenhouse gases and provide effective access to these data to enable multi-scale research on GHG emissions, sinks and their drivers.

The second objective is to provide information on regional budgets of greenhouse gas sources and sinks, their human and natural drivers, and the controlling mechanisms. ICOS will permit to detect changes in region- al greenhouse gas fluxes, early warning of

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negative developments and the response of natural fluxes to extreme climate events, to reduce uncertainties in Earth System models.

Europe is the third largest emitter of fossil CO_2, after China and the USA. Europe has committed itself to reduce its emissions by 20% in 2020. In this context establishing the current baseline of the carbon balance and monitoring its changes independently is crucial and timely. ICOS will provide key data and information in this respect.

ICOS is part of the global carbon strategy of the Group on Earth Observation (GEO), where well-calibrated surface networks are strengthened by complementary observations of CO_2 and CH_4 from space.

ICOS also strengthens the European leader- ship for GHG research, and several FP7 pro- grams ensure a wide usage for ICOS data.

Beyond scientists and international programmes (Global Carbon Project, WMO-GAW), users of ICOS include:

- pre-operational service providers in GMES/Copernicus (MACC-II, land services),
- regional authorities and protocol verification bodies,
- the private sector
- educational organizations, the media and the general public.

8.6.1.2. IAGOS[282]

Title	In-service Aircraft for a Global Observing System – European Research Infrastructure
Instrument	Collaborative project and coordination and support action
Total Cost	€ 4 389 127
EU Contribution	€ 3 300 000
Duration	60 months
Start Date	01/09/2008
Consortium	15 Partners from 3 countries
Project Coordinator	Forschungszentrum Jülich GmbH, DE
Key Words	Climate change, air quality, aviation, weather prediction

IAGOS aims at establishing a cost efficient, world class Research Infrastructure for high-quality observations of atmospheric composition on a global scale. This will be

282 http://www.iagos.org/

achieved by merging scientific measurement technology with the global infrastructure of commercial aviation. The specific objectives are to:

- collect global data sets of atmospheric chemical composition in the upper troposphere and lower stratosphere and vertical profiles of trace species by a set of autonomous instruments deployed aboard a fleet of passenger aircraft of internationally operating airlines
- provide long-term, frequent, regular, accurate, and spatially resolved in-situ data on atmospheric chemical composition, aerosol particles and clouds to the global scientific community.

IAGOS will eliminate major deficiencies in current atmospheric observation capabilities by filling the gap between satellite observations and ground based data.

IAGOS will provide long term, high-quality in-situ data for the upper troposphere and lower stratosphere where information is very sparse compared to the surface, although this region is paramount for understanding the causes of climate change. These data will serve as a basis for analyses of trends and budgets of atmospheric trace species as well as for investigating atmospheric trans- port processes

IAGOS will also provide vertical profile in- formation at many locations over the globe from thousands of take-offs and landings. These profiles are essential for the validation of numerical models and satellite data products, including those used for IPCC and for the Copernicus Atmospheric Service.

Real-time transmission of IAGOS multi-component datasets will enable weather services and airlines to exploit the data for improving air quality forecasts and numerical weather prediction, and potentially for improved crisis management during volcanic eruptions.

8.6.1.3. ACTRIS[283]

Title	Aerosols, Clouds, and Trace gases Research InfraStructure Network
Instrument	Collaborative project and coordination and support action
Total Cost	€ 11 496 772
EU Contribution	€ 7 800 000
Duration	48 months
Start Date	01/04/2011
Consortium	29 partners from 19 countries
Project Coordinator	Gelsomina Pappalardo
Key Words	Climate change, air quality, long-range transport of pollutants, aerosols, clouds, trace gases

ACTRIS aims at integrating European ground- based stations equipped with advanced atmospheric probing instrumentation for aerosols, clouds and short-lived gas-phase species. ACTRIS has the essential role to sup- port building of new knowledge as well as policy issues on climate change, air quality and long-range transport of pollutants. The main objectives are:

- to provide long-term observational and high-quality data relevant to climate and air quality research on the regional scale produced with standardized or comparable procedures and access to high-quality information and services for the user communities
- to provide a coordinated framework to support transnational access to European advanced infra- structures and enhance training of new scientists in the field of atmospheric observation
- to develop new technologies and the use of multiple techniques at ground-based stations, particularly for the calibration/ validation/ integration of satellite sensors and improvement of parameterisations used in global and regional scale climate and air quality models.

The scientific community and many national, EU and international programmes and projects heavily rely on the high-quality atmospheric data as currently provided by ACTRIS.

The data products facilitate and enhance scientific exchange with user communities working on models, satellite retrievals, and forecast systems. The access opportunities

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to the high quality infrastructures strength- en and reinforce European collaboration, and training of the young research community are of great benefit to the research infrastructures through sharing of experience, knowledge, and human capital, and will promote atmospheric research and develop future research activities using best practices and innovative investments in atmospheric instrumentation. For the future, the development of new synergetic algorithms for advanced higher-level products will further improve the knowledge of atmospheric processes. It is expected that ACTRIS outcomes will be used to support decisions in a wide range of policy areas, including air quality, but also health, international protocols, and research requirements.

8.6.1.4. EUFAR[284]

Title	European Facility for Airborne Research in environmental and geoscience
Instrument	Collaborative project and coordination and support action
Total Cost	€ 9 657 391
EU Contribution	€ 8 000 000
Duration	60 months
Start Date	1/10/2008
Consortium	32 partners (14 operators of airborne facilities, and 18 experts in airborne research)
Project Coordinator	Jean-Louis Brenguier, Météo-France, FR
Key Words	Airborne research, Measurement campaign, Environmental and Geo-sciences, Instrumental research, Climate Change, Air Quality, Land Use, Air Pollutant Emissions, Atmosphere-Biosphere Interactions, Model Parameterisations

The main goal of the project is to provide scientists with access to the most complete range of research infrastructures, EUFAR:

- develops transnational access to national infra- structures
- reduces redundancy and fills the gaps
- improves the service by strengthening expertise through exchange of knowledge, development of standards and protocols, constitution of databases, and joint instrumental research activities
- promotes the use of research infrastructures, especially for young scientists from countries where such facilities are lacking.

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EUFAR will provide:

- improved access to – and use of – the pool of research infrastructures through (i) the unique portal to all airborne research activities in environmental and geosciences in Europe; (ii) the coordinated implementation of access activities amongst the operators; (iii) the exchange of knowledge via the expert working groups; (iv) the education and training activities; (v) the improvement and harmonization of standards and proto- cols; (vi) the archive of data generated and easy access to users.
- optimum development of research infrastructures through (i) the independent overview of EUFAR progress by experienced and eminent re- searchers; (ii) the collect of scientific demand and the exploration of solutions; (iii) the three joint research activities.
- collaborative arrangements and perspectives for the long-term sustainability of EUFAR.

8.6.1.5. INGOS[285]

Title	Integrated Non-CO_2 Greenhouse gas Observing System
Instrument	Collaborative project and coordination and support action
Total Cost	€ 10 000 000
EU Contribution	€8 000 000
Duration	48 months
Start Date	01/10/2011
Consortium	34 partners from 14 countries
Project Coordinator	Alex Vermeulen
Key Words	Climate change, non-CO_2 greenhouse gases, monitoring, inverse modelling, emissions.

The objective of InGOS is to integrate existing European facilities for monitoring of atmospheric non-CO_2 greenhouse gases (NCGHGs), at ecosystem flux measurement sites and over the ocean, by developing common quality control and quality assurance procedures. New measurement techniques and instrumentation will be explored for preparing the integration of NCGHG measurements into ICOS, thus giving these observations an operational, long-term monitoring perspective.

Sub objectives are:

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- harmonize and standardize the measurements of NCGHGs
- provide capacity building in new member states and countries with inadequate existing infrastructure
- support existing observation sites and transfer of selected sites into supersites
- integrate and further integrate marine observations of the NCGHGs with land-based observations
- improve measurement methods by testing new innovative techniques and strategies
- test advanced isotope techniques for application in the network to enable attribution of the atmospheric fractions to source categories
- integrate data for network evaluation by using inverse modelling and data-assimilation methods and developments in bottom up inventories
- link the network to remote sensing data of column abundances from in-situ and satellite observations
- prepare for the integration of the NCGHG network with the Integrated Carbon Observation System.

InGOS will lead to major advances in the following areas:

- integrate European facilities for monitoring of NCGHGs
- improve the quality of historical, current and future NCGHG measurements
- prepare expansion of the current network with new stations in under sampled regions
- provide Near-Real Time access to atmospheric NCGHG data
- improve analysis methods using innovative techniques and strategies
- improve halocarbon measurements
- link remote sensing data to the in situ network
- attribute source categories by advanced isotope techniques
- inverse Modelling of European NCGHG measurements
- link to European flux towers
- ocean observations
- InGOS Data Centre.

8.6.1.6. IS-ENES

Title	Infrastructure for the European Network for Earth System Modelling – Phase 2
Instrument	Collaborative project and coordination and support action

Title	Infrastructure for the European Network for Earth System Modelling – Phase 2
Total Cost	€ 11 175 385
EU Contribution	€ 7 999 941
Duration	48 months
Start Date	01/04/2013
Consortium	23 partners from 11 countries
Project Coordinator	Sylvie Joussaume
Key Words	Earth system modelling, climate change, model data archives, high-performance computing

IS-ENES2 has four main objectives:

- to foster the integration of the European Climate and Earth system modelling community
- to enhance the development of Earth System Models,
- to support high-end simulations enabling to better understand and predict climate variations and change
- to facilitate the application of Earth system model simulations to better predict and understand climate change impacts on society by enhancing the dissemination of model results from both global and regional model experiments.

IS-ENES2, builds on the outputs of IS-ENES and the FP7 METAFOR project. It encompasses both global and regional models and supports the data and metadata infrastructure as well as international standards for the WCRP CMIP5 and CORDEX experiments. It further supports developments to ease the use of climate model data by the climate impact research community. It strengthens the ENES community capacity to provide more reliable decadal predictions at regional scale for society.

Networking activities will increase the cohesion of the European ESM community and advance a coordinated European Network for Earth System modeling.

Joint research activities will improve the efficient use of ESMs, high-performance computers, access to model results in terms of data and metadata and will contribute to the development of international databases and standards.

Finally, IS-ENES2 will provide services on models and model data and metadata both to climate modeling groups and to the users of model results, including the impacts community.

IS-ENES2 will mainly benefit to the climate modeling and climate impact communities. It will also enhance innovation through collaboration with ICT technologies and through use of model results for emerging European Climate Services and corporations.

8.6.2. Ocean and Marine research

8.6.2.1. EURO-ARGO[286]

Title	Global Ocean Observing Infrastructure
Instrument	Collaborative project and coordination and support action
Total Cost	01/01/2008
EU Contribution	30 months
Duration	€ 4 210 105
Start Date	€ 2 995 859
Consortium	Institut Français de Recherche pour l'Exploitation de la MER (IFREMER) Brest, FR
Project Coordinator	Pierre-Yves LE TRAON

The main objective of the Euro-Argo preparatory phase is to undertake the work needed to ensure that by 2010 Europe will be able to:

- deploy, maintain and operate an array of 800 floats. This will require Europe to deploy 250 floats per annum worldwide.
- provide a world-class service to the research (cli- mate) and environment monitoring (e.g. GMES) communities.

The main expected outcome of the preparatory phase proposal is an agreement between member states and other funding agencies for long term (> 10 years) operation of Euro-Argo (financial, governance, organization, technical). To reach such an agreement, it will be necessary to work on several key technical (float technology, data management and delivery system) and organizational (logistics for deployment, coordination of national contributions) issues, to consolidate and broaden the user community and to demonstrate further the impact and utility of the infrastructure for Europe.

The preparatory phase proposal work packages will inter alia focus on:

- the consolidation and strengthening of existing national contributions to the infrastructure.
- the development of a direct EC-wide contribution through Copernicus

286 www.ifremer.fr/euro-argo/

- the development of legal and governance arrangements for the Euro-Argo infrastructure
- evaluation and improvement of the European contribution to the Argo data management and de livery system
- enhancing European float technological capabilities (performances, sensors, communication systems) and working towards using Argo to study aspects of ocean biogeochemistry
- the development of a vigorous European Argo user community
- exploiting the open access to Argo data as an educational "window" on the oceans and their role in climate
- developing new partnerships between European Argo nations, new European countries and nations outside Europe
- integrating the European observing array into the international system
- developing a ten year implementation plan.

8.6.2.2. GROOM[287]

Title	Gliders for Research, Ocean Observation and Management
Instrument	Collaborative project
Total Cost	€ 4 938 338
EU Contribution	€ 3 500 000
Duration	36 months
Start Date	01/10/2011
Consortium	19 partners from 9 countries
Project Coordinator	Laurent Mortier, UNIVERSITE PIERRE-ET- MARIE CURIE, FR
Key Words	Underwater gliders, Marine Research Infrastructure, Ocean Observing System

The objective of the GROOM project is to design a new European Research Infrastructure (RI) that uses underwater gliders for collecting oceanographic data for research applications and oceanic monitoring. This infrastructure will be based on a distributed architecture of gliderports around the European seas and overseas, working in close coordination. This architecture is the required and cost-effective way to operate fleets gliders in combination with other existing observing systems. This infrastructure

287 www.groom-fp7.eu

must be suitable to deploy, maintain and operate individual as well as fleets of gliders continuously for operational monitoring to the benefit of the regional and global ocean observing systems and for a wide range of marine research fields. As an overall objective, the GROOM project will propose a roadmap for a ten year implementation plan of a global glider program.

The expected results of GROOM will comprise:

- consolidation of the fragmented infrastructure into one coherent system, but keeping the individual Member States identity and responsibility,
- increase of the scientific benefit for users of the infrastructure by, for example, defining protocols and standards, ensuring interoperability, opening the infrastructure for outside users, establishing an adequate data distribution system,
- provision of the basis for establishing the detailed plans for a new glider legal infrastructure by evaluating the existing legal and financial models against the requirements of a glider infrastructure
- communication to European stakeholders and international bodies active with marine research infrastructure and observing systems via publications in respective journals and via international oversight committees
- tests and operations at sea of tools and methods, as well of new research strategies (new sensors, fleet deployments). The existing national RIs will manage these tests in European seas and overseas, resulting in an early stage of a future European RI.

8.6.2.3. MESOAQUA[288]

Title	Network of leading MESOcosm facilities to advance the studies of future AQUAtic ecosystems from the Arctic to the Mediterranean
Instrument	Collaborative project and coordination and support action
Total Cost	€ 4 559 470
EU Contribution	€ 3 500 000
Duration	48 months
Start Date	01/01/2009
Consortium	5 partners from 5 countries
Project Coordinator	University of Bergen, NO
Key Words	Marine ecosystems, pelagic food web

Mesocosm science requires a relatively costly and complex infrastructure that has only been developed in a limited number of almost exclusively land-based and in-shore locations around the world. Transfer of know-how, data and training between these facilities has been limited and mainly dependent on personal contacts. To meet this shortfall, MESOAQUA worked in synergy to strengthen experimental ecology as a discipline within European and international marine science. The overall objectives of MESOAQUA are to: offer researchers access to a range of leading mesocosm facilities in contrasting environments from the Arctic to the Mediterranean; develop and test new technologies that allow access to off-shore environments; improve the services of the facilities through the exchange of technology and experience; facilitate cross-disciplinary fertilisation, transnational network building and a better coordination of mesocosm research; train young scientists in the use of experimental ecosystem research.

During four years, MESOAQUA offered to more than 150 European and not-European marine scientists, access to its mesocosm facilities where they were leading or contributing to 23 different mesocosm experiments. MESOAQUA advanced the state-of-the-art of mesocosm technology and expanded the range of environments in which they can be used, collaborating to the development and test of two state-of-the art mesocosm platforms that can be used for open ocean research. MESAQUA has tremendously increased the research standard of the European mesocosm facilities through an inter-facility transfer of technology and dissemination of knowledge. MESOAQUA has successfully optimized the effectiveness and enhanced the exchange of information and dissemination of knowledge about mesocosm research, by creating a mailing list (≈ 500 contacts) and a web portal (http://mesoaqua.eu) that function as an

288 http://www.mesoaqua.eu/

international information hub for establishing new contacts and for coordination of research activities.

8.6.3. Arctic research

8.6.3.1. SIOS[289]

Title	Svalbard Integrated Earth Observing System - Preparatory Phase
Instrument	Construction of New Research Infrastructures - Preparatory Phase
Total Cost	€ 6 675 481
EU Contribution	€ 3 999 965
Duration	48 months
Start Date	01/10/2010
Consortium	26 partners from 14 countries, plus 23 associated partners from additional 5 countries
Project Coordinator	Jon Børre Ørbæk
Key Words	Arctic, Research Infrastructure, Earth System Science, Climate Change, Environmental Change, ESFRI Roadmap

SIOS shall be a regional observational sys- tem for long term acquisition and proliferation of fundamental knowledge on global environmental change within an Earth System Science (ESS) perspective in and around Svalbard. SIOS aims to be the world's leading large-scale research infrastructure in the Arctic, and will provide state-of-the-art research services and observations to the international polar research community.

SIOS will:

- improve collaboration and formalise scientific and observational integration between the extensive existing research infrastructures already in place in Svalbard.
- provide a regional, world class, integrated observing system for long-term acquisition of fundamental data about global environmental change in an Earth System Science perspective.
- provide better coordinated services for the international research community with respect to access to infrastructure, data and knowledge, sharing of data, logistics, training and education.

289 www.sios-svalbard.org

- establish close coordination with other ESFRI projects with Arctic nodes, regional research networks in the European Arctic and contribute to the realisation of a pan-Arctic Observing Network (SAON), as endorsed by the Arctic Council.

The fact that Svalbard is hosting a unique set of international research stations in all fields of natural science, contributes to better understand the multitude of environmental arctic change. The integration and structuring of coordinated observations with clear scientific goals, is the means of SIOS to achieve an understanding of the coupled and underlying processes in global change. SIOS thus supply added value to all the investors beyond what their own investments would provide in solitude, and the enhancements of the research infrastructure shall be made to achieve this.

SIOS will set an example for how to systematically construct observational networks in the Arctic. The joint services offered by SIOS will generate added value for all partners and benefit the international polar research community as a whole. SIOS will establish an experimental environment where it will be attractive to perform shorter term basic and applied research against the combined back- drop of both the core measurement program and the services provided by the Knowledge Center. The nature of such basic and applied research will not be restricted by SIOS but can potentially inform subsequent evolution of SIOS monitoring activities.

SIOS thus contributes to further develop the research infrastructure in and around Svalbard into the leading polar research infra- structure in the Arctic.

8.6.3.2. INTERACT[290]

Title	International Network for Terrestrial Research and Monitoring in the Arctic
Instrument	Research Infrastructures for Polar research
Total Cost	€ 9 362 620
EU Contribution	€ 7 300 000
Duration	48 Months
Start Date	01/01/2011
Consortium	32 partners from 12 countries and 20 Observer Stations
Project Coordinator	Terry Callaghan
Key Words	Climate change, changes in the cryosphere, biosphere, feedback mechanisms, trans-national access to the whole Arctic, research station’s managers forum, improving monitoring technology,

290 http://www.eu-interact.org/

Title	International Network for Terrestrial Research and Monitoring in the Arctic
	improving data access and outreach

INTERACT has a main objective to build capacity for identifying, understanding, predicting and responding to diverse environmental changes throughout the wide environmental and land-use envelopes of the Arctic. Implicit is the aim to build capacity for monitoring, research, education and outreach.

Detailed objectives include sustaining the current observing capacity of existing infrastructures and their networking activities throughout the Arctic, expanding this observing capacity by responding to new needs from the research, assessment and wider stakeholder communities, improving the efficiency of observing by developing and deploying new observing technologies implemented with standard protocols, and making archived and new observations more accessible to a wide range of users. Further- more, INTERACT aims to generate increased research activity by increasing access to the Arctic for researchers and to provide legacy by engaging the next generation of researchers in collaborative educational activities. INTERACT aims to provide outreach to relevant local, regional and global stakeholders.

INTERACT has already increased the capacity for monitoring, research, education and out- reach in the Arctic. INTERACT has grown from 33 to over 50 research infrastructures (and is still growing) in all arctic countries. Almost all the major northern terrestrial infrastructures in the North will be collaborating within INTERACT. The INTERACT Stations are strategically sampling the environmental space of the Arctic. The one-stop-shop provides immediate and simple access to terrestrial facilities, activities and information from the whole environmental envelope, as well as a rapid response system to record extreme events with potentially large impacts. Within the first two years 360 researchers have received access to 20 research stations.

INTERACT has become a major initiative recognised at local, regional and global levels. It is a task within SAON and is contributing to GEO. It has been endorsed by all major Arctic initiatives.

8.6.4. *Biodiversity*

8.6.4.1. ANAEE

Title	Infrastructure for Analysis and Experimentation on Ecosystems
Instrument	Collaborative project and coordination and support action
Total Cost	€ 4 787 692
EU Contribution	€ 3 400 000
Duration	42 months
Start Date	01/11/2012
Consortium	13 partners from 10 countries
Project Coordinator	Abad Chabbi
Key Words	Research infrastructure, ecosystem, experimental, distributed infrastructure, in natura platform, in vitro platform, ecotron, modelling platform, analytical platform, roadmap, governance, legal framework, business plan, innovation

AnaEE will provide Europe with a distributed and coordinated set of in natura and in vitro experimental sites covering the full range of Europe's ecosystems and climate zones. These highly-equipped sites will be linked to centralised state-of-the-art analytical and modelling platforms that will analyse and predict in a precise manner the response of the main continental ecosystems to environ- mental and land use changes.

AnaEE is on the ESFRI (European Strategy Forum on Research Infrastructures) roadmap and will be rolled out in three phases:

- preparatory Phase (2012 to 2016)
- construction Phase (2014 to 2018)
- implementation Phase (2018 onwards).

AnaEE will provide scientists with a unique platform to conduct experimental research into climate, land use and global changes. The integrated experimental, modelling and analytical facilities within AnaEE will allow scientists to manipulate drivers using state-of-the-art techniques in a highly inter- disciplinary research environment and generate high quality data and projections on continental ecosystems responses to global changes.

AnaEE will provide industry actors with opportunities to develop new technologies as part of this state-of-art experimental plat- form enabling them to develop new products, expand markets and consequently create jobs and socio-economic benefits for society at wide.

AnaEE will provide policy makers with the capacity to acclimate and mitigate the effects of climate change by providing them with the quality data, analyses and forecasts needed to make informed decisions on environmental and land-use regulation and policies.

8.6.4.2. TREES4FUTURE[291]

Title	Designing Trees for the Future
Instrument	Research Infra-structures Integrating Activity
Total Cost	€ 9 059 348
EU Contribution	3 7 000 000
Duration	48 months
Start Date	01/11/2011
Consortium	28 partners from 13 countries
Project Coordinator	Dr. Luc E. Pâques, INRA, FR
Key Words	Forest, Infrastructure, Breeding, Wood Quality, Climate Change, Adaptation, Innovation, Genetics, Biological Resources, Wood Technology, GIS, Modelling, Databases, Economy, Environment

The project partners of Trees4Future represent a wide range of expertise from the tree/population scale to the forestry land- scape scale. Trees4Future will develop new integrated facilities and research tools, in addition to providing trans-national access (TNA) to their research infrastructures. The results of their joint research effort will help the European forestry sector respond in a sustainable manner to increasing demands for wood products and services (including the preservation of forest biodiversity) in the context of changing climatic conditions.

Trees4Future will develop:

- a user-friendly analytical platform for statistical and genetic data analysis. This will be a novel and unique platform in Europe that will enable forest researchers to have free access to a wider, better performing and integrated way of analysing their datasets, coupled with a data-mining tool
- a platform for molecular analysis. The platform will collect and provide a set of genetic markers and standardised laboratory protocols for genetic identification and fingerprinting of forest resources from several species. It will support the development of a pan-European traceability system for example for forest reproductive material

291 www.trees4future.eu

- a GIS-based decision making tool for better matching forest tree species and varieties to environmental conditions across Europe, in particular in the context of climate change. This tool will also enable breeders to delineate pan-European breeding zones and deployment zones in the frame of collaborative tree improvement programmes
- a clearinghouse with GIS functionality. The research data from national and EU environmental and genetic databases, plots and resources will help improve existing data sources and provide a common reference point to access the data via geo-enabled web services
- integrated compatible modelling tools for prediction of forest wood resources and services. These tools will be interconnected and enriched by integrating genetic information as well as wood quality models in order to better assess forest goods and services and their sustainability in relation to management practices and changes in environment. They will help with evaluating adaptation and mitigation strategies for European forests
- high-throughput phenotyping methodologies. For some key-traits linked to tree adaptation and wood properties, improved or innovative assessment methods or tools will be developed to increase phenotyping capacity, compatible with new needs in genetic studies and genomic selection for example. Several of these outcomes together with TNA infrastructures should further support the creation of a European Tree Breeding Centre envisioned in the preceding project TREEBREEDEX.

9. EDUCATION, TRAINING AND PUBLIC AWARENESS

Key Developments

The EU has been investing a significant amount of effort and resources to increase the awareness of the Europeans to the challenges posed by the impacts of climate change and to the opportunities arising from, in particular, reducing greenhouse gas emissions. Actions in the field of education and training, in addition to awareness raising campaigns, have played a major role.

The key developments and highlights since NC5 are:

- The EU-wide awareness-raising campaigns
  - You Control Climate Change (2005 to 2009) and
  - A world you like with a climate you like
- Lifelong Learning Programme – Education and training components
- Intelligent Energy Europe Programme - Education and training components
- Sustainable Energy Europe Campaign
- Covenant of Mayors
- European Mobility Week
- Green Week
- The involvement of stakeholders in the decision making process (namely on the EU strategy on adaptation to climate change and the Roadmap for moving to a competitive low-carbon economy in 2050)

9.1. Introduction and general policy toward education, training and public awareness

This chapter on education, training and public awareness has been structured in order to be as consistent as possible with the structure proposed by the UNFCCC reporting guidelines, thus enhancing comparability with reports by other Parties and facilitating the task of the expert review team.

The chapter focuses on key aspects related to education, training public awareness and support to developing country partners on matters related to Article 6 of the Convention. In order to keep the chapter concise, only a brief description of the most relevant activities is included. In most cases the internet address of the activities is provided, thus facilitating access to additional information.

In the European Union, responsibility for education and training policy lies with Member States. The EU's role is to support the improvement of national systems through complementary EU level tools, mutual learning, exchange of good practices and financial support.

The Member States' 6th National Communications report on details of education and training activities at the national level. Nevertheless, the EU supports the Member States' activities under different programmes and actions. Therefore, the EU 6th

National Communication reports not only on public awareness activities, but also on education and training activities at the EU level.

9.2. Primary, secondary and higher education

Activities on primary, secondary and higher education comprise

- The Lifelong Learning Programme
- The Intelligent Energy Europe Programme

9.2.1. Lifelong Learning Programme - Education[292]

http://ec.europa.eu/education/lifelong-learning-programme/doc78_en.htm

The European Commission's Lifelong Learning Programme enables people at all stages of their lives to take part in stimulating learning experiences, as well as helping to develop the education and training sector across Europe.

With a budget of nearly € 7 billion for 2007 to 2013, the programme funds a range of actions including exchanges, study visits and networking activities. Projects are intended not only for individual students and learners, but also for teachers, trainers and all others involved in education and training.

There are several sub-programmes with environment, sustainability and climate change related activities:

- Comenius: Environmental sustainability training for children through online simulation, exploration and collaboration;
- Erasmus: The lived experience of climate change: interdisciplinary e-module development and virtual mobility;
- Erasmus: Development of MSc programme in environmental security and management (available in several languages).

9.2.2. Intelligent Energy Europe Programme - Education[293]

http://ec.europa.eu/energy/intelligent/

Intelligent Energy – Europe (IEE) offers a helping hand to organisations willing to improve energy sustainability. Launched by the European Commission in 2003, the programme is part of a broad push to create an energy-intelligent future. It supports EU energy efficiency and renewable energy policies, with a view to reaching the EU 2020 targets (20 % cut in greenhouse gas emissions, 20 % improvement in energy efficiency and 20% of renewable energy sources in EU energy consumption).

In an effort to help young children understand many of the issues behind climate change, the programme has supported a number of decentralised, practical, grassroots schemes which promote energy education in primary schools all over Europe. The projects bring together local experts on energy efficiency and the children's teachers to run entertaining and informative classes on energy-saving issues.

292 The Lifelong Learning Programme also has a focus on training, which is dealt with in the relevant section of this chapter.

293 The Intelligent Energy Europe Programme also has a focus on training, which is dealt with in the relevant section of this chapter.

9.2.3. *European Environment Agency (EEA) initiatives on education and training on climate change*

The EEA, an agency of the European Union, addresses many audiences through its communication activities, including children and young people. Various products and events are used to communicate about climate change and other environmental topics in a creative and educational manner.

Between 2008 and 2012 the main actions of the EEA in terms of education on climate change were:

- Eco Agents, the EEA educational 'flagship' targeting children, is a website in the form of a comic strip. It included downloadable quizzes on climate change and a library of related links, among other things. The intended target audience is 9-12 year old children across Europe. Eco Agents is available in 24 languages.
- EEA and Eco Schools collaboration. In October 2007, the EEA and the Eco Schools network held a workshop to develop educational environmental material on climate change, biodiversity and sustainable lifestyle. The target audience is teachers of 9-14 year-old children across Europe. The process continued over the 2008-2012 period.

9.3. Public information campaigns

The European Commission has carried out several EU-wide public information and awareness-raising campaigns that are of direct or indirect relevance to climate change.

Many of the campaigns make considerable use of the internet and social media tools, but all also include opportunities for personal live interaction. The campaigns employ websites, Facebook pages, Twitter feeds, video productions, seminars, workshops and other types of live events.

The main campaigns undertaken during the reporting period were:

- You Control Climate Change
- A world you like with a climate you like
- Sustainable Energy Europe Campaign
- Resource Efficiency Campaign
- Biodiversity Campaign
- Covenant of Mayors
- European Mobility Week
- Green Week
- European Business Awards for the Environment
- European Green Capital Award

9.3.1. You Control Climate Change

http://ec.europa.eu/clima/sites/campaign/index.htm

The European Commission launched this public awareness raising campaign in May 2006. The campaign aimed to give people a sense of responsibility, among other things by providing practical tips on how small changes to daily habits can achieve collectively significant reductions in GHG emissions.

The campaign used a wide variety of supports to reach a broad public, especially young people. The campaign website, available in 21 language versions, was the cornerstone of the campaign and the place where all the resources and information were available.[294] Other supports included videos, publications, advertising (TV, cinema, newspaper, online, outdoor), posters, applications (screen saver, carbon calculator), game (Living together!), news articles, and video podcasts.

The campaign was carried out in 3 phases from 2006 to 2009, with a budget of approximately €7.2 million.

9.3.2. A world you like, with a climate you like

http://world-you-like.europa.eu/en/

A world you like, with a climate you like is the European Commission's latest pan-European public communication campaign on climate change. Focused on practical solutions to climate change, it ran from October 2011 to December 2012.

The campaign's central message was that making the transition to low-carbon society is not only urgent but also feasible, affordable and will enhance our quality of life. The campaign showcases and promotes dialogue on existing solutions and best practices applied by citizens, businesses and authorities across the European Union. It covered five areas: travel and transport; production and innovation; building and living; shopping and eating; and re-use and recycling.

The campaign was centred on an interactive, user friendly website in 23 languages which featured background information on the low-carbon society, videos of success stories for each Member State and information on the campaign events. The website also had a dedicated section about the more than 250 partner organisations which support the campaign by promoting it through their own networks and events.

Through the campaign the Commission wanted to hear from Europeans about their expectations and success stories. For this purpose, the World You Like Challenge was set up to find and reward the most creative, efficient, inspiring and practical solutions to reduce greenhouse gas emissions. Some 269 projects took part. Following a public vote from which a shortlist of best projects was compiled, one European winner as well as one national winner for Bulgaria, Italy, Lithuania, Poland and Portugal and three European level winners were chosen.

In addition, through the campaign website and a range of social media channels (Facebook, Twitter, YouTube, Flickr and Pinterest), people were able to discuss Europe's low-carbon future with other Europeans including Connie Hedegaard, European Commissioner for Climate Action. Commissioner Hedegaard also participated personally in more than 10 events in different EU Member States.

294 http://ec.europa.eu/environment/climat/campaign/index_en.htm

9.3.3. *Sustainable Energy Europe Campaign*

http://www.eusew.eu/index.php

The Sustainable Energy Europe Campaign (2005-2011 and 2012-2015) is a European Commission initiative to raise public awareness and promote sustainable energy production and use across Europe. The campaign showcases activities dedicated to energy efficiency and renewable energy solutions. The focus is on spreading best practice in sustainable energy technology, building alliances and inspiring new energy ideas and actions.

The annual highlight of the campaign is Sustainable Energy Week, which consists of a high level policy conference held in Brussels and a series of local Energy Days for the general public throughout Europe, organised by municipalities, regions and other stakeholders.

9.3.4. *Resource Efficiency Campaign*

www.generationawake.eu

https://www.facebook.com/GenerationAwake

"Generation Awake. Your choices make a world of difference!" is an EU campaign to encourage consumers to be more efficient in their use of resources. It is raising awareness of the need to use scarce natural resources wisely and encouraging citizens to think about their impact on the planet when making purchasing decisions.

The key message is 'consume differently, and think before you choose'. By making the right choices we can all help preserve natural resources, save money, reduce our impact on the environment and make our future more sustainable.

The main tools are a dedicated multi-lingual website and a Facebook page where visitors are encouraged to join "Generation awake" and accept challenges, like using only public transport for a month or reducing showering time to save water.

9.3.5. *Biodiversity Campaign*

www.weareallinthistogether.eu

This EU-wide campaign (completed in 2012), raised public awareness of the need to halt the loss of biodiversity, among other things to help combat climate change.

9.3.6. *Covenant of Mayors*

http://www.covenantofmayors.eu/index_en.html

The Covenant of Mayors initiative encourages local and regional authorities to commit to meet or exceed the EU's target of reducing greenhouse gas emissions by 20 % by 2020. They do so by voluntarily developing Sustainable Energy Action Plans. The Covenant was launched by the European Commission in 2008, and by late November 2013 had been signed by 5 395 local and regional authorities with a combined population of over 176 million people.

For more information, see the Policies and Measures section.

9.3.7. *European Mobility Week*

http://www.mobilityweek.eu/home/

European Mobility Week is an annual campaign on sustainable urban mobility organised with the political and financial support of the Directorates-General for the Environment and Transport of the European Commission. The campaign, which runs from 16 to 22 September every year, encourages local authorities to introduce and promote sustainable transport measures and to invite their citizens to try out alternatives to car use. As part of the week's activities many local authorities organise a car-free day where designated areas are reserved solely for pedestrians, cyclists and public transport for the entire day.

Since its introduction in 2002, the impact of European Mobility Week has steadily grown, both across Europe and around the world. In recent years, the campaign has spread to countries outside the EU, including Japan, Taiwan, Brazil, Colombia and Ecuador.

In 2013, 1 930 cities from a record 47 countries in the EU and beyond took part in European Mobility Week. Since 2002 a total of 7 700 permanent measures to improve sustainability have been implemented by participating cities, mainly focussing on infrastructure for cycling and walking, traffic calming, improving transport accessibility and raising awareness about sustainable travel behaviour.

9.3.8. Green Week

http://ec.europa.eu/environment/greenweek/

The European Commission's Green Week is the biggest annual conference on European environment policy. It is open to the public and participation is free of charge.

Green Week offers a unique opportunity for debate and exchanges of experiences and best practice. Over the past decade, the conference has established itself as an unmissable event for anyone involved with protecting the environment. The 2012 edition attracted some 3 100 participants from government, business and industry, non-governmental organisations, academia and the media.

The themes of Green Week over recent years have been:

- 2008 - Sustainable Consumption and Production
- 2009 - Climate Change: act and adapt
- 2010 - Biodiversity – our lifeline
- 2011 - Resource efficiency: using less, living better
- 2012 - Every drop counts: the water challenge
- 2013 – Cleaner air for all

More than 16 000 people and 860 speakers participated in the Green Week events over these five years. The busiest year was 2009 (dedicated to climate change), with more than 4 000 people attending.

9.3.9. European Business Awards for the Environment

http://ec.europa.eu/environment/awards

The European Business Awards for the Environment, presented by the European Commission every two years since 1987, recognise European companies that have made an outstanding contribution to sustainable development.

The competition has four award categories: management, product, process and international co-operation. The scheme rewards companies that set an example in each category through a combination of innovation, economic viability, environmental concern and social responsibility.

To be eligible, companies must first succeed in their national award schemes, which are organised throughout Europe every year. This means that the companies awarded the European prize are 'the best of the best'; the most far-sighted, responsible and innovative across Europe.

9.3.10. European Green Capital Award

http://ec.europa.eu/environment/europeangreencapital/index_en.htm

Europe is an urban society that faces many environmental challenges. The European Commission has long recognised the important role that local authorities play in improving the environment.

The European Green Capital Award has been conceived as an initiative to promote and reward these efforts.

The award aims to provide an incentive for cities to inspire each other and share best practices, while at the same time engaging in friendly competition. In other words, the cities become role models for each other.

Starting in 2010, one European city has been awarded the title of European Green Capital each year. The award is given to a city that:

- has a consistent record of achieving high environmental standards;
- is committed to ongoing and ambitious goals for further environmental improvement and sustainable development; and
- can act as a role model to inspire other cities and promote best practices to all other European cities.

The winners to date are Stockholm (Sweden) 2010, Hamburg (Germany) 2011, Vitoria-Gasteiz (Spain) 2012, Nantes (France) 2013. Copenhagen (Denmark) will be European Green Capital in 2014 and Bristol (United Kingdom) in 2015.

9.3.11. Eurobarometer results on climate change (for 2009 and 2011)

http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/1162&format=HTML&aged=1&language=EN&guiLanguage=fr

http://ec.europa.eu/public_opinion/archives/ebs/ebs_322_en.pdf

http://ec.europa.eu/public_opinion/archives/ebs/ebs_372_en.pdf

Two surveys on European's attitudes towards climate change have been published in November 2009 and October 2011 respectively:

Both in 2009 and 2011, Europeans considered climate change to be the second most serious problem the world faced (after poverty, lack of food and drinking water). In

2013, for the first time, the availability of energy was added to the list of issues presented to the respondents. It was cited as a serious issue by 28 % of EU citizens. The perceived seriousness of climate change has increased between the two surveys: while in 2009 the average rating out of 10 for the perceived seriousness of the problem was 7.1; in 2011, the average rating was 7.4.

In 2009, 64 % of respondents believed that citizens themselves were not doing enough to combat climate change. In 2011, however, 53 % reported that they had personally taken some form of action while 41 % stated that they had not. In 2011, almost 80 % (up from the near two-thirds in 2009) consider that taking action to combat climate change can boost the economy and jobs and over two-thirds support basing taxation to a greater extent on energy use, with a majority in favour of this in every Member State.

There is a widespread expectation that Europe will become a climate-friendly, low-carbon economy by 2050:

- 88% believe Europe will be using more renewable energy;
- 87% expect we will be more energy-efficient; and
- 73% believe cars will be powered more efficiently.

9.3.12. Websites, media and social media

The table below lists the key climate change websites and social media, in addition to those identified in this chapter.

Table 9-1 Websites, and social media

Title	**Address**
DG Climate Action	http://ec.europa.eu/dgs/clima/mission/index_en.htm
Connie Hedegaard, Commissioner for Climate Action	http://ec.europa.eu/commission_2010-2014/hedegaard/index_en.htm
Commissioner Hedegaard on Facebook	https://www.facebook.com/ConnieHedegaardEU
Commissioner Hedegaard on Twitter	@CHedegaardEU
Active media outreach through press releases media articles and interviews	http://tinyurl.com/cwms82z (e.g.)
European Climate Adaptation Platform	http://climate-adapt.eea.europa.eu/
Energy strategy 2020	http://ec.europa.eu/energy/energy2020/energy2020_en.htm
Energy efficiency	http://ec.europa.eu/energy/energy2020/efficiency/index_en.htm
Energy-saving light-bulbs	http://ec.europa.eu/energy/lumen/index_en.htm
Emissions trading 'mindstretcher'	http://www.eea.europa.eu/themes/climate/multimedia/emissions-trading-mindstretcher

9.3.13. *Publications*

The table below lists key climate change publications and their internet address.

Table 9-2 List of publications

Title	Address
Environment for Europeans magazine (quarterly, circulation 60 000)	http://ec.europa.eu/environment/news/efe/archives.html
Intelligent Energy Europe magazine (bi-annual, 50 000 copies)	http://ec.europa.eu/energy/intelligent/promotional-tools/iee-magazine/index_en.htm
Climate change: fact sheet	http://ec.europa.eu/clima/publications/docs/factsheet-climate-change_en.pdf
The EU Emissions Trading System (EU ETS): fact sheet	http://ec.europa.eu/clima/publications/docs/factsheet_ets_2013_en.pdf
Ensuring safe use of Carbon Capture and Storage in Europe	http://ec.europa.eu/clima/publications/docs/factsheet_ccs_en.pdf
Resource efficiency	http://ec.europa.eu/environment/pubs/pdf/factsheets/resource_efficiency/en.pdf
Sustainable production and consumption	http://ec.europa.eu/environment/pubs/pdf/factsheets/sustainable_consumption.pdf
Eco-innovation	http://ec.europa.eu/environment/pubs/pdf/factsheets/eco_innovation.pdf
Nature's role in climate change	http://ec.europa.eu/environment/pubs/pdf/factsheets/Nature%20and%20Climate%20Change/Nature%20and%20Climate%20Change_EN.pdf
EU Biodiversity strategy	http://ec.europa.eu/environment/nature/info/pubs/docs/factsheets/Biod%20Strategy%20FS.pdf
Ecosystem goods and services	http://ec.europa.eu/environment/pubs/pdf/factsheets/Eco-systems%20goods%20and%20Services/Ecosystem_EN.pdf
Soil: the hidden part of the climate cycle	http://ec.europa.eu/environment/soil/pdf/soil_and_climate.pdf
Ensuring safe use of carbon capture and storage in Europe	http://ec.europa.eu/clima/publications/docs/factsheet_ccs_en.pdf
Renewables make the difference	http://tinyurl.com/cv2q388
Better light with less energy	http://tinyurl.com/d94sy6t
EU fast start funding report 2011	http://ec.europa.eu/clima/policies/finance/international/faststart/docs/fast_start_2011_en.pdf
The EU and developing countries working together	http://ec.europa.eu/europeaid/infopoint/publications/europeaid/244a_en.htm
Global Climate Change Alliance	http://www.gcca.eu/usr/GCCA_English_lo-res-rev.pdf

9.3.13.1. EEA publications

The tables below list the key climate change publications by the European Environment Agency and their internet address.

The general EEA publications page is http://www.eea.europa.eu/publications.

Table 9-3 EEA regular reports

Title	Address
EEA Signals (annual)	http://www.eea.europa.eu//publications/eea-signals-2013
2010 state of environment and outlook report	http://www.eea.europa.eu/soer/synthesis/synthesis
Transport and environment (annual)	http://www.eea.europa.eu/publications/foundations-for-greener-transport
EU GHG inventory (annual)	http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2013
GHG trends and projections (annual)	http://www.eea.europa.eu/publications/ghg-trends-and-projections-2013

Table 9-4 Examples of EEA ad-hoc reports

Title	Address
Forests, health and climate change	http://www.eea.europa.eu/publications/forests-health-and-climate-change
Regional climate adaptation – the Alps	http://www.eea.europa.eu/publications/alps-climate-change-and-adaptation-2009

9.3.14. Video productions

The table below lists video productions and their internet address.

Title	Address
Feature video on Roadmap for a low-carbon economy	http://tinyurl.com/cq3zxr4
Commissioner Hedegaard video clip ahead of Durban conference	http://tinyurl.com/c5x79vq
Videos on energy efficiency, security and renewables	http://ec.europa.eu/energy/efficiency/publications/index_en.htm http://ec.europa.eu/energy/intelligent/promotional-tools/videos/index_en.htm http://ec.europa.eu/avservices/video/player.cfm?ref=I058287
One Degree Matters (EEA documentary)	http://www.eea.europa.eu/multimedia/films/one-degreematters/view
Environmental Atlas of Europe (EEA)	http://www.eea.europa.eu/atlas/eea
Information videos and green tips (EEA)	http://www.eea.europa.eu/multimedia/climate-change-2014-time-to-act/view http://www.eea.europa.eu/multimedia/green-tipg-tyres/view

9.4. Training programmes

As with education, the EU programmes that are most relevant to training on climate change are

- The Lifelong Learning programme, and
- The Intelligent Energy - Europe Programme.

9.4.1. Lifelong Learning Programme – Training

As stated in section 9.2.1, the European Commission's Lifelong Learning Programme enables people at all stages of life to take part in stimulating learning experiences, as well as helping to develop the education and training sector across Europe.

Two of its two sub-programmes have climate change relevant training activities:

- **Leonardo da Vinci**: Training Mediterranean local authorities and civil organisations on integrated coastal zone management and reaction to the impacts of climate change
- **Leonardo da Vinci**: Training municipal climate protection managers in Central Europe http://www.clipma.eu/

9.4.2. Intelligent Energy Europe Programme - Training

http://ec.europa.eu/energy/intelligent/

As mentioned in section 9.2.2, the Intelligent Energy – Europe (IEE) Programme offers a helping hand to organisations willing to improve energy sustainability.

Intelligent Energy Europe supports a number of training programmes across Europe with a contribution of up to 75 % of the budget. The main training areas are energy saving, building certification, renewable energy technologies, biofuels and sustainable transport. Training or capacity building programmes typically target a variety of actors including local authorities, energy agencies, energy businesses, building professionals, and building owners.

The following are some of the programme's key training initiatives:

- **ManagEnergy Vocational Training corner** on energy efficiency and renewables. ManagEnergy offers a wide range of tools and facilities which aim at enabling best practice sharing, ensuring capacity building and improving networking among energy actors across Europe. http://learn-energy.net/training/#2
- **BUILD UP portal** for energy efficiency in buildings aims at training the construction work force at national level in all Member States. The actions aim at establishing national qualification platforms and roadmaps as well as setting up or upgrading qualification schemes. http://www.buildup.eu/home
- **Training on Sustainable Urban Mobility Plans** for public authorities. Training materials have been developed and training workshops took place in 2012 in many EU Member States. http://mobilityplans.eu/index.php?ID1=9&id=9
- **EDUCATE**: Promoting and disseminating sustainable practices in architecture.

- **UP-RES** (Urban planners with renewable energy skills): Workshops and professional development programmes on energy issues to train urban and regional planners in five countries (Hungary, Finland, Spain, United Kingdom and Germany).
- **ECOWILL**: Roll-out of eco-driving training courses.
- **TRANSPORT LEARNING**: Training to help transport professionals achieve energy savings in urban transport.

9.4.3. ManagEnergy

http://www.managenergy.net/

ManagEnergy is a technical support initiative financed under the Intelligent Energy - Europe programme and managed by the European Commission's Executive Agency for Competitiveness and Innovation (EACI). It supports local and regional energy actions in the fields of energy efficiency and renewable energy. Its main target groups include local and regional public authorities, energy agencies and other organisations. It was launched in 2002 following requests for improved communication and information on locally relevant sustainable energy issues.

ManagEnergy offers a wide range of tools and facilities, which aim at enabling best practice sharing, ensuring capacity building and improving networking among energy actors across Europe.

They include training resources, technical workshops tailored to local and regional needs, an annual award competition for case studies, high-quality publications, networking events at the European and local scale as well as an interactive website with policy and funding information, cutting-edge partner search tools, interactive maps, project databases, audiovisual libraries and capacity building resources.

9.5. Resource or information centres

It is the EU's policy to make all relevant information publicly available. For a list of publications and websites, please refer to the respective sections above.

9.6. Involvement of the public and non-governmental organisations

EU law requires extensive engagement and consultation of stakeholders during the policy-making process. The following two examples illustrate stakeholder engagement and consultation in the process of formulating EU mitigation and adaptation policies. Both policy initiatives were preceded by wide-ranging consultation and benefited from a broad spectrum of scientific and policy expertise.

9.6.1. EU strategy on adaptation to climate change

http://ec.europa.eu/clima/policies/adaptation/what/docs/swd_2013_132_en.pdf

The preparation of the Adaptation Strategy, adopted by the European Commission in April 2013, included the following steps:

- Consultation with the Adaptation Steering Group: This group was created in September 2010 to support the Commission in developing its approach to adaptation. The ASG consists of representatives from EU Member States and a wide range of stakeholders, including business organisations and NGOs. The Group met seven times between September 2010 and January 2013.

- Ad hoc online public consultation: This ran for 13 weeks between May and August 2012. The Commission received a total of 175 replies from a broad range of stakeholders, including Member States, business organisations, environmental NGOs and citizens.
- Thematic seminars: Various events were held in 2012 to consult Member States and key stakeholder groups on specific dimensions of the Adaptation Strategy (e.g. standards, forestry).

9.6.2. A Roadmap for moving to a competitive low-carbon economy in 2050

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SEC:2011:0288:FIN:EN:PDF

Prior to adopting the Roadmap in March 2011, the European Commission consulted stakeholders through an online questionnaire on their vision and views regarding an EU low-carbon economy by 2050. To prepare its impact assessment of the Roadmap, a review was undertaken of reports published by the end of 2010 on how to decarbonise the economy and society.

9.7. International Cooperation on Education, Training and Public Awareness

9.7.1. Amended New Delhi Work Programme on Article 6 of the Convention

The European Union contributed actively to the intermediate and final reviews of the Amended New Delhi Work Programme on Article 6 of the Convention (education, training and public awareness) and to the elaboration in 2012 of its successor, the Doha Work Programme on Article 6. This was carried out through written submissions and active EU participation in Article 6 negotiations.

The EU also provided funding to the UNFCCC Secretariat for Article 6 activities. The main activities supported in 2012 were the workshop on the implementation of Article 6 in least developed countries, held in Bonn on 19-21 June 2012, in which the EU's Focal Point on Article 6 took part, and youth participation at COP 18/CMP 8 in Doha.

The European regional workshop on Article 6 was held in Stockholm, Sweden – an EU Member State – on 18-20 May 2009.

9.7.2. Article 6-related international cooperation activities

The EU has been actively supporting a number of activities to implement Article 6 in developing countries and other third countries. More specific details about the EU’s international cooperation on climate change are provided in the respective section. Below is a list of examples of EU-supported activities relating to education, training and public awareness in third countries.

9.7.2.1. Global Climate Change Alliance (GCCA)

http://www.gcca.eu/pages/1_2-Home.html

The GCCA was launched by the European Commission in 2007 to strengthen dialogue and cooperation on climate change between the EU and the most vulnerable developing countries, particularly least developed countries and small island developing states (for more information on the GCCA see the chapter on international cooperation on adaptation).

Mainstreaming climate action into development and poverty reduction is a key focus of GCCA training activities. In 2011 and 2012 the GCCA held training workshops on mainstreaming climate change into national development planning and budgeting in all its regions. Around 200 senior officials from finance, planning and environment ministries participated.

9.7.2.2. Climate Change Media Partnership

http://www.climatemediapartnership.org/about/

The Climate Media Partnership, set up by Internews, Panos and the International Institute for Environment and Development (IIED), aims to improve media coverage of climate change issues in developing countries. The EU provided funding of € 768 000 for the 2009 to 2011 period.

9.7.2.3. World Bank Partnership for Market Readiness (WBPMR)

The EU's contribution to the WBMPR, for the 2011-2016 period, amounts to € 5 million for capacity building in developing countries, including the organisation of training workshops to help countries build expertise in market mechanisms.

9.7.2.4. Supporting access to information and justice on environmental matters in Kyrgyz Republic

The EU has provided support amounting to € 270 000 for civil society capacity-building on environment, including training of NGOs, regional environment protection departments, local governments and judiciary. The funding took place between 2008 and 2011.

9.7.2.5. Programme for environmental awareness raising in Central Asia (AWARE)

The AWARE programme aims at supporting environmental awareness in Central Asia and enhancing regional cooperation and partnership with Europe regarding environmental awareness on the most problematic environmental areas, including climate change. The EU's contribution amounted to € 800 000 for the 2011-2013 period.

9.7.2.6. Strengthening Capacity in Developing Countries for Training Purposes on Climate Change project

http://www.c3d-unitar.org

The project Capacity Development for Adaptation to Climate Change & GHG Mitigation in Non-Annex I Countries (C3D) seeks to improve the capacity of research and training institutions in developing countries to support climate change adaptation and mitigation action. The project is run by the UN Institute for Training and Research (UNITAR).

The EU provided funding of € 1.4 million over the period 2006-2009.

9.7.2.7. The CLARIS LPB Project

http://www.claris-eu.org

The CLARIS LPB Project aims at predicting the regional climate change impacts on La Plata Basin (LPB) in South America, and at designing adaptation strategies for land-use, agriculture, rural development, hydropower production, river transportation, water resources and ecological systems in wetlands.

One of the CLARIS LPB project objectives has been to train young South American students and scientists in European institutes through grants allocated each year.

9.7.2.8. Group on Earth Observations (GEO)[295]

The Group on Earth Observations is coordinating efforts to build a Global Earth Observation System of Systems, or GEOSS and aims at, among other objectives, developing capacity-building activities in the domain of earth observation, providing support to international research initiatives in which Europe would contribute to the development of observing systems.

Within it, specifically, the purpose of the GEO Network for Capacity Building (GEONetCab) project is to create the conditions for the improvement and increase of the GEO (Group on Earth Observations) capacity building activities and framework, with special emphasis on developing countries, new EU member states (and EU neighbouring states). This applies particularly to climate monitoring and increasing the effectiveness and efficiency of GEO capacity building for application in the GEO societal benefit areas.

295 For more information on GEO, please see section 8.5.1

10. LIST OF ABBREVIATIONS

AAU	Assigned Amount Unit
AEA	Annual Emission Allowances
AMESD	African Monitoring of Environment for Sustainable Development
Art	Article
BAM	baseline scenario of EUCLIMIT
BR	Biennial report
BR1	1st Biennial report
BRICS	Brazil, Russia, India, China and South Africa
CAP	Common Agricultural Policy
CB	Capacity building
CCC	Climate Change Committee (under the Monitoring Mechanism Decision)
CCCA	Cambodia Climate Change Alliance
CCPMs	Common and Coordinated Policies and Measures
CCS	Carbon Capture and storage
CDM	Clean Development Mechanism
CEOS	Committee on Earth Observation Satellites
CER	Certified Emission Reduction
CIF	Climate Investment Funds
CION	European Commission
CITL	Community Independent Transaction Log
CM	Cropland Management
CM SAF	Satellite Application Facility on Climate Monitoring
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2eq	Carbon dioxide equivalents
COP	Conference of Parties
COSME	Programme for the Competitiveness of enterprises and SMEs
COSPAR	Committee on Space Research
CP	Commitment Period
CPA	Classification of products by activity in the European Union
CRF	Common Reporting Format
CTF	Common Tabular Format
DCs	Developing countries
DDC	District Development Committee
DG	Directorate-General
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EAP	Environment Action Programme
ECMWF	European Centre for Medium range Weather Forecasting
ECU	European Currency Unit

ECV	Essential Climate Variable
EDCTP	European and Developing Countries Clinical Trials Partnership
EEA	European Environment Agency
EEAS	European External Action Service
Eionet	European Environment Information and Observation Network
EIT	Economy in transition
EMU	Economic and Monetary Union
EO	Earth Observation
EP	European Parliament
ERA	European Research Area
ERA-NET	European Research Area Net
ERC	European Research Council
ERDF	European Regional Development Fund
ERT	Expert Review Team
ERU	Emission Reduction Unit
ESA	European Space Agency
ESD	Effort Sharing Decision
ESF	European Social Fund
ESSP	Earth System Science Partnership
ETAP	EU Environmental Technologies Action Plan
ETC/ACM	European Topic Centre on Air Pollution and Climate Change Mitigation
ETS	Emission trading scheme
EU ETS	The European Union's emission trading scheme
EU	European Union
EUCLIMIT	Development and application of EU economy-wide climate mitigation modelling capacity (project)
EU-13	The new EU Member States: Estonia, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia, Czech Republic, Hungary, Cyprus (joined 2004); Bulgaria, Romania (joined 2007), Croatia (joined 2013)
EU-15	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom
EU-27	EU-15 plus Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia,
EU-28	EU-27 plus Croatia
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUR	Euro
EURATOM	European Atomic Energy Community
FACCE-JPI	Joint Programming Initiative Agriculture, Food Security and Climate Change
FCDR	Fundamental Climate Data Records
FlexMechs	Flexible Mechanisms under the Kyoto Protocol
FM	Forest Management
FP	Framework Programme
FP6	6^{th} Framework Programme

FP7	7th Framework Programme
FSF	Fast Start Financing
GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GFCS	Global Framework for Climate Services
GHG	Greenhouse Gases
GIS	Geographical Information Systems
GM	Grazing Land Management
GVA	Gross Value Added
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
IA	Impact Assessment
IAB	Impact Assessment Board
ICPC	International Cooperation Partner Countries
ICSU	International Council for Science
IDR	In Depth Review
IET	International Emissions Trading
IOCCG	International Ocean Colour Coordinating Group
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental panel on climate change
JI	Joint Implementation
JPI	Joint Programming Initiative
JRC	Joint Research Centre
koe	Kilograms of Oil Equivalents
KP	Kyoto Protocol
LBA	Legally-Binding Agreement
lCER	Long-term Certified Emission Reduction
LDCF	Least Developed Countries Fund
LDCs	Least developed countries
LECB	Low Emission Capacity-Building Programme
LEDS	Low-Emission Development Strategies
LULUCF	Land use, land use Change and Forestry
MESA	Monitoring of Environment and Security in Africa
MISR	Multi-angle Imaging SpectroRadiometer
MMD	Monitoring Mechanism Decision
MMR	Monitoring Mechanism Regulation
MRV	Monitoring, Reporting and Verification
MS	EU Member State
MSG	Meteosat Second Generation

Mt	Megatonnes
Mtoe	Megatonnes of oil equivalent
N_2O	Nitrous Oxide
NACE	Statistical classification of economic activities in the European Union
NAMA	Nationally Appropriate Mitigation Action
NAP	National Adaptation Plan
NAS	National Adaptation Strategy
NASA	National Aeronautics and Space Administration
NC	National Communication
NC4	4th National Communication
NC5	5th National Communication
NC6	6th National Communication
NCCC	National Climate Change Committee
NCCSP	Nepal Climate Change Support Programme
NCGHG	non-CO_2 greenhouse gas
NEC	National Emissions Ceiling
NER	New Entrant Reserve
NF_3	Nitrogen Trifluoride
NIR	National Inventory Report
NMVOC	Non-methane volatile organic compounds
NREAP	National Renewable Energy Action Plan
NOx	Nitrogen oxides
ODA	Official Development Assistance
PaMs	Policies and measures
PASAP	Peri-urban water and sanitation programme
PFCs	Perfluorocarbons
QELRC	quantified emission limitation and reduction commitment
RMU	Removal Unit
RSO	Research and Systematic Observation
RV	Revegetation
SAF	Satellite Application Facility
SANSA	South African National Space Agency
SBI	Subsidiary Body for Implementation
SBSTA	Subsidiary Body for Scientific and Technological Advice
SCCF	Special Climate Change Fund
SDS	Sustainable Development Strategy
SEF	Standard Electronic Format for reporting Kyoto Protocol units
SF_6	Sulphur Hexafluoride
SICA	Specific International Cooperation Actions
SME	Small and Medium-sized Enterprises
SO_2	Sulphur Dioxide

SPP	Strategic Planning and Programming
tCER	Temporary Certified Emission Reduction
TFEU	Treaty on the Functioning of the European Union
toe	Tonnes of Oil Equivalents
TT	Technology transfer
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations framework convention on climate change
USD	United States of America Dollars
VDC	Village Development Committee
VE	Verified emissions
WAM	With additional measures scenario
WCRP	World Climate Research Programme
WEM	With existing measures scenario
WG I	Working Group I under the CCC
WG II	Working Group II under the CCC
WOM	Without measures scenario

11. APPENDIX: SUMMARY OF REPORTING OF SUPPLEMENTARY INFORMATION UNDER ARTICLE 7, PARAGRAPH 2 OF THE KYOTO PROTOCOL.

Information reported under Article 7 paragraph 2	National Communication section(s)
National systems in accordance with Article 5, paragraph 1	3.3
National registry	3.4
Supplementarity relating to the mechanisms pursuant to Articles 6, 12 and 17	4.3.2, 4.3.3, 5.5
Policies and measures in accordance with Article 2	4.3.4
Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures	4.2.5
Information under Article 10	
Art 10, para a (efforts to improve emissions inventories)	3.3
Art 10, para b (policy action on mitigation AND adaptation measures)	4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 6.4
Art 10, para c (Activities related to transfer of technology)	7.6, 7.7
Art 10, para d (Activities related to systematic observation)	8.2, 8.3
Art 10e (Activities related to international education and training, and national level public awareness)	9.3, 9.7
Financial Resources	7.2, 7.3, 7.4

ANNEX 1 - FIRST BIENNIAL REPORT FROM THE EUROPEAN UNION UNDER THE UN FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC)

Contents

1. BR INTRODUCTION

This Annex 1 to the EU's 6th National Communication (NC) under the UNFCCC is the 1st Biennial Report (BR) of the European Union (EU) under decision 2/CP.17 of the Conference of the Parties under the UNFCCC.

As defined in the UNFCCC biennial reporting guidelines for developed country Parties[296], the information is structured into:

- information on greenhouse gases (GHG) emissions and trends and the GHG inventory including in-formation on national inventory system (section 2),
- Quantified economy-wide emission reduction target (section 3),
- progress in achievement of the quantified economy-wide emission reduction targets (section 3),
- projections (section 5) and
- provision of financial, technological and capacity building support to developing countries (section 6).

Tabular information as defined in the common tabular format (CTF) for the UNFCCC biennial reporting guidelines for developed country Parties (UNFCCC decision 19/CP.18) are enclosed in the CTF Appendix. For the CTF submission to the UNFCCC, the electronic reporting facility provided by the UNFCCC Secretariat has been used as required by UNFCCC decision 19/CP.18.

The 28 Member States of the European Union[297] submit separate BRs to the UNFCCC; however, in the EU's submission the chapters on Greenhouse gas inventory information (see section 2) and GHG projections (see section 5) reflect the sum of information compiled across the Member States.

In some sections of this 1st Biennial Report, the EU-15[298] is referred to next to EU-28. This is because the EU-15 has a common target for the first commitment period under the Kyoto Protocol.

296 Annex I to UNFCCC decision 2/CP.17

297 Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom

298 Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom

2. INFORMATION ON GHG EMISSIONS AND TRENDS, GHG INVENTORY INCLUDING IN-FORMATION ON NATIONAL INVENTORY SYSTEM

2.1. Introduction and summary information from the national GHG inventory

The legal basis of the compilation of the EU inventory and the inventory methodology and data availability is briefly described. The greenhouse gas data presented in this chapter are consistent with the 2013 submission of the EU to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat[299] except for the EU-28 aggregates where the data for Croatia was added to the data for EU-27 to reflect the enlargement of the Union to 28 Member States. The data for Croatia was taken from its UNFCCC submission.

As of 1 July 2013, the European Union consists of 28 Member States after the accession of Croatia. As the 2013 EU inventory was submitted prior to this enlargement, it covers the EU-27 only. However, for this National Communication, the Union now covers the 28 Member States as will the inventory submission in 2014. The aggregates for the EU-15 with a collective arrangement for fulfilment of the Kyoto target under the first commitment period are not affected.

Summary tables of GHG emissions for the EU-15 and the EU-28 for emission trends by gas and by sector in the common tabular format are presented in CRF Tables 1 (a) and 1(b) in the CTF Appendix. These data and the complete submissions of the Member States under Council Decision 280/2004/EC are available on the EEA website (http://www.eea.europa.eu/).

The EU inventory was compiled from data delivered by the 27 EU Member States by 15th March 2013 under Council Decision 280/2004/EC and subsequent updates to these data received by 15th May 2013. The data presented in this report takes into account the resubmission of the EU inventory to the UNFCCC of 18 November 2013. The data for Croatia, included in the EU-28 aggregates, was taken from its UNFCCC resubmission of 15 November 2013.

2.2. National inventory arrangements

2.2.1. Summary information on national inventory arrangements

The EU GHG inventory is the direct sum of the sectoral emissions data contained in the national inventories of the EU-28 and EU-15 Member States. The legal basis of the compilation of the EU inventory up to June 2013 was Council Decision No. 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol. From 8 July 2013, it was replaced by the Regulation No 525/2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change (hereafter referred to as the Monitoring Mechanism Regulation or MMR). More details of the Regulation are given in section 5.1.1 of this document. The Directorate General for Climate Action of the European Commission is the overall body responsible for preparing the inventory of the European Union.

299 European Environment Agency, Technical Report No 08/2013 Annual European Union Greenhouse Gas Inventory 1990–2011 and Inventory Report 2013.

The main institutions involved in the compilation of the EU GHG inventory are the Member States, the European Commission Directorate General for Climate Action, the European Environment Agency (EEA) and its European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM), Eurostat, and the Joint Research Centre (JRC).

More detailed information is given in section 3.3.1 of the EU's 6th National Communication.

2.2.2. Summary information on changes to national inventory arrangements since the last National Communication or Biennial Report

Since the 5th National Communication the following changes have occurred in the national inventory arrangements:

- In its initial report, the EU notified in relation to its national system that the Environment Directorate General of the European Commission (DG Environment) is responsible for preparing the inventory of the EU. In 2010, the overall responsibility for the preparation of the inventory of the EU moved from the DG Environment to the new DG Climate Action. This change had no impact on the functioning of the EU's national system as the DG Climate Action was created from the climate change branch of the DG Environment, which was already in charge of the EU's inventory.

- In section 3.5.2 of its initial report "The roles and responsibilities of various agencies and entities in relation to the inventory development process, as well as the institutional, legal and procedural arrangements made to prepare the inventory", the EU identified "The European Topic Centre on Air and Climate Change" as one of the entities that have an active role in the preparation of the annual EU inventory.

- Regulation (EEC) 401/2009 of 23 April 2009 on the European Environment Agency (EEA) and the European Environment Information and Observation Network (Eionet) describes, in its Article 4(4)-(6), European Topic Centres as part of the Agency's network. European Topic Centres (ETCs) are centres of thematic expertise contracted by the European Environment Agency (EEA) to carry out specific tasks identified in the EEA strategy. The contract between the EEA and the previous Topic Centre, the European Topic Centre on air and climate change (ETC/ACC), expired at the end of 2010. Its replacement, the new European Topic Centre on air pollution and climate change mitigation (ETC/ACM), was established by a contract between the lead organisation Rijksinstituut voor Volksgezondheid en Milieu (RIVM) in the Netherlands and the EEA. The framework agreement entered into force on 15/12/2010 and will expire on 31/12/2013. A new contract was put in place, to start from 01/01/2014, ensuring a seamless transition and smooth business continuity.

- The ETC/ACM assists the European Environment Agency (EEA) in its support of EU policy in the field of air pollution and climate change mitigation. The specific tasks of the ETC/ACM are detailed in the annual implementation plans agreed between the EEA and the ETC/ACM. The ETC/ACM involves 10 organisations and institutions from different European countries.

3. QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGET

The EU and its Member States communicated an independent quantified economy-wide emission reduction target of a 20 per cent emission reduction by 2020 compared with 1990 levels. This is documented in the UNFCCC document FCCC/SB/2011/INF.1/Rev.1 of 7 June 2011. In the EU submission to the UNFCCC from 20 March 2012 (FCCC/AWGLCA/2012/MISC.1) the EU target is explained further.

The use of carbon credits from international market-based mechanisms is explained in the EU submission from 2012. With regard to the role of Land Use, Land-Use Change and Forestry (LULUCF), the EU pledge does not include emissions/removals from LULUCF.

More detailed information on the EU target is given in CTF Table 2 in the CTF Appendix.

4. PROGRESS IN ACHIEVEMENT OF THE QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGETS

4.1. Introduction and summary on mitigation actions and their effects

In the European Union, there are two distinct levels of policies and measures (PaMs) that have an impact on greenhouse gas emissions:

(1) European Union policies, which are proposed by the Commission and subsequently approved, amended or rejected by the Council of the European Union and the European Parliament. These common and coordinated policies and measures (CCPM) are applicable to all Member States, though Member States may implement Directives at different points in time. The EU's National Communication concentrates on these CCPMs

(2) National policies developed and implemented by Member States themselves. As such, these policies and measures are outside the scope of this National Communication.

The scope of this section comprises

- Descriptions of cross-sectoral PaMs and sectoral PaMs on energy[300], industry, agriculture, land use, land use change and forestry (LULUCF) and waste (sections 4.2 through 4.7),
- Descriptions of changes in domestic institutional arrangements (section 4.9),
- An assessment of the economic and social consequences of response measures (section 4.10),Estimates of emission reductions and removals (section 4.11) and
- Information on the use of units from the market-based mechanisms and land use, land-use change and forestry activities (section 4.12).

Complementing the descriptions of policies and measures in the respective sectoral chapters, quantifications of the PaMs' impacts on GHG emission reduction are summarised in CTF table 3 in **Error! Reference source not found.**. These (mostly) ex-ante estimates have been produced by the European Commission in individual policy impact assessments and assume full implementation of the CCPMs. However, estimates are not available for all CCPMs and all years covered in CTF Table 3. Some older estimates refer to the EU-15 while more recent estimates are for the EU-27 or the EU-28. In contrast, the estimates of expected GHG emission savings presented in the Projections (section 5) are uniquely derived from aggregating MS estimates.

4.2. Cross-cutting policies and measures

4.2.1. Overview

The following cross-sector policies are covered in this section:

- EU Emissions Trading Scheme

300 Energy related PaMs as defined in the BR reporting guidelines are split up into the sub-sectors 'Energy' and 'Transport' as the EU's 1st BR also serves as a part of the EU's 6th National Communication. In the UNFCCC reporting guidelines for National Communications, the split between 'Energy and 'Transport' PaMs is required.

- Effort Sharing Decision
- CCS Directive
- Taxation of Energy Products and Electricity
- Research and Innovation in Climate and Energy
- Structural and Cohesion Funds
- National Emissions Ceiling Directive.

For information on impact of these cross-sector policies, please refer to CTF Table 3 in the CTF Appendix.

4.2.2. EU Emissions Trading Scheme

The European Union Emissions Trading Scheme (EU ETS) is one of the key policy instruments implemented in the EU to achieve its climate policy objectives. It was established by Directive 2003/87/EC (the Emissions Trading Directive) and entered into force on 1 January 2005. The EU ETS was established in the context of international mitigation commitments under the Kyoto Protocol and aimed at helping Member States reach their individual Kyoto targets in a cost-effective manner.

As part of the Climate and Energy package adopted in 2009, the Emission Trading Directive was revised through Directive 2009/29/EC (the amended ETS Directive) in order to help the EU achieve its commitment to cut its greenhouse gas (GHG) emissions by 20 % compared to 1990 levels by 2020.

During the second trading period from 2008-2012 the scope of the EU ETS covered on average 41 % of total GHG emissions in the EU-28 (39 % in the EU-15). The scheme covered approx. 13 200 stationary installations in the energy and most industrial sectors, including power stations and other combustion plants, oil refineries, coke ovens, iron and steel plants and factories making cement, glass, lime, bricks, ceramics, pulp, paper and board. Since 2012 about 1 200 aircraft operators have also been included in the scheme.

A discussion on interactions with other policies and measures is published in section 4.12 of the EU's 6th National Communication under the UNFCCC. More detailed information on the first and second period of the EU ETS is available in the EEA Trends and Projections Report 2013[301].

4.2.2.1. General information

The EU ETS is based on a "cap and trade" approach whereby a total limit (cap) on CO_2 emissions is set for the regulated installations. During the first two trading periods, most emissions allowances were allocated for free by governments according to national allocation rules and a small amount of allowances was auctioned. By the end of April each year, an amount equivalent to the emissions from the previous year must be surrendered by installation operators. Operators holding more allowances than is required to cover their verified emissions may either sell allowances to other operators or bank them for use in future years.

301 EEA 2013 Trends and Projections Report, http://www.eea.europa.eu/publications/trends-and-projections-2013

The first trading period of the EU ETS covered the years 2005–2007 and was widely seen as a pilot period. It was followed by a second trading period (2008–2012) corresponding to the first commitment period under the Kyoto Protocol. In 2013, the EU ETS entered its third trading period, which will run until 2020.

Throughout the trading periods there has been a change in scope of the scheme with regard to participating countries and installations, sectors and gases: The EU ETS started with the EU-25 in 2005, but the number of countries it covers has since increased to 31: Bulgaria and Romania entered the EU ETS in 2007. Norway, Iceland and Liechtenstein joined in 2008, stationary installations from Iceland are participating in the EU ETS from 2013 onwards[302]. Croatia joined the European Union on 1st of July 2013 and has been participating in the EU ETS since 1st January 2013.

During the first trading period fewer installations participated in the EU ETS than in the second trading period. There are different reasons for this:

- Some countries allowed for opt-outs (temporary exclusion of installations) during the first trading period of the EU ETS (United Kingdom, Netherlands and Belgium).
- For the second trading period, the definition of combustion installations was clarified by the European Commission[303]. This resulted in the inclusion of additional installations in the EU ETS from 2008 onwards in several Member States which had applied a more restrictive definition from 2005 to 2007.

Since 2012 aviation has been included in the scheme (see section 4.2.2.3). Additional sectors and gases covered from 2013 onwards include[304]:

- Capture, transport and geological storage of GHG emissions,
- CO_2 emissions from the petrochemicals, ammonia and aluminium production,
- Nitrous oxide emissions (N_2O) from the production of nitric, adipic and glyoxylic acid,
- Perfluorcarbon (PFC) emissions from aluminium production.

Furthermore, from 2013 onwards, some countries used the possibility included in Article 27 of the Emissions Trading Directive to exclude small installations (emitting less than 25 000 tonnes CO_2 per year) from the scheme.

Industrial installations and aircraft operators covered by the EU ETS are required to have an approved monitoring plan, according to which they monitor and report their emissions during the year. In the case of industrial installations, the monitoring plan forms part of the approved permit that is also required. The data in the annual emissions report must be verified before 31 March of each year by an accredited verifier. Once verified, operators must surrender the equivalent number of allowances by 30 April of the same year. This annual procedure of monitoring, reporting and verification (MRV), as well as all processes connected to these activities, are known as the "compliance

302 Decision of the EEA Joint Committee amending Protocol 23 to the EEA Agreement concerning the cooperation between the surveillance authorities (Article 58). Official Journal of the European Union, L(100), 99–100

303 Communication from the Commission — 'Further guidance on allocation plans for the 2008 to 2012 trading period of the EU Emission Trading Scheme', COM(2005) 703 final

304 Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community (OJ L 140, 5.6.2009, p. 63–87)

cycle" of the EU ETS. New rules have applied to emissions from 1 January 2013 concerning EU ETS monitoring and reporting, accreditation and verification[305]. In case of non-compliance a penalty must be paid for any emissions in excess of the number of EUAs surrendered. For phase I the penalty was set at €40/tonne CO_2eq, while for phase II it was €100/tonne CO_2eq. Payment does not release the operator from the obligations to surrender an amount of allowances equal to the excess emissions.

Countries participating in EU ETS have a national registry to track verified emissions, free allowances and annually surrendered units by installations and aviation operators. At the European level a European Union Transaction Log (EUTL) records the issuance, transfer, cancellation, retirement and banking of allowances under the EU ETS[306], which has also been connected with the UNFCCC International transaction Log (ITL) since October 2008.

4.2.2.2. Emission caps

The emissions target of the EU ETS – the cap – is determined by the total amount of European Union Allowances (EUAs) which are available to the regulated entities either through free allocation or purchases or auctions. In the first and second trading periods, the exact number of these allowances depended on the National Allocation Plans (NAPs) drawn up by participating countries, which had to be reviewed and accepted by the European Commission. The individual caps of EU Member States as a total form the EU-wide cap. From the third trading period onwards, a single EU-wide cap determines the amount of emissions allowed to be emitted by EU ETS sectors[307]. Furthermore, from 2013 onwards, a linear reduction factor of - 1.74 % per annum applies.

Table [BR1] 4.1 shows caps for all participating countries in the second trading period. This amount is equal to the sum of allowances allocated for free and allowances auctioned or sold. The amount of allowances issued is compared to average ETS emissions in 2005 (scope corrected), the start date of the EU ETS. This comparison illustrates which countries had caps that set them on a path of reducing emissions between 2005 and 2012 and which countries had caps that allowed their emissions to grow during that period. The rationale for these diverging caps lies in the fact that national circumstances (growth trend development and carbon intensity trend development between 2005 and 2010) in the respective countries were considered when setting the caps[308]. Overall the cap implied a reduction target for EU-27 of 6 % compared to ETS emissions in the year 2005 (9 % for EU-15).

305 Commission Regulation (EU) No 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council.

306 http://ec.europa.eu/environment/ets/welcome.do?languageCode=en

307 Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community (OJ L 140, 5.6.2009, p. 63–87)

308 Communication from the Commission to the Council and to the European Parliament on the assessment of national allocation plans for the allocation of greenhouse gas emission allowances in the second period of the EU Emissions Trading Scheme accompanying Commission Decisions of 29 November 2006 on the national allocation plans of Germany, Greece, Ireland, Latvia, Lithuania, Luxembourg, Malta, Slovakia, Sweden and the United Kingdom in accordance with Directive 2003/87/EC, COM(2006) 725 final

Table [BR1] 4.1 Cap for the second trading period of the EU ETS

	2005 verified emissions (scope corrected)	Free allocation 2008-2012	Auctions and sales 2008-2012	Total EUAs issued 2008-2012	Total EUAs issued 2008-2012
	(Average) million EUA/year				as share of 2005 emissions
Austria	33.7	30.5	0.4	30.9	-8%
Belgium	60.6	56.7	1.9	58.6	-3%
Bulgaria	39.2	39.7	0.0	39.7	1%
Cyprus	5.1	5.5	-	5.5	8%
Czech Republic	82.5	86.1	0.5	86.6	5%
Denmark	26.5	23.9	0.6	24.5	-8%
Estonia	12.9	13.1	-	13.1	2%
Finland	33.5	37.5	-	37.5	12%
France	136.0	132.0	-	132.0	-3%
Germany	486.1	400.3	44.0	444.3	-9%
Greece	71.3	64.6	3.8	68.3	-4%
Hungary	27.6	25.0	1.5	26.5	-4%
Ireland	22.4	20.9	0.1	21.0	-6%
Italy	231.9	201.9	-	201.9	-13%
Latvia	2.9	4.6	-	4.6	61%
Liechtenstein	0.0	0.0	-	0.0	-1%
Lithuania	6.7	7.9	0.7	8.6	29%
Luxembourg	2.6	2.5	0.0	2.5	-4%
Malta	2.0	2.1	-	2.1	9%
Netherlands	84.3	84.3	3.2	87.5	4%
Norway	17.8	8.1	7.0	15.1	-15%
Poland	208.1	205.7	0.0	205.8	-1%
Portugal	37.2	32.0	-	32.0	-14%
Romania	69.6	74.2	0.1	74.3	7%
Slovakia	27.0	32.5	-	32.5	20%
Slovenia	8.7	8.2	-	8.2	-6%
Spain	189.9	152.2	-	152.2	-20%
Sweden	21.1	22.2	-	22.2	5%
United Kingdom	271.7	220.8	24.6	245.4	-10%
EU-15	1 708.5	1 482.1	78.5	1 560.6	-9%
EU-27	2 200.6	1 986.7	81.5	2 068.2	-6%
All EU ETS countries	2 218.5	1 994.8	88.5	2 083.3	-6%

Note: Croatia has been included in the EU ETS since 1st January 2013

Source: EEA 2013 Trends and Projections Report, NAP table decision

During the **first trading period**, almost all allowances were allocated for free to EU ETS installations (less than 1 % was auctioned or sold). The allocation level for each installation was mainly based on historical emissions. In the **second trading period**, 95 % of emission allowances were freely allocated. In many countries (e.g. Denmark, Germany, the United Kingdom), benchmarks were used to allocate allowances to electricity generators, while allocation was still largely based on historic emissions for industrial sectors. As a result, free allocation (relative to emissions) tended to be higher for industrial sectors compared to electricity generation.

While auctions played a very minor role in the first trading period, in the second trading period about 5 % of the total ETS cap for the second trading period was auctioned or sold. Most countries implemented rather simple auctioning procedures with single round, single price auctions. EUAs were auctioned or sold by 16 auctioning countries throughout the 2008-2012 period. The volume of auctioned EUAs increased from 53 million EUAs in 2008 to 125 million EUAs in 2012.

In the **third trading period** auctioning is the default method for allocating allowances instead of free allocation: More than 40 % of allowances will be auctioned in the 2013-2020 period with progressively rising shares each year:

- For the power generation sector, the rule is that operators no longer receive any free allowances but have to buy them. The experience of the first two trading periods shows that power generators have been able to pass on the national cost of allowances to customers even when they received them for free; however eight Member States which joined the EU since 2004 have made use of a derogation.
- In sectors other than power generation, the transition to auctioning is taking place progressively. Manufacturing industry will receive 80 % of its allowances free of charge in 2013 but this will decrease annually to 30 % in 2020. Allowances not allocated for free will be auctioned. In the aviation sector, however, only 15 % of aviation allowances will be auctioned over the whole 2013-2020 period.

The auctioning of allowances is governed by the EU ETS Auctioning Regulation[309]. For free allowances, harmonised allocation rules apply which are based on ambitious EU-wide benchmark of emission performance, which are laid down in the Benchmark Decision[310].

In accordance with the rules set out in the Benchmarking Decision, all Member States and EEA-EFTA countries have carried out a preliminary calculation of the number of free allowances to be allocated to each installation in their territory and have notified these so-called national implementation measures (NIMs) to the Commission.

The Commission carried out in-depth assessments of each notification to ensure completeness and compliance with the relevant legal provisions. The EFTA Surveillance Authority did the same for EEA-EFTA notifications. As the preliminary allocation through NIMs exceeded the maximum amount of allowances available, a cross-sectoral correction factor has been calculated and has to be applied (Article 10a.5 of the revised ETS Directive). On the basis of the NIM Decision[311] EU Member States and EEA-EFTA countries can take final allocation decisions and issue the allowances for 2013. The allowances allocated for free in 2013 can be used for compliance for 2013 emissions to be reported in 2014, but not for 2012 emissions.

Five percent of the total quantity of allowances will be put into a reserve for new installations or airlines that enter the system after 2013 ("new entrants"). The allocations from this reserve should mirror the allocations to corresponding existing installations. In principle, any allowances remaining in the reserve shall be distributed to

309 Commission Regulation No 1031/2010 on the timing, administration and other aspects of auction of greenhouse gas emission allowances pursuant to Directive 2003/87/EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowances trading within the Community.

310 2011/278/EU: Commission Decision of 27 April 2011 determining transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC of the European Parliament and of the Council (notified under document C(2011) 2772).

311 Commission Decision of 5 September 2013 concerning national implementation measures for the transitional free allocation of greenhouse gas emission allowances in accordance with Article 11(3) of Directive 2003/87/EC of the European Parliament and of the Council (OJ L 240, 7.9.2013, p.27–35).

Member States for auctioning. The distribution key shall take into account the level to which installations in Member States have benefited from this reserve.

By setting cap levels under the EU ETS, EU Member States as well as Iceland, Liechtenstein and Norway have shared their national efforts required to reach their Kyoto target among the sectors covered by the ETS and other sectors. These caps correspond to a certain number of Kyoto units being transformed into EU emission allowances and allocated/sold to EU ETS operators. In doing so, these countries have fixed the overall contribution of the EU ETS to reach their burden-sharing or Kyoto target, and they have indirectly determined the number of Kyoto units that remain for the other sectors not covered by the EU ETS (such as buildings, transport or agriculture). Hence, they have assigned themselves a 'non-ETS emissions budget' for 2008 to 2012, equivalent to their initial assigned amount reduced by the ETS cap that they have determined. In other words, governments have split their Kyoto emission budgets into two: one budget is allocated to the sectors covered by the ETS, where total emissions are capped under EU or national law and the distribution of abatement measures among sources is determined by market forces within the trading mechanism; the remaining budget is allocated to non-ETS sectors. This is one main outcome of the introduction of the ETS, which affects the reaching of the Kyoto target for all countries included in EU ETS. It sets a pressure on reductions in Non-ETS sectors, which are mostly covered by the Effort Sharing Decision (see section 4.2.3).

4.2.2.3. Inclusion of aviation

Since 1 January 2012 aviation has been part of the EU ETS[312]. In principle the EU ETS covers all flights arriving at and departing from airports in all EU Member States, Norway, Iceland, and Liechtenstein. However, in 2012 only flights within the EU Member States, Norway, Iceland, Liechtenstein and between closely related territories were covered[313]. This "stopping the clock" decision was taken in order to facilitate negotiation of a global agreement on aviation emissions, which should be decided in autumn 2013 by the General Assembly of the International Civil Aviation Organisation (ICAO).

After the 38th ICAO meeting in autumn 2013, the EU Commission has published a proposal for a European Regional Airspace Approach, taking into account the ICAO Resolution A38-17/2. This proposal would need to be agreed between the European Parliament and Council. The key features of the revised ETS scheme resulting from this proposal would be that 1) all emissions from flights between airports in the European Economic Area (EEA, covering the 28 EU Member States plus Norway and Iceland) would continue to be covered; 2) from 2014 to 2020, flights to and from countries outside the EEA would benefit from a general exemption for those emissions that take place outside EEA airspace. Only emissions from the part of flights taking place within EEA airspace would be covered; 3) to accommodate the special circumstances of developing countries, flights to and from third countries which are not developed

312 Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC.

313 Decision No 377/2013/EU of the European Parliament and of the Council of 24 April 2013 derogating temporarily from Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community.

countries and which emit less than 1 % of global aviation emissions would benefit from a full exemption[314].

The cap on aviation is based on average historic emissions in this sector between 2004 and 2006 (221.4 million t CO_2 for all participating countries[315]). The cap for 2013-2020 equals 95 % of the baseline emissions[316]. It thus expands the total ETS cap by approximately 10 %. The predominant method of distribution will be free allocation to aircraft operators (82 % in 2013-2020), 15 % will be auctioned and the remaining 3 % are allocated to the special reserve for new entrants and fast growing airlines[317]. Free allocation is based on benchmarks which were calculated by dividing the total number of allowances to be allocated for free by the sum of the tonne-kilometre data reported by aircraft operators in their applications for free allocation[318].

Aircraft operators receive specific allowances, called EU Aviation Allowances (EUAAs). Whereas aircraft operators may use aviation allowances as well as common EU allowances (EUAs) from the stationary sectors, stationary installations are not allowed to use aviation allowances for compliance. In addition, a certain quantity of international credits may be used by aircraft operators: up to 15 % of their verified emissions in 2012; from 2013 onwards "each aircraft operator shall be entitled to use international credits up to a maximum of 1.5 % of its verified emissions during the period from 2013 to 2020, without prejudice to any residual entitlement from 2012."[319]

4.2.2.4. Linking the EU ETS to the international carbon market

The EU ETS is directly linked with the Kyoto Protocol's project mechanisms according to Directive 101/2004/EC. Any trading or transfer of EU allowances (EUAs), which serve the purpose of proving compliance of an operator under the EU ETS, implies the transfer of an equal quantity of assigned amount units (AAUs) under the KP between Member States or within a Member State. In addition, operators that are liable under the EU ETS are allowed to use credits from both Clean Development Mechanism (CDM) and Joint Implementation (JI) projects to comply with their legal obligation, as emission reduction units (ERUs) originated by JI projects and certified emission reductions (CERs), originated by CDM projects are converted into EUAs by Member States.

The exact quantity of CDM or JI credits (CERs or ERUs) that can be used by operators is regulated on an installation level. The National Allocation Plans for the second trading period define the entitlements for the use of CERs and ERUs in general as a percentage of the free allocation for each operator in the 2008-2012 period. The exact percentage for each country is published in the NAP table decisions and varies from 4 % in Estonia to 22 % in Germany. These amounts must have been consistent with the individual Member State's supplementarity obligation under the Kyoto Protocol. In

314 European Commission Memo: Commission proposal for European Regional Airspace Approach for the EU Emission Trading for Aviation- Frequently asked questions. 16th October 2013; http://europa.eu/rapid/press-release_MEMO-13-905_en.htm.

315 Commission Decision of 7 March 2011 on historical aviation emissions pursuant to Article 3c(4) of Directive 2003 87 EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowance trading within the Community".

316 Directive 2008 101 EC of the European Parliament and of the Council of 19 November 2008 amending Directive 2003 87 EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community.

317 Directive 2008 101 EC.

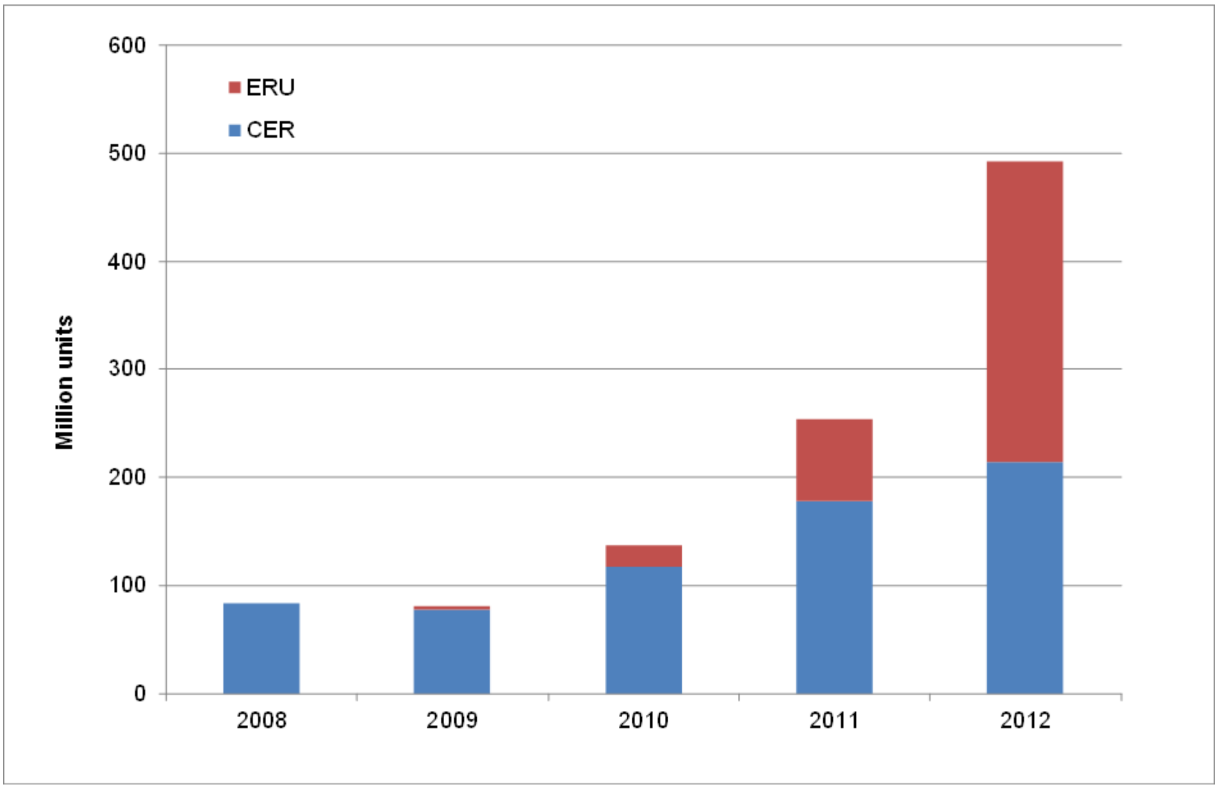
318 Commission Decision of 26 September 2011 on benchmarks to allocate greenhouse gas emission allowances free of charge to aircraft operators pursuant to Article 3e of Directive 2003/87/EC of the European Parliament of the Council.

319 Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC.

total, up to 1.4 billion CERs or ERUs could have been used by all participating countries in the second trading period. This corresponds to 14 % of the total free allocation (in all 30 countries) in the second trading period.

Operators in all countries, except Liechtenstein, have used project based credits so far. At the end of the second trading period 76 % of the allowable offsets had been used, adding up to 11 % of verified emissions for the whole period 2008-2012. Operators in the EU-27 used 663 million CER and 376 million ERUfor the 2008-2012 period to comply (EU-15: 528 million CER and 281 million ERU). The annual amounts are shown in *Figure [BR1] 4-1*.

Figure [BR1] 4-1 Credits from CDM & JI surrendered in 2008–2012



Source: EEA 2013 Trends and Projections Report[320]

For information on the total use of CER and ERU by Member States please refer to section 4.11.

Unused entitlements from the second period can be carried over to the third trading period. The exact amount per operator for the second and third period is determined in line with the methodology set out in the amended EU ETS Directive (Article 11a(8)) and is further specified in the Regulation on determining international credit entitlements (RICE)[321]. Operators from some countries that received comparatively low entitlements for the use of CERs and ERUs for the second trading period (e.g. operators in the United Kingdom) will be allowed to use additional credits from 2013 onwards.

320 EEA 2013 Trends and Projections Report, http://www.eea.europa.eu/publications/trends-and-projections-2013

321 Commission regulation on determining international credit entitlements pursuant to Directive 2003/87/EC of the European Parliament and of the Council (OJ L 299, 9.11.2013, p.32-33). http://ec.europa.eu/clima/policies/ets/linking/docs/rice_regulation_20131107_en.pdf

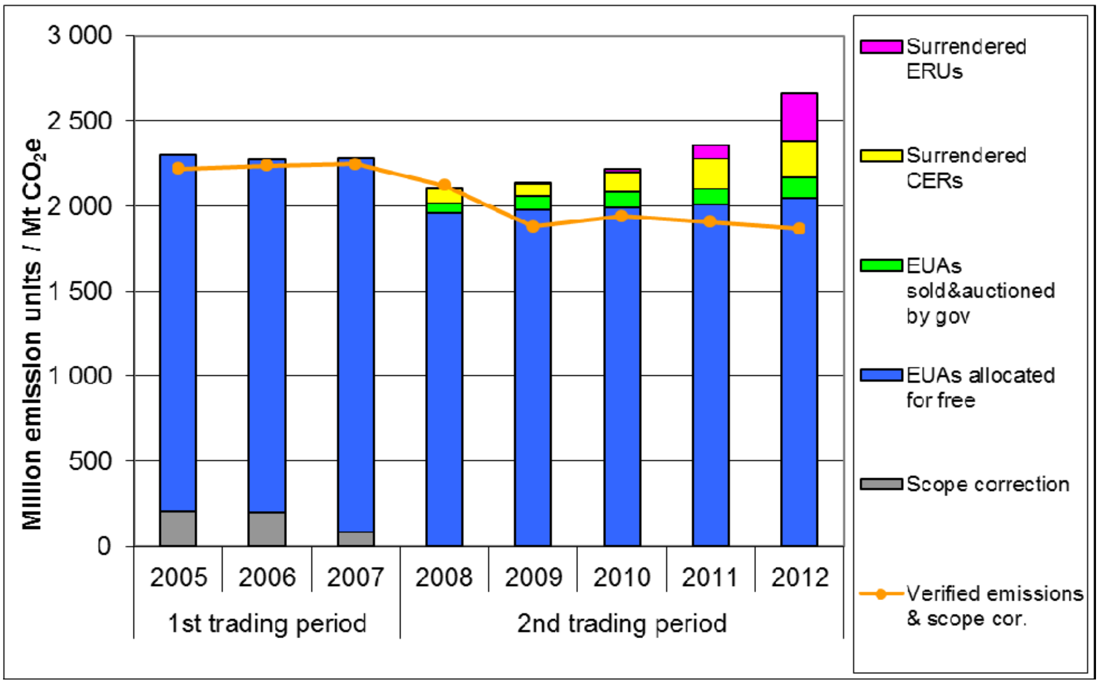
EU ETS participants operating stationary installations will be entitled to use international credits during the 2008-2020 period up to the higher of either the international credit entitlement specified in the National Allocation Plan for the second trading period or 11 % of the free allocation of EU allowances granted to them in that period. Operators of stationary installations who were new entrants during the second trading period and operators of stationary installations newly included in the scope of the EU ETS in the third trading period which did not receive free allocations nor entitlements for international credit use in the second period, will be able to use international credits up to a maximum of 4.5 % of their verified emissions in the third period. The Regulation also sets out special provisions for operators of stationary installations with a significant capacity extension and operators of stationary installations which received free allocation during the second trading period which carry out activities newly included in the EU ETS in the third period. Finally, aircraft operators are entitled to use international credits beyond those allowed in 2012, up to a maximum of 1.5 % of their verified emissions in the third period.

4.2.2.5. Emission trends, demand and supply balance and discussion on backloading

Between 2005 and 2012, verified emissions in stationary installations decreased by 16 %, taking into account the change in ETS scope between the two first trading phases (see *Figure [BR1] 4-2* below). In the first trading period, emissions increased slightly between 2005 and 2007. During the second trading period, they decreased significantly in 2008 and 2009, with a significant proportion of this decrease due to the financial and economic crisis. In 2008 emissions were 5 % below 2005 levels. They decreased to 15 % below 2005 levels in 2009 and stayed at this level in 2010 (-13 %), 2011 (-14 %) and 2012 (-16 %). The most important sector with regard to number of installations and verified emissions is sector 1 "Combustion installations", which mainly consists of installations for electricity and heat generation.

During the first trading period permits supplied by governments exceeded verified emissions in all three years. Since banking was not possible between the first and the second trading periods, no surplus could be carried over into 2008. In 2008, the amount of EUAs freely allocated, auctioned or sold was not sufficient to cover verified emissions during this year. Operators additionally surrendered CERs. The remaining shortfall was covered by borrowing, i.e. using a number of emissions permits available for 2009. From 2009 to 2012, however, the supply of permits made available by the governments consistently exceeded demand in each year. The additional use of CERs and ERUs contributed to the accumulating surplus.

Figure [BR1] 4-2 Supply and demand balance 2008–2012, all EU ETS countries



Source: EEA 2013 Trends and Projections Report, including scope correction from EEA

In total a cumulated surplus of nearly 1.8 billion EUAs can be observed at the end of the second trading period. Since banking is allowed between the second (2008–2012) and third trading period (2013-2020), this surplus is carried over to the next stage of the scheme.

As a short-term measure, the Commission has taken the initiative of proposing that the auctioning of 900 million allowances is postponed from the years 2013-2015 until 2019-2020, when it is expected that demand will have picked up. This 'back-loading' of auctions would be accomplished by amending the EU ETS Auctioning Regulation and is currently under discussion in the Council and European Parliament[322].

4.2.2.6. Use of revenues

The revised EU ETS Directive stipulates that at least half of the revenues from the auctioning of general allowances and all of the revenues from auctioning aviation allowances should be used to combat climate change in Europe or other countries. Member States are obliged to inform the Commission of how they use the revenues. Following this, some national climate funds are set up to establish separate budget structures to finance national and international climate-related expenditures, as is the case with the German "Special Energy and Climate Fund".

On EU level the so-called "NER300" is one of the world's largest funding programmes for innovative low-carbon energy demonstration projects. It is based on Article 10(a) 8 of the revised Emission Trading Directive 2009/29/EC. The programme is conceived as a catalyst for the demonstration of environmentally safe carbon capture and storage (CCS) and innovative renewable energy (RES) technologies on a commercial scale

322 COM (2012) 652 final http://ec.europa.eu/clima/policies/ets/reform/docs/com_2012_652_en.pdf

within the European Union. It is funded from the sale of 300 million emission allowances from the new entrants' reserve (NER) set up for the third phase of the EU ETS. The funds from the sales are to be distributed to projects selected through two rounds of calls for proposals, covering 200 and 100 million allowances respectively. Under the first call for proposals the European Commission in December 2012 granted funding to 23 renewable energy projects, totalling €1.2 billion. This amount is estimated to have leveraged additional funding of over €2 billion from private sources. The projects that have been awarded funding are now moving towards implementation. They must reach their final investment decisions by December 2014 and enter into operation by December 2016. Detailed information is available from the project website[323].

4.2.2.7. Linking with external emission trading schemes and further extensions

The EU recognises that linking the EU ETS to GHG emission trading schemes in third countries will increase the cost-efficiency of achieving the EU emission reduction targets[324]. In October 2007 the first such linking was effected by the EU and Norway, Iceland and Liechtenstein. Switzerland and the EU are currently discussing the possibility of linking their two schemes, which would operate on the basis of mutual recognition of emission allowances. Since the beginning of 2013, the Swiss ETS is based on a new and revised CO_2 Act, which was devised with a view to making the two trading schemes more compatible and hence making linking possible.

In addition, Australia and the European Commission announced their agreement in August 2012 on a pathway towards fully linking their emissions trading schemes. An interim link will be established in July 2015 allowing Australian operators to use EU allowances for some of their compliance. It has been announced that the full link, which would also allow operators in the EU ETS to use Australian certificates for compliance, will “start no later than 1 July 2018”[325].

The European Commission is a founding member of the International Carbon Action partnership (ICAP)[326] which was set up in October 2007. ICAP is a partnership of 30 governments with the aim of providing a forum to share experiences and knowledge among countries and regions that have implemented or are actively pursuing the implementation of carbon markets through mandatory cap and trade systems.

In addition the extension of the scope of the EU ETS to other sectors is actually discussed as one option in the report from the Commission to the European Parliament and the Council on the state of the European carbon market in 2012[327].For instance, a further extension of the EU ETS to cover emissions from international shipping is being discussed as well as alternative ways to regulate shipping emissions.

The EU has stated its priorities for linking the EU ETS as: environmental effectiveness, economic efficiency, avoidance of leakage and fairness and accessibility. Factors such as impacts on competition, employment and administrative costs are considered important as well[328].

323 http://www.ner300.com/

324 Directive 2003/87/EC of the European Parliament and of the Council of 13th October 2003 establishing a scheme for GHG emission allowance trading within the Community and amending Council Directive 96/61/EC. Recital 18.

325 http://ec.europa.eu/clima/policies/ets/linking/index_en.htm

326 http://icapcarbonaction.com/

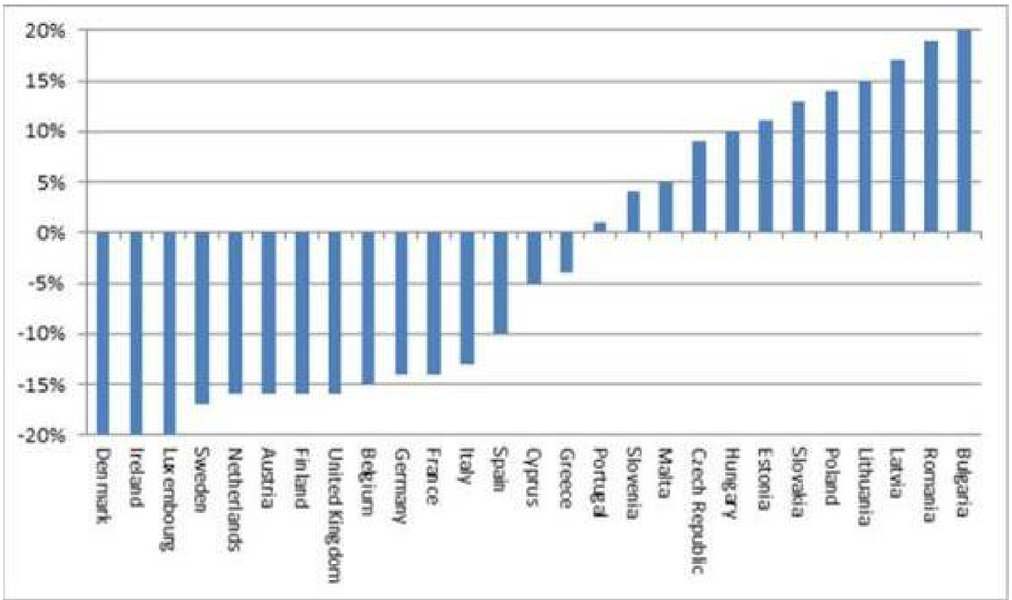
327 COM (2012) 652 final.

328 SEC(2008) 52 Commission staff working document on Accompanying document to the Proposal for a Directive of the European Parliament and the Council amending Directive 2003/87/EC so as to improve and extend the EU greenhouse gas emission allowance trading system. Impact Assessment – COM(2008) 16 final.

4.2.3. *Effort Sharing Decision*

The Effort Sharing Decision (Decision No 406/2009/EC[329] - ESD) establishes annual targets for the greenhouse gas (GHG) emissions of Member States between 2013 and 2020, which are legally binding and only refer to GHG emissions that are not included within the scope of the EU ETS (i.e. transport (except aviation), buildings, agriculture (excluding LULUCF) and waste). Each Member State must define and implement national policies and measures (i.e. promotion of public transport, energy performance standards for buildings, more efficient farming practices and conversion of animal waste to biogas) to limit the GHG emissions covered by the ESD. The inclusion of the ESD within the EU's climate and energy package ensures that the abatement potential from non-ETS sectors contribute to the delivery of the EU-wide target of reducing GHG emissions by 20 % below 1990 levels by 2020.

Figure [BR1] 4-3 Member State GHG emission limits in 2020 compared to 2005 levels



Source: Decision No 406/2009/EC

Article 3 (1) of the ESD states that 'Each Member State shall, by 2020, limit its greenhouse gas emissions at least by the percentage set for that Member State in Annex II to this Decision in relation to its emissions in 2005'. The emission limits set within Decision No 406/2009/EC were based upon the relative performance of each Member State with regards to their Gross Domestic Product per capita. Emission limits range from a 20 % emission reduction below 2005 levels by 2020 for the richest Member States (i.e. Denmark, Ireland, Luxembourg) to a 20 % increase for the least wealthy one (i.e. Bulgaria). The aggregated outcome of the national targets associated with the ESD should result in an EU-wide emission reduction of approximately 10 % below 2005 levels by 2020.

Article 3 (2) of the ESD lays down that annual emission allowances (AEAs), which are defined as 'the annual maximum allowed greenhouse gas emissions in the years 2013 to

329 OJ L 140, 5.6.2009, p. 136.

2020’, should follow a linear trajectory for all Member States that is calculated based upon their ‘average annual greenhouse gas emissions during 2008, 2009 and 2010’ from a 2009 starting point. The annual limits and compliance control ensure that Member States maintain progress in implementing policies and measures in order to reduce GHG emissions in accordance with the GHG emission limits for 2020. On the 26th March 2013 the European Commission adopted a Decision[330] determining the AEAs, in tonnes of CO_2 equivalents, for each Member State from 2013 to 2020 (calculated using two different global warming potential values from the second and fourth IPCC assessment reports).

The progress of Member States in meeting the emission reduction targets set in the Effort Sharing Decision is assessed as part of the European Semester.

4.2.4. CCS Directive

The Second European **Climate Change** Programme (**ECCP II**), launched in October 2005, set up a Working Group on Carbon and Capture and Geological Storage (CCS) with the mandate to explore this technology as a means of reducing climate change.

The need for the development of both policy and regulatory frameworks for CCS was stressed by the Working Group and by the European Commission[331]. On 17th December 2008 the European Parliament adopted its resolution on the proposal for a Directive on the geological storage of carbon dioxide[332] and amending previous Council Directives.[333]

The CCS Directive establishes a legal framework for the environmentally safe geological storage of CO_2 to facilitate and encourage the development of an important mitigation measure to reduce CO_2 emissions. Article 2 of the CCS Directive states that the legislation will apply to all geological formations located within the EU that store CO_2 and the requirements will need to be enforced over the entire lifetime of a storage site. The geological storage of CO_2 below a 100 kilotonne threshold for the purposes of research and development are exempted from the legislation. Key requirements within the CCS Directive include:

- Conditions for site selection: Article 4 (4) of the CCS Directive states that a site can only be selected for use ‘if under the proposed conditions of use there is no significant risk of leakage and if no significant environmental or health risk exist.’
- Storage permits: Article 6 (1) of the CCS Directive makes clear that no geological storage of CO_2 will be possible without a storage permit.
- CO_2 stream acceptance criteria: Article 12 (1) of the CCS Directive outlines that the CO_2 stream must consist overwhelmingly of CO_2 to prevent any adverse effects on the security of the transport network or the storage site.

330 OJ L 90, 28.03.2013, p. 106.
331 COM (2006) 843 final.
332 OJ L 140, 5.6.2009, p.114.
333 Council Directive 85/337/EEC, 96/61/EC, Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC and Regulation (EC) No 1013/2006.

- Monitoring and corrective measures: Article 13 of the CCS Directive states that operators must closely monitor their site and Article 16 obligates the operator to take corrective measures in the case that leakage does occur.
- Site closure: Article 17 of the CCS Directive contains provisions on closure and post-closure obligations, and sets out criteria for the transfer of responsibility from the operator to the Member State.
- Financial security: Article 19 of the CCS Directive outlines that financial security needs to be proven before a CCS plant starts operating to ensure that all of the requirements associated with the Directive can be fulfilled.
- Liability: Given that the operators of CCS plants are covered by the Emissions Trading Scheme – the liability for leakage is with the operator who would be required to surrender allowances for any leaked emissions.

Funding for CCS-related activities originates from, among other sources, the revenues generated from the auctioning of allowances under the EU ETS. Member States determine the use of these revenues. However, the legislation requires that at least 50 % of the revenues generated from the auctioning of allowances are used for specific activities among which is the environmentally safe capture and geological storage of carbon dioxide.

The construction and operation of twelve commercial demonstration projects including geological storage of carbon dioxide as well as the demonstration projects of innovative renewable energy technologies will be stimulated through the creation of a fund equal to 300 million allowances in the new entrants' reserve (NER) until 31st December 2015. Under the first call for proposals to the European Commission no CCS projects were funded in part due to the fact that many CCS projects were not sufficiently advanced; however unused funding has been carried over and is available following a second call for proposals that was launched in April 2013.[334]

Preliminary estimates of the impact of the proposed Directive are referred to in the European Commission Impact Assessment and indicate that 7 MtCO_2 could be stored by 2020 and up to 160 Mt by 2030. This assumes a 20 % reduction in GHG emissions by 2020, provided that CCS obtains private, national and European Community support and proves to be an environmentally safe technology. The CO_2 emissions avoided in 2030 could account for some 15 % of the reductions required in the EU[335].

4.2.5. Taxation of Energy Products and Electricity

Directive 2003/96/EC (the Energy Taxation Directive) provides EU-wide rules for taxation of energy products and electricity[336]. The Directive covers all taxes on energy consumption, except for VAT and provides for common taxation rules and common minimum levels of taxation.

The Directive applies to energy products used as motor fuel or heating fuel and electricity. Energy products used for purposes other than as motor or heating fuel and

334 http://ec.europa.eu/clima/policies/lowcarbon/ner300/index_en.htm

335 European Parliament, CCS, text adopted at the sitting of 17 DEC 2008 (P6_TA-PROV (2008) 12-17).

336 OJ L 283, 31.10.2003, p.51.

situations when an energy product serves primarily as a raw material in industrial processing as well as electricity used in some energy-intensive industrial processes fall outside the scope of the Directive. Electricity is in general taxed at consumption; fuels and electricity used to generate electricity are exempt from taxation.

Based on their typical uses, the most important sectors affected by energy taxation are transport, households, services, agriculture and lighter industrial processes using energy for combustion. Finally, the Directive allows (under certain conditions) for exemptions or reductions to promote renewable sources of energy.

In April 2011 the Commission adopted a proposal for a directive revising the Energy Taxation Directive[337]. Its purpose is to bring the legal framework on taxation more closely in line with the EU's energy and climate change objectives and in particular it aims to:

(3) Ensure consistent treatment of energy sources within the Energy Taxation Directive in order to provide a genuine level playing field between energy consumers independent from the energy source used.

(4) Provide an adapted framework for the taxation of renewable energies.

(5) Provide a framework for the use of CO_2 taxation to complement the carbon price signal established by the EU Emission Trading Scheme while avoiding overlaps between the two instruments.

The Commission proposes to split the existing tax on energy products into a CO_2-related tax and a general energy consumption tax. The former tax is based on the reference emission factors and the latter is based on the net calorific value of the energy products. For electricity only the general energy consumption tax applies.

The amended Directive sets minimum levels of taxation for the CO_2 tax and the general energy consumption tax, which after the expiry of transitional periods should be the same for all energy products depending on their use (as heating fuel or motor fuel).

Biofuels and bio liquids which fulfil the sustainability criteria laid down in EU legislation are not subject to CO_2 taxation.

The proposed legal act falls under a special legislative procedure requiring a unanimous approval by the Council of the EU following consultations with the European Parliament and the European Economic and Social Committee. The Parliament and the Committee came forward with opinions but the Council has not yet agreed on the new act.

4.2.6. Research and Innovation in Climate and Energy

Research is a shared competence of the EU and its Member States. There are two types of RSO actions that can be distinguished: those that are implemented by MS and others that are coordinated at EU level. Actions coordinated at EU level only are reported in section 8 of EU's 6th National Communication.

The EU contributes to Research and Systematic Observation (RSO) through the involvement of multiple actors and through a suite of instruments, tools and programmes and across multiple sectorial policies including:

337 COM (2011) 169 final.

- EU Framework Programmes (FP) for Research and Technological Development,
- LIFE+ (EU's funding instrument for the environment),
- Competitiveness and Innovation Framework Programme,
- International Development Cooperation,
- Contribution to and/or financial support for major international institutions, research initiatives and programmes such as the UNFCCC, the Intergovernmental Panel on Climate Change (IPCC) and the Global Climate Observing System (GCOS), among others.

A new EU research and development programme (Horizon 2020) has been set up for the 2014-2020 period. It contains the objective of reaching 35 % climate related expenditures.

4.2.7. Structural and Cohesion Funds

The Structural and Cohesion Funds[338] are the financial instruments of European Union cohesion policy, which is intended to narrow the development disparities among regions and Member States. These funds participate fully, therefore, in pursuing the goal of economic, social and territorial cohesion. For the 2007-2013 period, the budget allocated to regional policy amounted to around € 348 billion, comprising € 278 billion for the Structural Funds and € 70 billion for the Cohesion Fund. This represents 35 % of the Community budget and is the second largest budget item'.

Within the cohesion policy, there are two Structural Funds:

(6) European Regional Development Fund (ERDF) is currently the largest. Since 1975 it has provided support for the creation of infrastructure and productive job-creating investment, mainly for businesses;

(7) European Social Fund (ESF), set up in 1958, contributes to the integration into working life of the unemployed and disadvantaged sections of the population, mainly by funding training measures.

In order to speed up economic, social and territorial convergence, the European Union set up a Cohesion Fund in 1994. It is intended for countries whose per capita GDP is below 90% of the Community average. The purpose of the Cohesion Fund is to grant financing to environment and transport infrastructure projects. However, aid under the Cohesion Fund is subject to certain conditions. If the public deficit of a beneficiary Member State exceeds 3 % of national GDP (Economic and Monetary Union (EMU) convergence criteria), no new project will be approved until the deficit has been brought under control.

These funds are used to co-finance regional development related measures between 2007 and 2013 in the framework of the three objectives, namely:

(8) The 'convergence' objective to accelerate the convergence of the least developed EU Member States and regions by improving growth and employment conditions. This objective is financed by the ERDF, the ESF and

338 http://europa.eu/legislation_summaries/glossary/structural_cohesion_fund_en.htm

the Cohesion Fund. It represents 81.5 % of the total resources allocated. The co-financing ceilings for public expenditure amount to 75 % for the ERDF and the ESF and 85 % for the Cohesion Fund;

(9) The 'regional competitiveness and employment' objective to anticipate economic and social change, promote innovation, entrepreneurship, environmental protection and the development of labour markets which include regions not covered by the Convergence objective. It is financed by the ERDF and the ESF and accounts for 16 % of the total allocated resources. Measures under this objective can receive co-financing of up to 50 % of public expenditure;

(10) The 'European territorial cooperation' objective to strengthen cooperation at cross-border, transnational and interregional levels in the fields of urban, rural and coastal development, and foster the development of economic relations and networking between small and medium-sized enterprises (SMEs). This objective is financed by the ERDF and represents 2.5 % of the total allocated resources. Measures under the Territorial Cooperation objective can receive co-financing of up to 75 % of public expenditure.

The economic crisis has inevitably hindered progress towards the achievement of the three objectives of the 2007-13 framework. The EU Commission states that there is evidence to suggest that the economic crisis and the responses to it are leading to widening regional disparities, e.g. between capital or manufacturing regions and less developed or peripheral regions.[339] In response to the financial crisis, approximately € 36 billion (11 % of the total funds) was reallocated from one thematic area to another by the end of 2012 to support the most important political priorities and strengthen certain interventions. The majority of this reallocation was diverted to the ERDF and Cohesion Fund (more than € 30 billion). Key priorities for increased spending included innovation and R&D, generic business support, sustainable energy (in particular towards energy efficiency), cultural and social infrastructure, roads and the labour market. The EU Commission also passed further anti-crisis measures to improve the flow of EU financing (i.e. reduction of national co-financing) to promote economic growth.

Despite the economic crisis, the delay in the start of the programme (due to the extension of the previous period) and a lack of administrative capacity the structural and cohesion policy has made several concrete achievements aggregated at the European level. For example, almost 400 000 jobs have been created to date, of which 190 000 since 2010.[340] Investments in energy efficiency and renewable energy sources of about € 10.3 billion have been planned over 2007-2013, of which the majority (i.e. € 9.5 billion) is to be delivered in convergence Member States and regions funded by the ERDF and Cohesion Fund. Key achievements include:[341]

- Up to the end of 2011, 23 185 renewable energy projects were reported to have been supported by 21 MS (Bulgaria did not report any achievements). 18 MS set targets (Cyprus, Estonia, Lithuania and Latvia did not).

339 COM (2013) 210 final.

340 COM (2013) 210 final.

341 http://ec.europa.eu/regional_policy/how/policy/doc/strategic_report/2013/factsheet4_energy.pdf .

- Overall the additional capacity in MW by renewable energy projects amounts to 1 222 MW for the whole of the EU, reported by 11 MS.
- Total achievements reported by 11 MS amount to a reduction in greenhouse emissions of 33 389 kt (Bulgaria, Poland, Romania and Slovakia did not report any achievements).

In addition several ambitious energy efficiency programmes in residential and public buildings also delivered significant energy savings, emission cuts and job creation in the construction sector. The EU Cohesion Policy overall contributes a great deal to mitigation and adaptation to climate change across the region through the breadth and depth of investments made.

4.2.8. National Emissions Ceilings

Directive 2001/81/EC[342] on National Emission Ceilings (NEC) for certain atmospheric pollutants sets upper limits for each Member State for the total emissions in 2010 of the four pollutants sulphur dioxide, nitrogen oxides, volatile organic compounds and ammonia that meet specified interim environmental and health objectives for acidification, eutrophication and ground-level ozone pollution in 2010.

'The interim environmental objectives set in the NEC Directive for 2010 are broadly met — based upon an assessment performed using the original 2001 scientific knowledge' (EEA, 2012)[343]. However, advances in the understanding of air pollution processes/impacts and modelling techniques over the last two decades (i.e. improvements in calculating the dispersion of air pollutants in the atmosphere on the regional scale have greatly improved) means that when the latest knowledge is applied a number of the NEC Directive's original objectives have not yet been achieved as better scientific understanding has revealed higher emissions intensity than originally assumed.

The European Commission plans to propose a revised NEC Directive by 2013 which will set emissions ceilings for 2020 and beyond for the four pollutants already regulated as well as for primary emissions of PM 2.5. The revised NEC Directive will take into account current EU legislation relating to specific source categories. For example, 'vehicles (Euro 5/6 and EURO VI), the revision of the IPPC- Directive and the decision of the European Council (March 2007) to reduce greenhouse gas emissions by 20 % and will factor in the 20 % renewables target'.[344] 'In the absence of new legislation, the NEC Directive remains in force and requires countries to keep emissions below national ceilings also in the years beyond 2010' (EEA, 2012[343]).

4.2.9. Cross-cutting policies and measures no longer in place

There are no policies that are no longer in place. However, it should be noted that the Monitoring Mechanism Decision has been replaced by the Monitoring Mechanism Regulation (cf. section 4.9.1).

342 OJ L 309, 27.11.2001, p. 22.

343 EEA (2012) Evaluation of progress under the EU National Emission Ceilings Directive - Progress towards EU air quality objectives, EEA Technical report No 14/201.

344 http://www.apis.ac.uk/overview/regulations/overview_NECD.htm

4.3. Sectoral policies and measures: Energy

4.3.1. Overview

The following sections list the most important EU policies and measures related to renewable energy, energy efficiency and energy market policies. Besides the policies and measures listed here, energy efficiency is promoted through various funding instruments on EU level, including cohesion policy and enlargement funding, research funding, the Programme for European Energy Recovery (EEPR) and the Competitiveness and Innovation Funding (CIP). For further information on funding instruments, see section 4.2 above. An overview of the measures including information on their impact on CO_2 emissions can be found in CTF Table 3 in the CTF Appendix.

Overall, the policies related to energy efficiency aim at a 20 % reduction of primary energy consumption in the EU-28 compared to the business-as-usual scenario by 2020. In absolute terms this means that total EU-28 primary energy consumption shall not exceed 1 483 Mtoe in 2020, which corresponds to a reduction of 370 Mtoe in 2020[345].

The following policies and measures are covered in this section:

- Renewable Energy Roadmap
- Renewable Energy Directive (2009/28/EC)
- Biomass Action Plan
- Cogeneration Directive (2004/8/EC)
- Directive on Energy End-use Efficiency and Energy Services (2006/32/EC)
- Energy Performance of Buildings (Directive 2010/31/EU)
- Energy Efficiency Plan 2011 (COM/2011/109)
- Energy Efficiency Directive (2012/27/EC)
- Internal Market in Electricity Directive (2009/72/EC)
- Ecodesign Framework Directive (Directive 2009/125/EC)
- Energy Labelling Directive (Directive 2010/30/EU)
- Green public procurement
- Energy star programme
- Motor Challenge Programme
- Strategic Energy Technology Plan (SET plan)
- Intelligent Energy Europe II Programme
- The Covenant of Mayors

The EU Emissions Trading Scheme is covered in section 4.2.2.

345 After Croatia's accession, the target has been adjusted on 13 May 2013 by Council Directive 2013/12/EU

4.3.2. Renewable Energy Roadmap

One of the first key pieces of legislation was Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market[346] (repealed by Directive 2009/28/EC, see further below). The Directive set indicative targets, which were different for each Member State, for renewable electricity consumption in 2010, which should lead to an indicative target for the EU-15 of 22.1% renewable electricity in total. In 2003 Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport[347] was adopted. This Directive set a target of 5.75% of biofuel energy content of all petrol and diesel for transport purposes placed on the market by December 2010.

The Commission's Progress Report in 2006 showed that only a few Member States had met their indicative targets, many were behind schedule and the overall contribution of renewables to total electricity consumption in the EU-27 was only 15.7% in 2006[348]. The biofuel targets in the transport sector were not achieved either; the result was only 1% in 2005 instead of the indicative target of 2%[349]. For this reason, the European Commission published a new long-term strategy for renewable energy in 2007: "**Renewable Energy Roadmap** — Renewable energies in the 21st century: building a more sustainable future"[350].

In this roadmap, the Commission concluded that high investment costs and the non-consideration of positive externalities of renewable energies as well as administrative problems were holding back a quicker expansion of renewables. To counteract these obstacles, the Commission suggested that grid access for renewable energy sources should be supported and that transparency on the energy markets for energy suppliers, consumers and installers of renewable energies should be increased. These improvements should be implemented by a new legislative framework including mandatory targets. The Renewable Energy Roadmap set targets of a 20% share of energy from renewable sources in the gross final EU energy consumption by 2020 and a minimum target of a 10% share of biofuels in transport by 2020. As a result, these targets were adopted by the new Renewable Energy Directive.

4.3.3. Renewable Energy Directive 2009/28/EC

Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC[351] (further referred to as Renewable Energy Directive) is one of three Directives adopted as part of the EU Climate and Energy Package[352]. It had to be implemented by the Member States by 5

346 OJ L 283, 27.10.2001, p. 33.

347 OJ L 123, 17.5.2003, p. 42.

348 The Renewable Energy Progress Report: Commission Report in accordance with Article 3 of Directive 2001/77/EC, Article 4(2) of Directive 2003/30/EC and on the implementation of the EU Biomass Action Plan. COM(2009)192 final.

349 Proposal for a Directive of the European Parliament and of the council on the promotion of the use of energy from renewable sources. COM(2008) 19 final.

350 Renewable Energy Road Map. Renewable energies in the 21st century: building a more sustainable future. COM (2006) 848 final.

351 OJ L 140, 5.6.2009, p. 16.

352 On 17th December 2008 the European Parliament agreed on the EU Climate and Energy Package, which for the first time provides an integrated and ambitious package of policies and measures to tackle climate change. The Climate and Energy Package included the 20-20-20 targets, which set the following key objectives:

To reduce greenhouse gas emissions by at least 20 % compared to 1990 by 2020, with a firm commitment to increase this target to 30 % in the event of a satisfactory international agreement being reached;

To achieve 20 % of energy from renewable sources by 2020 (as a share of total EU gross final energy consumption), supplemented by a target to achieve a minimum of 10 % renewable transport fuel; and

December 2010. As mentioned above, the Directive establishes a target of a 20% share of energy from renewable sources in the gross final energy consumption of the EU by 2020, a target which is also included in European 2020 strategy for growth.

The Directive also sets binding targets for individual Member States; these are based on their share of renewable energy in 2005, plus a flat rate increase of 5.5% per Member State, plus a GDP weighted increase, and then moderated to include a bonus for Member States who started their renewable energy development early. The Directive also includes a target of a minimum 10% share of renewable energy in all forms of transport, which can include biofuels, renewable electricity or hydrogen. Current contributions of renewable energy to the total final energy consumption in the EU-27 and its Member States, along with the 2020 targets, are shown in the EU's 6th National Communication, main body section 2.7.1.

The Renewable Energy Directive focuses on the support of regional and local development initiatives and structural funding, because renewable sources are often embedded in decentralised and small and medium-sized enterprise (SME) structures.

The key requirement of the implementation of the Renewable Energy Directive is the preparation of **National Renewable Energy Action Plan (NREAP)** by Member States every two years. In the NREAPs, Member States define sectoral targets (electricity, heating and cooling, and transport) and the policies and measures to achieve their national targets by 2020.

Member States are encouraged to cooperate towards achieving their renewable energy targets, so that targets can be achieved in the most cost-efficient manner. For instance, Member States which are planning to go beyond their national targets will be able to sell their surpluses. Flexibility measures may be introduced which take the form of "statistical transfers" of renewable energy from one country to another, joint projects between Member States and/or joint support schemes.

The Directive creates a sustainability regime for biofuels and bioliquids which includes a minimum GHG threshold that increases over time. The raw material for biofuels and bioliquids shall not be derived from land with a high level of biodiversity or with high carbon stocks. Further sustainability provisions (including broader environmental and social aspects) and indirect effects of biofuels will be monitored by the Commission.

The Commission estimates that achievement of EU renewable energy targets will cost € 13-18 billion per year. This investment will, however, help to bring down the price of those renewable energy technologies which are expected to form a growing part of global energy supply. By 2020, the implementation of the Directive is expected to achieve savings of 600 to 900 Mt CO_{2eq} emission per year[353], with the transport sector being responsible for a reduction of 48 Mt CO_{2eq} by 2020[354].

The most recent progress report (2013)[355] from the Commission states that there still exist barriers preventing the planned expansion of renewable sources, namely with

A commitment to save 20 % of total primary energy consumption by 2020 com-pared to a Business as Usual baseline.

353 Directive on the promotion of energy from renewable sources – Citizens' Summary http://ec.europa.eu/energy/climate_actions/doc/2008_res_citizens_summary_en.pdf

354 Impact Assessment accompanying the document - Proposal for a Directive of the European Parliament and of the Council amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources. SWD(2012) 343 final.

355 Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Renewable Energy Progress Report COM(2013) 175 final.

regard to administrative simplification and permitting procedures for infrastructure development and operation, but also because of the consequences of the economic crisis. At present, with a share of 12.7% of renewable energy, the EU Member States are still on track to achieve the 2020 targets but the growth of renewables is slower than expected. Given the current growth rates, the targets will not be reached in 2020. The report states that any disruption of investment policies will have significant impacts in the future and that at present more effort and further measures will be necessary on the part of Member States to achieve the 20% target. The progress report also shows that based on national reporting the 4.7% share of biofuels achieved in 2010 led to savings of 25.5 Mt CO_{2eq} in the EU.

4.3.4. Biomass Action Plan

European biomass policy plays a crucial role in any scenario designed to meet the European target of increasing the share of renewable energies to 20% by 2020. In December 2005 the **Biomass Action Plan**[356] set out a series of Community actions aimed at increasing the demand for biomass, improving supply, overcoming technical barriers and developing research. Biomass from improved forest management, wastes and agricultural crops shall be promoted as an energy source for heating, electricity generation and transport fuel.

The Biomass Action Plan identified a potential for biomass use in the EU of approx. 150 Mtoe by 2010 (compared to approx. 69 Mtoe biomass consumption in 2006). The impact assessment estimated that this increase would lead to GHG emission reductions of 148 million tonnes CO_2 eq (in comparison to the BAU scenario) in 2010[357] and would cost approx. € 9 billion per year.

4.3.5. Cogeneration Directive (2004/8/EC)

On 11 February 2004, Directive 2004/8/EC of the European Parliament and of the Council on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC[358] was adopted. This Directive will be repealed by Directive 2012/27/EU on energy efficiency (see further below) as of June 2014.

Directive 2004/8/EC creates a framework for the promotion and development of high efficiency cogeneration of heat and power. It does not include targets but urges Member States to carry out analyses of their potential for high efficiency cogeneration and to evaluate progress towards increasing the share of this technology.

In the 2006 Action Plan for Energy Efficiency[359] the Commission proposed a number of measures to promote cogeneration in the future: harmonizing calculation methods and guarantee of origins, improving metering and establishment of European standards, minimum performance requirements and regulations for district heating and micro cogeneration.

356 Biomass Action Plan. COM (2005) 628 final.

357 Impact Assessment – Annex to the Communication from the Commission - Biomass Action Plan. SEC(2005) 1573.

358 OJ L 52, 21.2.2004, p. 50.

359 Communication from the Commission – Action plan for Energy Efficiency: Realising the Potential. COM(2006)545 final.

In 2007, as part of the implementation of the original Directive, the Commission established harmonized efficiency reference values for the separate production of electricity and heat. These harmonized values were reviewed for the first time in February 2011[360], and will be reviewed every four years thereafter, to take account of technological developments and changes in the distribution of energy sources.

The impact assessment accompanying the proposal for the new Energy Efficiency Directive concluded in 2011[361] that the share of electricity from high efficiency CHP increased from 10.5% in 2004 to 11.0% only in 2008. As a result of a lack of clarity concerning minimum requirements, the national transposition of the Directive (in terms of efforts) made varied substantially across Member States.

4.3.6. Directive on Energy End-use Efficiency and Energy Services (2006/32/EC)

In 2006, Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC[362] was adopted, to be implemented in Member States by 2008. The Directive will expire on 04 June 2014 and will be repealed by Directive 2012/27/EU on energy efficiency (see further below).

The purpose of Directive 2006/32/EC is to make the end-use of energy more economic and efficient by:

- establishing indicative targets, incentives and the institutional, financial and legal frameworks needed to eliminate market barriers and imperfections which prevent efficient end-use of energy;
- requiring Member States to issue National Energy Efficiency Action Plans specifying how they intend to achieve energy savings in energy consumption[363]; and
- creating the conditions for the development and promotion of a market for energy services and for the delivery of energy-saving programmes and other measures aimed at improving end-use energy efficiency. Member States must ensure that the public sector adopts measures to improve energy efficiency, inform the public and businesses of the measures adopted and promote the exchange of good practice.

The Directive covers all forms of energy, and applies to providers of energy efficiency measures, energy distributors, distribution system operators and retail energy sales companies as well as to all non-ETS energy users. The Member States have to set themselves indicative national targets of at least 9% of energy savings for the ninth year of implementation (2016) of the Directive, based on the average final energy consumption of the last available five years.

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360 Commission Implementing Decision of 19 December 2011 establishing harmonized efficiency reference values for separate production of electricity and heat in application of Directive 2004/8/EC of the European Parliament and of the Council and repealing Commission Decision 2007/74/EC. 2011/877/EU.

361 Impact Assessment accompanying the document Directive of the European Parliament and of the Council on energy efficiency and amending and subsequently repealing Directives 2004/8/EC and 2006/32/EC. SEC(2001) 779 final.

362 OJ L 114, 27.4.2006, p. 64

363 For an assessment of national Energy Efficiency Action Plans, please see Commission Staff Working Document, Synthesis of the complete assessment of all 27 National Energy Efficiency Action Plans as required by Directive 2006/32/EC on energy end-use efficiency and energy services. Moving forward together on saving energy. SEC(2009) 889.

The impact assessment accompanying the proposal for the new Energy Efficiency Directive concluded in 2011[364] that the Member States would achieve their 9% target in 2016, but were nevertheless not on track to achieve the 20% objective in 2020. According to the assessment, energy savings of only 50-95 Mtoe would be reached in 2020, instead of the required 368 Mtoe.

4.3.7. Energy performance of buildings (2010/31/EU)

Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings[365] (further referred to as Buildings Directive) was adopted in 2010 and repeals Directive 2002/91/EC on the energy performance of buildings. Compared to the repealed Directive 2002/91/EC, this Directive has a broader scope and helps citizens to improve the energy efficiency of their houses and the construction industry to build buildings with energy efficient envelope and heating systems. The Buildings Directive is one of the main instruments which have been put in place to reach the EU's 20% reduction target for primary energy consumption by 2020.

The Directive obliges Member States to set minimum standards for the energy performance of new buildings and for existing buildings that are subject to major renovation work to achieve cost optimal levels. The Member States have to develop a methodology to calculate the energy performance of buildings considering, for example, thermal characteristics, heating insulation, hot water supply, air-conditioning installation, but also aspects that have a positive influence on the energy performance such as natural lighting. New buildings have to comply with these requirements and shall undergo a pre-assessment before construction work begins. By 31 December 2020, all new buildings shall be "nearly zero-energy buildings". New buildings occupied and owned by public authorities shall comply with the same criteria by 31 December 2018.

However, there are buildings that are not affected by this Directive, e.g. officially protected buildings (such as historic buildings), churches, temporary buildings, very small buildings.

All new technical systems and building elements shall comply with energy performance requirements as well. Regular inspections of heating and air-conditioning systems in buildings must be guaranteed.

Member States had to put in place a system for the energy performance certification of buildings by 9 July 2012. The energy performance indicator of the certificate has to be included in all sales or letting advertisements, and the certificate (along with its energy saving recommendations) has to be part of the sales and letting documents. Member States shall ensure that, when buildings are constructed, sold or rented out, an energy performance certificate is made available to the owner or by the owner to the prospective buyer or tenant, as the case might be. The specific energy performance requirements are implemented in national or regional building codes.

The Directive requires Member States to develop plans for increasing the numbers of low or zero energy and zero carbon buildings, such as passive houses.

364 Impact Assessment accompanying the document Directive of the European Parliament and of the Council on energy efficiency and amending and subsequently repealing Directives 2004/8/EC and 2006/32/EC. SEC(2001) 779 final.

365 OJ L 153, 18.6.2010, p. 13

The Commission's proposal for the Directive included an impact assessment[366] of the Directive to estimate expected reductions in energy consumption and CO_2 emissions. The minimum total impact of the options identified as being most beneficial and for which quantification was possible, was estimated to be 160 - 210 Mt/year CO_2 savings in 2020 compared to the 'business as usual' scenario. This corresponds to a reduction of 5-6% of the EU's final energy consumption in 2020.

4.3.8. Energy Efficiency Plan 2011 (COM/2011/109)

The Energy Efficiency Plan 2011[367] was adopted by the European Commission in March 2011 in the framework of the European Energy 2020 Strategy which aims at reducing primary energy consumption by 20% by 2020. The Energy Efficiency Plan 2011 is the overall background document related to energy efficiency. It is the result of a revision of the Action Plan on Energy Efficiency 2006 after the Commission found in 2011 in its progress report[368] that this plan would not sufficiently help to achieve the 20% target.

The main fields of action with the highest energy saving potential are the public and private building sector (including appliances) followed by the transport and industry sectors.

During the first implementation phase from 2011 to 2013 Member States have to set indicative national targets and develop energy efficiency programmes. After the first phase the Commission will assess whether the 20% objective is likely to be achieved. Otherwise, the Commission will set mandatory targets for each Member State during the second stage. Besides, additional measures will be implemented through new legislative proposals and measures. One of these new policies and measures is Directive 2012/27/EU on energy efficiency.

The Commission's proposal for the Energy Efficiency Plan included an impact assessment of the Directive in terms of expected reductions of energy consumption and of CO_2 emissions[369]. According to this assessment the 20% reduction in primary energy consumption would lead to a decrease of 740 Mt CO_2 annually in 2020. In addition, it is expected that the efficiency measures could generate financial savings of up to € 1000 per household per year and create about 2 million jobs in the EU[370].

4.3.9. Energy Efficiency Directive (2012/27/EU)

The European Parliament and the Council adopted Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC[371]. The Energy Efficiency Directive is one of the main instruments (apart from the Buildings Directive and the Eco-design and Energy Labelling

366 Impact assessment – Accompanying Document to the Proposal for a recast of the Energy Performance of Buildings Directive (2002/91/EC). SEC(2008) 2864.

367 Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions – Energy Efficiency Plan 2011. COM(2011) 109 final.

368 Progress report of the Energy Efficiency Action Plan 2006. SEC(2011) 275 final.

369 Impact Assessment accompanying document to the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Energy Efficiency Plan 2011. SEC(2011) 277 final.

370 http://ec.europa.eu/energy/efficiency/action_plan/action_plan_en.htm.

371 OJ L 315, 14.11.2012, p. 1.

Directives) which have been put in place to achieve the EU's 20% reduction target of primary energy consumption by 2020.

The Directive establishes a common framework of measures for the promotion of energy efficiency and is an act of legislation which supports the Energy Efficiency Plan 2011. It aims at keeping the EU's energy efficiency target on track and explicitly sets goals of 1 474 Mtoe of primary energy consumption and 1 078 Mtoe of final energy consumption by 2020. Due to Croatia's accession to the EU on 1 July 2013, the target has been adjusted to 1 483 Mtoe of primary energy consumption and 1 086 Mtoe of final energy consumption.[372] In case the EU is not on track to achieve these targets, the Commission is to propose further measures.

The key elements of the Directive are briefly described below:

- National targets and National Energy Efficiency Action Plans:

Each Member State has to establish indicative national energy efficiency targets for 2020 by April 2013 and report every year onwards on the progress made/the main measures taken in order to achieve the target. In addition Member States have to submit National Energy Efficiency Action Plans (NEEAP) every three years; the next NEEAPs will be due in 2014. Subsequently, the Commission has to assess the progress achieved in the EU and the MS and, if needed, will propose further measures.

- Removal of market barriers:

One aim of the Directive is to reduce barriers in the energy market and avoid market failure that are preventing increased energy efficiency at all stages of the energy chain. Such measures include, for instance, network tariffs and regulations but also the implementation of energy efficiency obligation schemes for energy suppliers. According to the Directive, energy distributors will have to save 1.5% of the energy sold to final customers every year from 1 January 2014 onwards. Member States can set up a certificate scheme in order to enable a trade of these energy savings with other sectors and customers.

- Energy audits and energy management systems:

High quality energy audits or energy management systems which include energy audits will become mandatory for large companies and the Member State will promote them especially in SMEs, e.g. by establishing support schemes. All enterprises other than SMEs will be obliged to carry out an energy audit every four years from 2015 onwards. If enterprises have implemented an energy management system that includes energy audits, they are excluded from the auditing obligation.

Member States have to ensure that the energy audits are performed by independent entities with qualified personnel in a cost-effective manner and that energy management systems include appropriate energy audits.

- Public sector:

The public sector plays a leading role when it comes to setting an example of energy efficiency. Every year 3 % of the floor area in their central government buildings has to be renovated to reach at least the minimum performance level in compliance with

372 OJ L141, 28.05.2013, p. 29

Directive 2010/31/EU (see section 4.3.7). Public bodies are encouraged to purchase only products, services and buildings with a high energy-efficiency performance.

- Private sector:

Member States must provide a long-term strategy for investments in building renovation by April 2014, including policies and measures.

There is an additional focus on the reduction of barriers for consumers by improving access to information on their energy consumption, e.g. through smart metering and billing. Smart metering shall be provided to customers of electricity, natural gas, district heating and cooling and hot water if technically and economically feasible. This keeps customers informed about their energy use. In January 2017, this right shall be extended to residents of buildings with common heating/cooling/hot water systems. With regard to billing, consumers shall be informed about their energy bills at least every 6 months.

- CHP and district heating/cooling:

The Energy Efficiency Directive also includes changes concerning cogeneration and district heating/cooling (repealing the Cogeneration Directive 2004/8/EC). All Member States are obliged to assess their potential for high efficiency cogeneration and efficient district heating/cooling by 31 December 2015. The Member States have to develop policies which promote efficient heating and cooling systems on the local and regional level especially in connection with high efficiency cogeneration.

The impact of the EED on CO_2 emissions was projected using PRIMES model runs in the EU Reference Scenario 2012/13.

4.3.10. Internal Market in Electricity Directive (2009/72/EC)

The creation of a genuine internal market for energy is one of the EU's priority objectives. The existence of a competitive internal energy market is a strategic instrument, both in terms of giving European consumers a choice between different companies supplying gas and electricity at reasonable prices, and of making the market accessible for all suppliers.

In 2009, Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC[373] was adopted and had to be transposed into national law by March 2011. The Directive aims to introduce common rules for the generation, transmission, distribution and supply of electricity. It also lays down universal service obligations and consumer rights, and clarifies competition requirements.

The rules for the organisation of the sector aim to develop a competitive, secure and environmentally sustainable market in electricity. Member States may impose on undertakings operating in the electricity sector public service obligations which cover, amongst other things, issues of environmental protection, energy efficiency, energy from renewable sources and climate protection.

In addition, Member States shall ensure that all customers have the right to choose their electricity supplier and to change their supplier easily, with the operator's assistance,

373 OJ L 211, 14.8.2009, p. 55

within three weeks. They shall also ensure that customers receive relevant consumption data. Electricity suppliers are obliged to inform final customers about: (1) the contribution of each energy source; (2) the environmental impact caused; and (3) their rights in the event of a dispute.

Finally, the national regulatory authorities have to take all reasonable measures in order to promote the integration of large and small-scale production of electricity from renewable energy sources and in order to facilitate access to the network for new generation capacity, in particular removing barriers that could prevent access for new market entrants and electricity from renewable energy sources.

The political target for the completion of the internal energy market is 2014. The most recent Communication of the Commission[374] points out that – at present – the implementation is not on track and that many Member States are delayed with the adjustment of their national legislations. These delays have negative effects such as a high market concentration of the generation market or investments driven too often by subsidies. However, some achievements have been made: Competition has increased because more suppliers entered the market and cross-border trade is growing. It has been noted that consumer satisfaction is still at a low level but that the switching rates have increased.

The Commission concludes that action has to be taken and has published an Action Plan to enforce the implementation of the Third Energy Package. The Action Plan includes regular status updates on national implementation by the Member States and infringement procedures. Transparency shall be increased for Member States by providing best practice examples of implementation; and for consumers by putting in place web-based guidance on consumer rights.

4.3.11. Ecodesign Directive (2009/125/EC)

In order to reduce the environmental impact of energy using products, the EU has implemented two major pieces of framework legislation: Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products[375] (further referred to as Eco-design Directive), which is the key element of the Community strategy on Integrated Product Policy, and its complementary Energy Labelling Directive. The Framework Directive for the Eco-design of Products provides mandatory requirements for product design, whereas the Energy Labelling Directive aims at increasing consumer awareness.

The Directive establishing a framework for the setting of eco-design requirements for energy-related products aims to improve the environmental performance of products throughout their life-cycle by encouraging the integration of environmental aspects at the earliest stages of their design.

The first Directive on eco-design of energy-using products, Directive 2005/32/EC of the European Parliament and of the Council of 6 July 2005 establishing a framework for the

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374 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Making the internal energy market work. COM(2012)663 final.

375 OJ L 285, 31.10.2009, p. 10.

setting of ecodesign requirements for energy-using products and amending Council Directive 92/42/EEC and Directives 96/57/EC and 2000/55/EC of the European Parliament and of the Council[376] entered into force in August 2005, and had to be transposed by Member States into national law by August 2007. As the name indicates, it targeted **energy-using** products. In October 2009 its scope was extended by a recast, Directive 125/2009/EC, in order to incorporate **energy-related** products (e.g. windows).

The Eco-design Directive is the main legal instrument and the overall framework in the EU for addressing the environmental performance of energy-related products. The main objective of the Eco-design Directive is to bring about improvements in environmental performance (including energy efficiency) throughout the entire product's life-cycle, from the mining of the raw material through to recycling at the end of a product's lifetime. Its focus is deliberately broad, covering, in principle, any product which – during its use – consumes energy (electricity, fossil fuel or renewable). However, there are some exemptions (e.g. means of transport – such as vehicles - for people and goods) which are not covered by this Directive.

The rules for the eco-design of energy-related products are the same across Europe, although they take into consideration national differences. Applicable criteria include water consumption, energy consumption and waste production as well as the extension of product life. For each phase of a product's life-cycle the following aspects have to be assessed:

- predicted consumption of materials, of energy and other resources;
- anticipated emissions to air, water or soil;
- anticipated pollution (noise, vibration, radiation, electromagnetic fields);
- expected generation of waste material;
- possibilities for reuse, recycling and recovery of materials or energy

All products placed on the market must undergo a conformity assessment to check compliance with the eco-design requirements and they must be marked with the CE sign.

As the Eco-design Directive is an overall framework directive, it does not provide mandatory requirements for specific products. Such requirements are specified in separate product-related regulations which exist for the following product groups:

- heating and water heating equipment[377]
- electric motors,
- lighting in the residential and tertiary sectors,
- domestic appliances,
- office equipment in the residential and tertiary sectors,
- consumer electronics,
- HVAC (heating, ventilation and air conditioning) systems, and

376 OJ L 191, 22.7.2005, p. 29.

377 Replacing, in some cases, older Directives specific to a certain product group such as Directive 92/42/EEC on Efficiency of new boilers.

- water pumps.

Not all energy-related products have quantified environmental obligations. Quantified environmental obligations are defined for products based on volume of sales in the EU and on the environmental impact at European level.

The overall impact of the Eco-design Directive will depend on how many implementing regulations are adopted. The emission reductions achieved could be very substantial over time, reaching 211 to 265 Mt CO_2/year by 2020, when all currently installed equipment covered under Directive 2009/125/EC will have been replaced[378].

4.3.12. Energy Labelling Directive

As mentioned above, the Energy Labelling Directive complements the Eco-design Directive. Since coming into force in its original version[379] in 1992, Directive 2010/30/EU of the European Parliament and the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products (further referred to as Energy Labelling Directive) has been amended to include further energy-using household appliances such as refrigerators and freezers. In May 2010 the EU Parliament and the Council adopted the recast Directive[380] to extend the scope to energy-related products used in the industrial and commercial sectors, as well as other products which have an impact on energy consumption during their use. Member States have been obliged to apply the provisions of the Directive from 20 July 2011 onwards.

The Energy Labelling Directive aims at the introduction of a label in order to help consumers to purchase energy-saving products; the use of energy-saving products should also consumers to save money. In addition, industry should be encouraged to develop more energy efficient appliances.

The products must be marked with information about the consumption of electricity and other forms of energy. Furthermore, the supplier must provide a description of the product, results of design calculations, test reports and references allowing a comparison with similar products.

With regard to the label, it has to show how a product is ranked in terms of energy consumption/efficiency, using a scale from A (most energy efficient) to G (least energy efficient). Since the Energy Label has already existed in the EU for more than 20 years, 90% of the products concerned by the Directive have already reached class A. For this reason, new categories were introduced (A+ to A+++) in the most recent version of the Directive.[381]

The following products are covered by the Energy Labelling Directive:

- lamps and luminaires,
- household tumble driers,

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378 Ökopool, Wuppertal Institute and Risk&Policy Analysts Ltd. (2010): Analysis of impact of efficiency standards on EU GHG emissions (eco-design directive), Task 3 report: Outlook on the estimated GHG emission reductions, Final Report (Sept 2010), p. 8.

379 Council Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances. OJ L 297, 13.10.1992, p. 16.

380 OJ L 153, 18.6.2010, p.1.

381 Research on EU product label options (2012), a study by Ipsos MORI, London Economics and AEA for the European Commission: http://ec.europa.eu/energy/efficiency/studies/doc/2012-12-research-eu-product-label-options.pdf.

- air conditioners,
- televisions,
- household washing machines,
- household refrigeration appliances,
- household dishwashers,
- household electric ovens,
- household combined washer-driers, and
- household electric tumble driers.

Apart from addressing consumers, the Energy Labelling Directive also provides a legal basis for the harmonization of public procurement at EU and Member State level. Member States shall promote public procurement of products belonging to the highest energy class, and set minimum criteria for the procurement of energy-related products.

The impact assessment[382] of the amendment of the Energy Labelling Directive showed that the broadened scope can lead to an emission reduction of about 65-78 Mt CO_2 per year up to 2020, which corresponds to an increase of +20 Mt CO_2 compared to the repealed Directive.

4.3.13. Green Public Procurement

The EU promotes the use of public procurement in Member States as a means of kick-starting the market for eco-innovative goods and services and to achieve its environmental goals in a cost-efficient manner. Public authority spending in the EU is worth an estimated € 2 000 billion per year, approx. 19% of the EU's GDP. Green public procurement (GPP) is a voluntary instrument that can substantially reduce unsustainable production and consumption patterns and could help to place new environmental technologies on the market.

A 2003 Communication on Integrated Product Policy encouraged Member States to adopt national action plans on GPP by the end of 2006[383]. In March 2004, the EC adopted two new public procurement Directives[384], which included provisions regarding the integration of environmental considerations into public procurement strategies.

On 16th July 2008, the Commission presented the Communication "Public Procurement for a better environment"[385]. It provides guidance on how the public sector can reduce environmental impact and stimulate innovation in green technologies. The Commission set an indicative target that by 2010, 50% of the public tendering procedures should comply with the core GPP criteria. Core criteria are suitable for use by any contracting authority across the Member States and address the key environmental impacts. They are designed to be used with minimum additional verification effort or cost increases.

382 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:DKEY=483101:EN:NOT.

383 Integrated product policy – Building on Environmental Life-Cycle Thinking. COM(2003) 302 final.

384 Directive 2004/18/EC on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts and Directive 2004/17/EC coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors. OJ L 134, 30.4.2004, p. 114.

385 Public Procurement for a better environment. COM(2008) 400 final.

In the meantime, a new procedure for GPP criteria development that includes stakeholders at several stages was implemented and a handbook on GPP addressing public authorities was published.

The most recent Annual Public Procurement Implementation Review 2012[386] found that the indicative target set in 2008 was not reached. In 2009 and 2010 only 26% of public contracts signed included all core GPP criteria. Nevertheless, a positive trend is visible and the share of GPP is increasing.

The Directives are estimated to have an emission reduction potential of 25-45 Mt CO_2eq per annum, most of which by making investments that cost less than 20 €/ton CO_2eq[387].

The key role of public procurement is laid down in many EU policy frameworks (e.g. Integrated Product Policy, Energy 2020 strategy) and legislative acts (e.g. Energy Efficiency Directive, Directive on energy performance of buildings and the Energy Labelling and Eco-design Directives).

4.3.14. Energy star programme

Final energy consumption in offices is about to increase as new applications and functionalities regularly appear on the market. Due to a lack of information efficient appliances often do not become prevalent on the market.

In order to raise awareness in users and manufactures the voluntary energy labelling programme “Energy Star” was created in 2000, in the context of a coordinating agreement with the USA government. This first agreement[388] was set for an initiating period of 5 years to establish the programme. In April 2003, the Council approved the European Community Energy Star Board (ECESB) as managing body.

The second 5-year period of the programme started in 2006[389]. It takes into account lessons learned from the first period and includes improved energy efficiency criteria. The Energy Star programme is embedded in the EU’s energy efficiency policy[390] and complements the Eco-design Directive for energy-related products (section 4.3.11) which sets mandatory minimum requirements.

When put on office appliances the Energy Star label shall help consumers to identify low energy consumption products. Moreover, it shall raise awareness in users and manufactures about energy use in offices. Office appliances certified by Energy Star shall use less energy in the stand-by as well as in the use phase. The manufacturers can test themselves or by an independent test laboratory if the performance of the product complies with the agreed specifications.

The ECESB is responsible for observing the testing of office equipment. If a product fails such checks the manufacturer is required to follow a plan provided by the ECESB to improve the product performance. In case of failing again the manufacturer will be excluded from the programme.

In February 2011 the US managing body (the Environmental Protection Agency) decided to toughen the certification procedure by introducing systematic checks by a

386 Annual Public Procurement Implementation Review 2012. SWC(2012) 342 final.

387 http://ec.europa.eu/clima/policies/eccp/docs/second_eccp_report_en.pdf.

388 Regulation (EC) No 2422/2001 of 6 November 2001 on a Community energy efficiency labelling programme for office equipment. OJ L 332, 15.12.2001, p.1.

389 Decision 2006/1005/EC of 18 December 2006 concerning the conclusion of the Agreement between the Government of the United States of America and the European Community on the coordination of energy-efficiency labelling programmes for office equipment. OJ L 381, 28.12.2006, p. 24.

390 Regulation (EC) No 106/2008 of 15 January 2008 on a Community energy-efficiency labelling programme for office equipment. OJ L 39, 13.2.2008, p.1.

third-party laboratory after the first approval. The EPA confirmed that EU products are not affected by these new requirements but in fact amendments of the programme require common agreement of both managing bodies. In addition, the EPA fears that US manufacturers would register their products in the EU to avoid increased efforts. Thus, it is expected that the current situation would not be acceptable for the US. For this reason the EU started analysing different options for the future of the Energy Star Programme.[391] In November 2012, the new agreement[392] was adopted by the Council for the next five year period. As the EU wants to protect SMEs from costly certification procedures, both approaches, self-certification in the EU and certification by a third-party in the USA, are kept. However, products sold on the US market have to undergo the third-party certification.

An assessment of the programme based on sales data for the years 2008-2011 estimates that the Energy Star succeeded in a 16% reduction (approx.) of the electricity consumption of new office equipment (approx. 3 Mt CO_2 avoided during the period 2008-2011).

4.3.15. Motor challenge programme

Launched in 2003, the Motor Challenge Programme[393] is a European Commission initiative to aid industrial companies to improve the energy efficiency of their electric motor driven systems. The programme focuses on compressed air, fan and pump systems, for which a large technical and economic potential for energy savings has been demonstrated.

The core of the programme is an Action Plan, by which a Challenge Partner commits to undertaking specific measures to reduce energy consumption. The participating company determines which production sites, and which types of systems, are covered by the commitment. The scope of the commitment is flexible, and can be limited to a single shop, or may include all of the company's European production sites.

Companies will receive aid, advice and technical assistance from the Commission and from participating National Energy Agencies to formulate and carry out their Action Plan.

An evaluation[394] of the Motor Challenge Programme in 2010 found that the participating companies cover a wide range of different industrial sectors: food (13%), metal and steel (12%) and water supply (9%). Most companies are large or medium-sized. According to the companies, 290 different energy efficiency measures had been implemented and approx. 87 kt of CO_2 had been saved annually.

4.3.16. Strategic Energy Technology Plan (COM/2007/723 and COM/2013/253)

The European Strategic Energy Technology Plan (SET-Plan)[395] aims to accelerate the development and deployment of cost-effective low carbon technologies to enable the

391 Communication from the Commission on the implementation of the ENERGY STAR programme in the European Union in the period 2006 – 2010. COM(2011) 337 final.

392 Council Decision of 13 November 2012 on the signing and conclusion of the Agreement between the Government of the United States of America and the European Union on the coordination of energy-efficiency labelling programmes for office equipment (2013/107/EU). L 63, 6.3.2013, p.5.

393 http://re.jrc.ec.europa.eu/energyefficiency/motorchallenge/index.htm.

394 http://iet.jrc.ec.europa.eu/sites/default/files/documents/scientific_publications/2010/the_european_motor_challenge_programme_evaluation_2003-2009.pdf.

395 A European Strategic Energy Technology plan (SET-Plan). COM(2007) 723 final.

EU to deliver EU 2020 and 2050 targets while ensuring a worldwide leadership in the production of energy technological solutions. The SET-Plan comprises measures relating to planning, implementation, resources and international cooperation in the field of energy technologies.

The following areas are covered by the SET-Plan: wind and solar energy, bio-energy, capture, transport and storage of CO_2, electricity grids, nuclear energy, fuel cells and hydrogen, which take the form of public-private partnerships or joint programmes between Member States. In addition, the SET-Plan includes the "Smart Cities" Innovation Partnership, which aims to improve energy efficiency and to step up the deployment of renewable energy in large cities.

4.3.17. Intelligent Energy - Europe II Programme

The Intelligent Energy — Europe II Programme (IEE II)[396] is a funding instrument dedicated to sustainable energy. It aims at fostering energy efficiency, promoting new and renewable energy sources and supporting energy diversification. It forms part of the overarching Competitiveness and Innovation Framework Programme (CIP)[397].

Grants and tenders were made available in four areas: energy efficiency and rational use of energy, new and renewable energy resources, energy in transport and integrated initiatives.

Through the participation of more than 3 000 public and private organisations across the EU, IEE II and its predecessor (IEE I) have become the main Community instruments in the field of energy efficiency and the use of new and renewable energy sources. They support the development and implementation of policies and Directives, support the creation of favourable market conditions, prepare the ground for investments, and help building capacities and skills. IIE II covers, for example, the ELENA facility and the BUILD UP Skills initiative. The European Local Energy Assistance (ELENA) facility provides financial and technical assistance to help local and regional authorities attract funding for sustainable energy projects. The BUILD UP Skills initiative was launched in 2011 in order to address the specific requirements of the on-site construction work force.

According to the 2012 performance report of the IEE[398], the projects under the ELENA facility are expected to result in an emission reduction of 570 000 tonnes of CO_2 equivalents. As another example, the "biogas regions" project under the IEE I programme, resulted in savings of 60 000 tonnes of CO_2 equivalents per year.

Currently the European Commission is planning a successor instrument to the IEE II programme, to cover the 2014-2020 period.

4.3.18. The Covenant of Mayors

After the adoption of the EU Climate and Energy Package, the European Commission launched the Covenant of Mayors[399] to endorse and support the efforts deployed by local authorities in the implementation of sustainable energy policies. The Covenant of

396 http://ec.europa.eu/energy/intelligent/index_en.htm.

397 Decision 1639/2006/EC of the European Parliament and of the Council of 24 October 2006 establishing a Competitiveness and Innovation Framework Programme (2007 to 2013). OJ L 310, 9.11.2006, p. 15.

398 http://ec.europa.eu/energy/intelligent/files/doc/reports/iee-ii-performance-report-2007-2011-final_en.pdf.

399 http://www.covenantofmayors.eu/.

Mayors plays an important role in mobilising local and regional actors around the fulfilment of the EU's climate and energy targets for 2020.

In order to translate their political commitment into specific measures and projects, Covenant signatories undertake to prepare and submit, within the year following their signature, a Sustainable Energy Action Plan (SEAP). The SEAP is the key document in which the Covenant signatory outlines how it intends to reach its CO_2 reduction target by 2020. It defines the activities and measures set up to achieve the targets, together with time frames and assigned responsibilities. By 2013, more than 4 000 mayors, representing more than 150 million inhabitants, have signed the Covenant. The SEAPs that were already submitted by the end of 2012 are expected to achieve a 29 % CO_2 emission reduction (on average) in 2020 compared to the base year (1990 is the recommended base year for the SEAPs, although it may differ in some cases). This corresponds to a reduction of approximately 150 million tonnes of CO_2.

4.3.19. Policies and measures no longer in place

There are no policies and measures (PaMs) no longer in place in the energy sector but there are directives and regulations included in the NC5 which have been replaced/repealed by new EU legislation. *Table [BR1] 4-2* shows the correspondence between "old" legislation and "new" legislation. Note that sometimes the content of the old legislation has been updated in more than one new piece of legislation. In this case the table includes the reference to the "main" new piece of legislation which replaces/repeals the old piece of legislation.

Table [BR1] 4-2 PaMs included in NC5 and corresponding PaMs included in NC6

PaM in NC5	**Corresponding PaM in NC6**
En1 – Developing the internal market (Directive 2003/54/EC, Directive 98/30/EC)	Internal Market in Electricity Directive (2009/72/EC)
En2 – Promotion of electricity from renewable energy sources (Directive 2001/77/EC)	Renewable Energy Directive (2009/28/EC)
En3 – Renewable Energy Directive (Directive 2009/28/EC)	Renewable Energy Directive (2009/28/EC)
En4 – Biomass Action Plan (COM (2005) 628 final)	Biomass Action Plan
En5- Action Plan on Energy Efficiency	Energy Efficiency Plan 2011 (COM/2011/109)
En6 – Directive on energy end-use efficiency and energy services (Directive 2006/32/EC)	Energy Efficiency Directive (2012/27/EC)
En7- Framework Directive Ecodesign (Directive 2005/32/EC)	Ecodesign Framework Directive (Directive 2009/125/EC)
En8- Cogeneration Directive (Directive 2004/8/EC)	Energy Efficiency Directive (2012/27/EC)
En9 – Motor Challenge Programme	Motor Challenge Programme
En10- Labelling Directive (Directive 2003/66/EC)	Energy Labelling Directive (Directive

PaM in NC5	Corresponding PaM in NC6
	2010/30/EU)
En11- Energy Performance of Buildings (Directive 2002/91/EC)	Energy Performance of Buildings (Directive 2010/31/EU)
En12- Strategic Energy Technology Plan (SET plan)	Strategic Energy Technology Plan (SET plan)
En13 – Green public procurement	Green public procurement
En14 – CCS storage	Moved to chapter on cross-cutting PaMs
En15- National Emission Ceilings Directive (2001/81/EC)	Moved to chapter on cross-cutting PaMs
En16 – Large Combustion Plant Directive	Integrated into the Industrial Emission Directive (2010/75/EU); moved to industry chapter
En17- EU Emission Trading Scheme (2003/87/EC)	Moved to chapter on cross-cutting PaMs

4.4. Sectoral policies and measures: Transport

4.4.1. Overview

In the following, the most important European initiatives in the transport sector are presented. Measures in the aviation industry have already been shown under the EU Emission Trading Scheme (see section 4.2.2), and measures relating to mobile air condition systems are discussed in section 4.5.4, below.

An overview of the measures including information on their impact on CO_2 emissions can be found in CTF Table 3 in the CTF Appendix.

The following policies and measures are covered in this section:

- Renewable Energy Directive (2009/28/EC)
- Strategy to reduce CO_2 from passenger cars and light-commercial vehicles (COM/2007/19)
- Regulation on CO_2 emissions from cars (443/2009)
- Regulation CO_2 emissions from light-commercial vehicles (510/2011)
- Biofuels Directive (repealed by Renewable Energy Directive)
- Fuel Quality Directive (2009/30/EC)
- Proposal for an amendment of the Fuel Quality Directive and the Renewable Energy Directive
- Euro 5 and 6 Standards (Regulation (EC) No 692/2008)
- Euro VI Standard for heavy duty vehicles (Regulation (EC) No 595/2009)

- Environmental performance requirements for motor vehicles and tyres (Regulations (EC) 661/2009, (EC) 1222/2009, EC 1235/2011, EC 228/2011 and (EU) 65/2012)
- Infrastructure charges for heavy goods vehicles (Directive 1999/62/EC as amended by Directives 2006/38/EC and 2011/76/EU)
- Clean Power for Transport package including the deployment of alternative fuel infrastructure
- Clean Vehicles Directive (2009/33/EC)
- Roadmap to a Single European Transport Area
- International maritime transport

4.4.2. Strategy to reduce CO_2 from light vehicles (COM/2007/19)

In 2007, the Commission adopted Communication COM(2007)19 final[400] outlining a comprehensive new strategy to reduce carbon dioxide emissions from new cars and vans sold in the European Union. Before 2007, the Community's strategy was based on three pillars: (1) voluntary commitments of the automobile industry; (2) consumer information (labelling); and (3) the promotion of fuel-efficient cars via fiscal measures (taxation). The new strategy was developed because the objectives of the pre-2007 strategy had only partly been achieved.

The 2007 strategy aimed at meeting the Community objective of an equivalent of 120 g CO_2/km by 2012 through a legislative framework which addressed supply-oriented measures. The package of measures contained the following elements:

- to fulfil the objective of 130 g CO_2/km for the average new car fleet by improvements in vehicle motor technology;
- setting minimum efficiency requirements for air-conditioning systems;
- compulsory fitting of accurate tyre pressure monitoring systems;
- setting maximum tyre rolling resistance limits in the EU for tyres fitted on passenger cars and light commercial vehicles;
- use of gear shift indicators, taking into account the extent to which such devices are used by consumers in real driving conditions;
- increased fuel efficiency in light-commercial vehicles (vans) in the aim of reaching 175 g CO_2/km by 2012 and 160 g CO_2/km by 2015;
- increased use of biofuels maximizing environmental performance.

In 2010 the European Commission published a progress report[401] on implementation of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles. It is unlikely that the objective of an equivalent of 120 g CO_2/km will be achieved in 2012. At the same time, according to EU monitoring data the manufacturers are on track

400 Results of the review of the Community Strategy to reduce CO2 emissions from passenger cars and light-commercial vehicles, COM(2007)19 final.

401 Progress report on implementation of the Community's integrated approach to reduce CO2 emissions from light-duty vehicles. COM(2010) 656 final.

to meeting the targets set in Regulation (EC) No 443/2009. Moreover, data shows that the average CO_2 emissions of 65% of newly registered cars were lower than 130 g CO_2/km in 2009.

In order to achieve these objectives a number of directives and regulations have been adopted in recent years. Most of them are described in the following sections.

4.4.3. CO_2 and cars (Regulation 443/2009)

In 2009, Regulation (EC) No 443/2009 of the European Parliament and of the Council of 23 April 2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles[402] (further referred to as CO_2 and Cars Regulation) was adopted. This regulation is the cornerstone of the EU's strategy to improve the fuel economy of new cars sold on the European market.

Under the CO_2 and Cars Regulation, the fleet average to be achieved by all new cars is 130 grams of CO_2 per kilometre (g/km) by 2015 – with the target to be phased in from 2012 - and 95 g/km by 2020. The 2015 and 2020 targets represent reductions of 18% and 40% respectively, compared with the 2007 fleet average of 158.7g/km. In terms of fuel consumption, the 2015 target is approximately equivalent to 5.6 litres per 100 km (l/100 km) of petrol or 4.9 l/100 km of diesel. The 2020 target equates to approx. 4.1 l/100 km of petrol or 3.6 l/100 km of diesel[403].

Key elements of the CO_2 and Cars regulation are:

- Emission limits are set according to the mass of vehicle, using a limit value curve. The curve is set in such a way that a fleet average of 130 grams of CO_2 per kilometre is achieved by 2015. The limit value curve means that heavier cars are allowed higher emissions than lighter cars while preserving the overall fleet average. Only the fleet average is regulated, so manufacturers are still able to make vehicles with emissions above the limit value curve, provided that these are balanced by vehicles below the curve.
- The EU fleet average target of 130g CO_2 per km will be phased in between 2012 and 2015. In 2012, an average of 65% of each manufacturer's newly registered cars must comply with the limit value curve set by the legislation. This share will rise to 75% in 2013, 80% in 2014, and 100% from 2015 onwards.
- If the average CO_2 emissions of a manufacturer's fleet exceed its limit value in any year from 2012, the manufacturer has to pay excess emissions premiums for each car registered. These excess emissions premiums amount to € 5 for the first g/km of exceedance, € 15 for the second g/km, € 25 for the third g/km, and € 95 for each subsequent g/km. From 2019, the cost will be € 95 from the first gram of exceedance onwards.
- Manufacturers can come together to form a pool which can act jointly in meeting the emissions target.

402 OJ L 140, 5.6.2009, p.1.

403 http://ec.europa.eu/clima/policies/transport/vehicles/cars/index_en.htm.

A further emission reduction to 95 g CO_2/km is specified for the **year 2020**. Following a thorough review to define modalities to reach a long-term target, the Commission proposed legislation[404] in July 2012 which set out the modalities of how this target is to be fulfilled. The proposal includes the following provisions[405]:

- All manufacturers would be required to achieve the same level of reduction - 27% - from the 2015 target;
- The target would continue to be set on the basis of a vehicle's mass;
- Eco-innovations would continue to apply once the new test procedure for vehicle type approval is in place;
- Super-credits with a multiplier of 1.3 would apply in 2020-2023 for vehicles emitting less than 35 g/km; this benefit would be limited to a maximum of 20 000 cars per manufacturer over the period;
- The penalty would remain at € 95 per g/km from the first “gram of exceedance”;
- Small-volume manufacturers would be given greater flexibility regarding when they can apply for their own reduction target;
- The smallest manufacturers, producing fewer than 500 cars per year, would be exempted from meeting the target;
- Niche manufacturers would receive a new target for 2020 – a 45% reduction from their 2007 level;
- The regulation would be reviewed by the end of 2014 in order to set reduction targets for post-2020.

The **impact assessment** carried out in 2012 related to a proposed amendment of Regulation (EC) No 443/2009 found that implementing the 2020 emission targets for cars and vans result in annual savings of 27 Mt CO_2 in 2020, and in 49 Mt CO_2 in 2030. The cumulative savings in the 2020-2030 period were estimated at around 422 Mt CO_2[406].

The most recent **progress report** of the EEA[407] indicates that in 2012 manufacturers once more improved their performance in terms of the CO_2 emissions of passenger cars: the average CO_2 emissions of the new car fleet in 2012 was 132.2 g CO_2/km. This was 3.5 g CO_2/km less than in the previous monitoring year (135.7 g/km in 2011).

Some of the key changes observed in the fleet are:

- the dieselisation of the fleet continues (54.9% of the vehicles registered in 2012 in Europe are diesel vehicles);
- the average mass is the highest of the last nine years;

404 Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EC) No 443/2009 to define the modalities for reaching the 2020 target to reduce CO2 emissions from new passenger cars. COM(2012) 393 final. .

405 http://ec.europa.eu/clima/policies/transport/vehicles/cars/index_en.htm.

406 Impact Assessment accompanying the documents Proposal for a regulation of the European Parliament and of the Council amending Regulation (EC) No 443/2009 to define the modalities for reaching the 2020 target to reduce CO2 emissions from new passenger cars and Proposal for a regulation of the European Parliament and of the Council amending Regulation (EU) No 510/2011 to define the modalities for reaching the 2020 target to reduce CO2 emissions from new light commercial vehicles SWD(2012) 213 final Part II.

407 EEA (2013): Monitoring CO2 emissions from new passenger cars in the EU: summary of data for 2012. http://www.eea.europa.eu/publications/monitoring-co2-emissions-from-new-cars

- the average engine capacity has decreased by 5% since 2007.

In spite of the increase in mass, dieselisation and improved vehicle technology have led to greater fuel efficiency and lower average CO_2 emissions per kilometre travelled.

4.4.4. CO_2 from light commercial vehicles (Regulation (EU) No 510/2011)

As part of the strategy to reduce CO_2 emissions from light-duty vehicles, the EU adopted legislation in 2011 which set CO_2 emission targets for new vans sold on the European market[408]. The Regulation is similar to the one for new cars. The CO_2 and Vans Regulation limits CO_2 emissions from new vans to a fleet average of 175 grams of CO_2 per kilometre by 2017 – with the target to be phased in from 2014 - and 147 g/km by 2020. These cuts represent reductions of 14% and 28% respectively, compared with the 2007 average of 203 g CO_2/km. In terms of fuel consumption, the 2017 target is approximately equivalent to 7.5 litres per 100 km (l/100 km) of petrol or 6.6 l/100 km of diesel. The 2020 target equates approximately to 6.3 l/100 km of petrol or 5.5 l/100 km of diesel[409].

Key elements of the legislation are[410]:

- Emission limits are set according to the mass of vehicle, using a limit value curve. The curve is set in such a way that a fleet average of 175 grams of CO_2 per kilometre is achieved by 2017. The limit value curve means that heavier vans are allowed higher emissions than lighter vans while preserving the overall fleet average. Only the fleet average is regulated, so manufacturers will still be able to make vehicles with emissions above the limit value curve, provided these are balanced by vehicles below the curve.
- The EU fleet average target of 175 g CO_2/km will be phased in between 2014 and 2017. In 2014 an average of 70% of each manufacturer's newly registered vans must comply with the limit value curve set by the legislation. This share will rise to 75% in 2015, 80% in 2016, and 100% from 2017 onwards.
- The legislation affects light commercial vehicles, which means vehicles used to carry goods weighing up to 3.5 tonnes (vans and car-derived vans, known as "N1") and which weigh less than 2 610 kg when empty.
- If the average CO_2 emissions of a manufacturer's fleet exceed its limit value in any year from 2014, the manufacturer has to pay an excess emissions premium (EEP) for each van registered. The excess emissions premium amounts to € 5 for the first g/km of exceedance, € 15 for the second g/km, € 25 for the third g/km, and € 95 for each subsequent g/km. From 2019, the cost will be € 95 from the first gram of exceedance onwards. This value is equivalent to the EEP for passenger cars.

A further emission reduction to 147g CO_2/km is specified for the **year 2020**. Following a thorough assessment of its costs and benefits, the Commission proposed legislation in

408 Regulation (EU) No 510/2011 of the European Parliament and of the Council of 11 May 2011 setting emission performance standards for new light commercial vehicles as part of the Union's integrated approach to reduce CO2 emissions from light-duty vehicles. OJ L .145, 31.5.2011, p.1.

409 http://ec.europa.eu/clima/policies/transport/vehicles/vans/index_en.htm

410 http://ec.europa.eu/clima/policies/transport/vehicles/vans/index_en.htm

July 2012 confirming this target and setting out the modalities of how it should be reached[411]. The proposal includes the following provisions[412]:

- The feasibility of meeting the target by 2020 is confirmed;
- All manufacturers would be required to achieve the same level of reduction - 19% - from the emissions level in 2010;
- The target would continue to be set on the basis of a vehicle's mass;
- Eco-innovations would continue to apply once the new test procedure for vehicle type approval is in place;
- The penalty would remain at € 95 per g/km from the first gram of exceedance;
- Small-volume manufacturers would be given greater flexibility regarding when they can apply for their own reduction target;
- The smallest manufacturers, producing fewer than 500 vans per year, would be exempted from meeting the target;
- The regulation would be reviewed by the end of 2014 in order to set reduction targets for post-2020.

The **impact assessment** carried out for the proposal for Regulation 510/2011 includes two options and various assumptions[413]. According to this study the annual CO_2 equivalent savings are expected to be 11.3 Mt CO_2 and 0.6 Mt CO_2 for passenger and freight respectively in 2020 and 3.7 Mt CO_2 for passenger vans and 1.6 Mt CO_2 for freight vans in 2030. The cumulative CO_2 emissions savings between 2020 and 2030 would amount to 26.5 Mt and 11.7 Mt for passenger and freight respectively.

4.4.5. Biofuels Directive (repealed by Renewable Energy Directive)

Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of renewable energy in transport[414] set indicative targets for biofuels and other renewable energy used in the transport sector. Member States were allowed to set their own targets, but indicative targets were set at a 2% biofuel share by 2005 and 5.75% by 2010. The Commission's progress report COM(2009)192[415] assessed the progress made towards achieving the 2010 targets set by Directive 2003/30/EC and showed that in 2007 the use of biofuels in road transport was below the target, namely at 2.6% for the EU as a whole.

Therefore, the Directive was repealed on 31.12.2011 by the Renewable Energy Directive (see section 4.3.3), which sets mandatory targets. By 2020, the share of renewable energy shall amount to 10 % of fuels consumed in the transport sector, which

411 Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) No 510/2011 to define the modalities for reaching the 2020 target to reduce CO2 emissions from new light commercial vehicles. COM(2012) 394 final.

412 http://ec.europa.eu/clima/policies/transport/vehicles/vans/index_en.htm

413 Impact Assessment accompanying the documents Proposal for a regulation of the European Parliament and of the Council amending Regulation (EC) No 443/2009 to define the modalities for reaching the 2020 target to reduce CO2 emissions from new passenger cars and Proposal for a regulation of the European Parliament and of the Council amending Regulation (EU) No 510/2011 to define the modalities for reaching the 2020 target to reduce CO2 emissions from new light commercial vehicles SWD(2012) 213 final Part II.

414 OJ L 123, 17.5.2003, p. 42.

415 The Renewable Energy Progress Report - Commission Report in accordance with Article 3 of Directive 2001/77/EC, Article 4(2) of Directive 2003/30/EC and on the implementation of the EU Biomass Action Plan, COM(2005)628. COM(2009) 192 final.

can include biofuels, renewable electricity or hydrogen originating from renewable sources.

In addition, the Renewable Energy Directive sets a number of sustainability criteria that must be met for biofuels and bioliquids to count towards the target, including a minimum threshold of GHG savings for biofuels: The life cycle GHG emissions of biofuels used must be at least 35% lower than from the fossil fuel replaced. This threshold will be raised to 50% in 2017. The Directive also lays down that biofuels must not derive from land with high carbon stocks or high biodiversity.

Furthermore, the Member States are encouraged to introduce certification schemes for biofuels to ensure that the sustainability criteria are implemented along the whole chain of custody.

4.4.6. Fuel Quality Directive (2009/30/EC)

Directive 2009/30/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC[416] (further referenced as Fuel Quality Directive) tightens the requirements for a number of fuel parameters. The Directive introduces a binding target for fuel suppliers to reduce life-cycle GHG emissions per unit of energy from fuel and energy supplied by up to 6% by 2020 compared to 2010, with intermediate targets of 2% by 2014 and 4% by 2017.

The reduction shall be obtained through the use of biofuels, alternative fuels or reductions in flaring and venting at production sites. Another indicative life cycle GHG emissions reduction of 4% (overall 10 %) shall be achieved by means of implementation of new technologies such as carbon capture and storage (CCS) and purchase of carbon credits from the Clean Development Mechanism (CDM). New technologies and CDM could contribute a 2% reduction each. Suppliers can choose to group together to meet these targets jointly.

The Directive applies to all petrol, diesel and biofuels used in road transport, as well as to gas oil used in non-road-mobile machinery. The blending of fuels and refinery efficiency are expected to be the main contributors to meeting the target[417].

To facilitate implementation of the target the amended Directive determines a reporting mechanism for the life-cycle GHG emissions from fuels (including fossil fuel and renewable fuels), which covers crude oil production, refining, distribution and retail as well as fuel combustion. Fuel suppliers shall report annually (starting from January 2011) the total volume of each fuel type and the life cycle GHG emissions per unit of energy to a designated authority. As the scope of the Directive covers fuel production right through to combustion of the fuel, biofuels will play a key part in achieving the targets. The Directive therefore incorporates the same sustainability criteria (and minimum GHG savings requirements) for biofuels as those introduced in the Renewable Energy Directive (see section 4.3.3).

416 OJ L 140, 5.6.2009, p. 88.

417 http://ies.jrc.ec.europa.eu/uploads/jec/JECBiofuels%20Report_2011_PRINT.pdf

To encourage and enable a more widespread use of biofuels, the Directive also implies fuel standards which allow the distribution of biofuels by means of higher blending rates within fossil fuels. The Directive will phase in a 10% blending limit for ethanol in petrol (E10), while continuing the production and supply of 5% bioethanol (E5) on the market for older cars. For diesel, the maximum biodiesel blend will be increased from the current 5% to 7% (B7), with an option to increase it further in the future and allowing Member States to permit higher blends already.

The CO_2 emission saving potential but can be estimated as follows: If the Directive is properly implemented it will deliver savings of 6% of total well-to-wheel road transport CO_2 emissions in 2020, therefore the saving potential will amount to roughly 55 Mt CO_2 in 2020, excluding indirect land use change (ILUC) emissions.

4.4.7. Proposal for an amendment of the Fuel Quality Directive and the Renewable Energy Directive

It is planned that both the Fuel Quality Directive and the transport-related section of the RES Directive will be amended because GHG emissions related to indirect land use changes (ILUC) are not taken into account under the current legislation[418]. Indirect land use change can reduce the GHG savings associated with the use of biofuels and bioliquids.

Most of today's biofuels are produced from crops grown on agricultural land such as wheat and rapeseed. When agricultural or pasture land previously destined for the food, feed and fibre markets is diverted to the production of biofuels, the non-fuel demand will still need to be satisfied. Although this additional demand may be met through intensification of the original production, bringing non-agricultural land into production elsewhere is also possible. It is in the latter case that land-use change occurs indirectly (hence the term indirect land-use change). While most biofuel feedstocks are produced in the EU, the estimated indirect land-use change emissions are mostly expected to take place outside the EU, where the additional production is likely to be realised at the lowest cost. In the case that this production is realised through the use of additional land, its conversion could lead to substantial greenhouse gas emissions being released if high carbon stock areas such as forests are affected as a result.

The proposed Directive aims at limiting the contribution that conventional biofuels (with a risk of ILUC emissions) make towards attainment of the targets in the Renewable Energy Directive. In addition, the GHG performance of the biofuel production processes shall be improved. Therefore, a minimum threshold of 60% for the GHG emission savings is proposed for biofuel production installations starting operation after 1 July 2014.

Furthermore, food-based biofuels (1^{st} generation biofuels) should be limited to a share of 5% of the total fuel consumption, which corresponds to the estimated share of 1^{st} generation biofuels in the European Union in 2011. This implies that in order to fulfil the 10% target, the remaining 5%[419] would have to come from a combination of 2^{nd} and 3^{rd} generation biofuels which do not directly compete with food crops and are produced

418 Proposal for a Directive of the European Parliament and of the Council amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources. COM(2012) 595 final.

419 Increased energy efficiency measures in transport also contribute indirectly to achieving the 10% target by lowering the overall energy demand.

from waste, residues, non-food cellulosic material or ligno-cellulosic biomass and renewable electricity in road and rail. In order to promote the use of 2nd and 3rd generation biofuels the proposal includes a list of biofuel feedstocks that are counted multiple times towards fulfilling the target.

Finally, Member States and fuel suppliers will also be obliged to report the estimated life cycle greenhouse gas emission savings from biofuels and bioliquids, including the estimated indirect land use change emissions and the methodology for reporting will be reviewed and updated in the light of scientific developments.

The impact assessment[420] estimates that the proposed legislation leads to annual emission reductions of 48 Mt CO_2 in the year 2020, 27 Mt of which are expected to be ILUC emission reductions.

The proposal is at an early stage in the legislative process.

4.4.8. Euro 5 and 6 Standards (Regulation (EC) No 692/2008)

To limit pollution caused by road vehicles, Commission Regulation (EC) No 692/2008 of 18 July 2008 implementing and amending Regulation (EC) No 715/2007 of the European Parliament and of the Council on type-approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information[421] introduced new common minimum requirements for air quality emissions from motor vehicles and their replacement parts (Euro 5 and Euro 6 standards). Air quality emission limits are set separately for petrol and diesel vehicles. The Euro 5 standard came into force on 1 September 2009 for the approval and on 1 January 2011 for the registration of vehicles on the EU market, whereas the Euro 6 standard will be effective from 1 September 2014 for the approval of vehicles, and from 1 January 2015 for the registration and sale of new types of cars.

The Regulation applies to all passenger vehicles, vans, and commercial vehicles intended for the transport of passengers or goods or certain other specific uses (for example ambulances) weighing less than 2 610 kg. It limits emissions of carbon monoxide (CO), non-methane hydrocarbons and total hydrocarbons, nitrogen oxides (NO_X) and particulates (PM). It covers tailpipe emissions, evaporative emissions and crankcase emissions. There are different limits for (1) diesel vehicles and (2) petrol, natural gas and LPG vehicles. In addition, it sets requirements for the durability of pollution control devices.

The introduction of the Euro 6 standard will require substantial reductions of emissions of nitrogen oxides for all vehicles equipped with diesel engines. For example, NO_X emissions from diesel passenger vehicles will be capped at 80 mg/km (an additional reduction of more than 50% compared to the Euro 5 standard). Combined emissions of hydrocarbons and nitrogen oxides will be capped at 170 mg/km for diesel passenger vehicles (compared to 230 mg/km under Euro 5).

However, the impact of implementing Euro 5 and Euro 6 standards on CO_2 emissions will be very low. Some air pollutant abatement technologies (such as lean NOx trap

420 Impact Assessment accompanying the document Proposal for a Directive of the European Parliament and of the Council amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources. SWD(2012) 343 final.

421 OJ L 199, 28.7.2008, p. 1.

catalysts) could have a negative impact on fuel efficiency and CO_2 emissions. Other technologies (such as SCR catalysts) and overall improvements in energy design could improve fuel efficiency. It is broadly expected that the impact of the Euro 6 standards will not lead to a change in fuel efficiency. Overall the implementation of Euro 5 standards for light vehicles is expected to provide a small reduction of CO_2 emissions by 2020 (2 Mt of CO_2 equivalents by 2020). The implementation of Euro 6 standards is expected to deliver no discernible impact on CO_2 emissions relative to Euro 5.[422]

4.4.9. Euro VI Standard for heavy duty vehicles (Regulation (EC) No 595/2009)

Commission Regulation (EC) No 595/2009 of the European Parliament and of the Council of 18 June 2009 on type-approval of motor vehicles and engines with respect to emissions from heavy duty vehicles (Euro VI) and on access to vehicle repair and maintenance information and amending Regulation (EC) No 715/2007 and Directive 2007/46/EC and repealing Directives 80/1269/EEC, 2005/55/EC and 2005/78/EC[423] was adopted on 18 June 2009 and will apply from 31 December 2013. The regulation intends to reduce harmful exhaust emissions, including ozone precursors such as nitrogen oxides and hydrocarbons as well as particles. It replaces both the "Euro IV" limits (applied since November 2006), and the "Euro V" emission limits (applied since October 2008).

The Regulation provides harmonized technical rules for trucks, lorries and buses (heavy vehicles over 2 610 kg) for type approval and standards for the durability of pollution control devices. Among other things, it sets a limit value for total nitrogen oxides (NOx), which is 460 mg/kWh (80% less compared with Euro V), and the agreed particle mass limit which amounts to 10 mg/kWh - a 66% reduction compared with the Euro V stage limits.[424]

The impacts of implementing Euro VI standards on CO_2 emissions are very low. Tighter emission limits could have both direct and indirect effects on fuel consumption and greenhouse gas emissions. The direct impact is due to some forms of engine technology and after-treatment resulting in slightly higher CO_2 emissions in comparison with the Euro V stage. Given the nature of emission limits under consideration, and the likely technologies used to reach these limits, a small direct negative impact on CO_2 could be expected. According to the Regulation's impact assessment[425], it is expected that fuel consumption could be maintained close to the level in Euro V in the long term.

In relation to heavy duty vehicles, the European Commission presented a proposal for an amendment of Directive 96/53/EC laying down maximum authorised dimensions in national and international traffic[426]. This proposal intends, among other things, to grant derogations from the maximum dimensions of vehicles for the addition of aerodynamic devices to the rear of vehicles or to redefine the geometry of the cabs for tractors, leading to the reduction of fuel consumption and greenhouse gas emissions.

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422 Impact Assessment for Euro 6 emission limits for light duty vehicles. http://ec.europa.eu/enterprise/automotive/pagesbackground/pollutant_emission/impact_assessment_euro6.pdf.

423 OJ L 188, 18.7.2009, p.1.

424 http://europa.eu/rapid/press-release_IP-08-1982_en.htm?locale=en

425 Annex to the Proposal for a Regulation of the European Parliament and of the Council on the approximation of the laws of the Member States with respect to emissions from on-road heavy duty vehicles and on access to vehicle repair information, Impact Assessment. SEC(2007) 1718.

426 Proposal for a Directive of the European Parliament and of the Council amending Directive 96/53/EC of 25 July 1996 laying down for certain road vehicles circulating within the Community the maximum authorised dimensions in national and international traffic and the maximum authorised weights in international traffic. COM(2013) 195 final.

4.4.10. Environmental performance requirements for motor vehicles and tyres (Regulations (EC) 661/2009, (EC) 1222/2009, EC 1235/2011, EC 228/2011 and (EU) 65/2012)

Regulation (EC) No 661/2009 of the European Parliament and of the Council of 13 July 2009 concerning type-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units intended therefore[427] entered into force on 20 August 2009. The regulation integrates both environmental and safety requirements for type approval of motor vehicles and tyres. It applies to vehicles of passenger transport (category M), transportation of goods (category N) and trailers (category O).

The fuel efficiency of motor vehicles shall be increased by introducing tyre pressure monitoring systems and gear shift indicators. Tyre pressure monitoring systems shall be mandatory only for passenger cars and provide the driver with information on the pressure of tyre over time.

Furthermore, tyres have to meet requirements regarding their safety, rolling resistance and rolling noise emissions. Manufacturers shall guarantee that all new vehicles sold on the market have to comply with the requirements of this regulation.

Regulation (EC) No 1222/2009 of the European Parliament and of the Council of 25 November 2009 on the labelling of tyres with respect to fuel efficiency and other essential parameters[428] entered into force on 1 November 2012. The objective is to influence energy demand by promoting the market transformation towards fuel-efficient tyres, also known as low-rolling resistance tyres (LRRT). The labelling shall inform consumers about fuel efficiency, wet grip and external rolling noise. It will complement the type approval legislation on tyres that addresses the supply side by means of minimum requirements for tyre manufacturers. Tyre suppliers must provide this information by using a scale so that it is clearly visible on the product. The scale ranges from A (best) to G (bad) and is available for the fuel efficiency class and the wet grip class. Information on the external rolling noise value is indicated in decibels.

For fuel efficiency/rolling resistance the labelling class must be determined according to the scale specified in Annex I to the Regulation and measured in accordance with Annex 6 of UNECE Regulation No 117 and its subsequent amendments and aligned according to the procedure laid down in Commission Regulation (EU) No 1235/2011[429] amending Regulation (EC) No 1222/2009. For wet grip of C1 tyres (passenger cars), the test method is contained in the Commission Regulation (EU) No 228/2011[430] amending the Regulation (EC) No 1222/2009; for C2 and C3 tyres (light commercial vehicles and heavy duty vehicles respectively), the test method is contained in the Commission Regulation (EU) No 1235/2011 amending the Regulation (EC) No 1222/2009 (with reference to ISO15222 standard). Noise tests have to be performed in accordance with UNECE Regulation No 117.

Good quality tyres can reduce fuel consumption significantly as they account for 20 to 30% of fuel consumption. According to the impact assessment made when proposing

427 OJ L 200, 31.7.2009, p.1.

428 OJ L 342, 22.12.2009, p. 46.

429 OJ L 317, 30.11.2011, p. 17

430 OJ L 62, 9.3.2011, p. 1

these new regulations, the total CO_2 emission savings from all vehicle types are expected to range from 1.5 to 4 million tonnes annually by 2020.[431]

The equipment of manual gearbox vehicles with gear shift indicators is regulated by Commission Regulation (EU) 65/2012 implementing Regulation (EC) No 661/2009 of the European Parliament and of the Council as regards gear shift indicators and amending Directive 2007/46/EC of the European Parliament and of the Council[432]. The technical CO_2 reduction potential of gear shift indicators is estimated at 6% in case of 100% utilization rate[433].

4.4.11. Infrastructure charges for heavy goods vehicles

Directive 1999/62/EC of the European Parliament and of the Council of 17 June 1999 on the charging of heavy goods vehicles for the use of certain infrastructures[434] and its two amendments[435,436] set common rules on distance-related (tolls) and time-based (vignettes) road user charges for heavy goods vehicles. These rules stipulate how and to what extent the cost of construction, operation, maintenance and development of the infrastructure as well as the costs of traffic-related noise and air pollution can be borne (through tolls and vignettes) by road users.

The Directive lays down certain rules to be observed by Member States. Tolls must include an "infrastructure charge", which cannot exceed what is necessary to recover the costs of construction, maintenance,repair and operation of the tolled infrastructure; since the most recent amendment to the Directive, tolls may also include an "external cost charge" which reflects the cost of air pollution and/or noise pollution, provided that the external cost charges respect maximum values defined in Annex IIIb to the Directive.

Evaluation studies that have been published on the tolling systems in several EU Member States suggest that road freight transport is sensitive to changes in transport prices and that the relevant actors respond to the price signals given by the tolls. Statistics on freight transport in two Member States show that the introduction of the tolls coincided with a decrease in the average distance travelled by trucks, notably resulting from the optimisation of road transport itself (reduction of empty running, increase in load factors).(see ex-post evaluation of the Directive[437]) While, in the same two countries, increase in rail freight transport activity has also been observed, it is difficult to establish a direct and general relationship between the introduction of road tolls and modal shift from road to other transport modes.

4.4.12. Clean Power for Transport package including the deployment of alternative fuel infrastructure

On 24 January 2013, the European Commission presented a Communication laying out a comprehensive European alternative fuels strategy[438] for the long-term substitution of

431 Commission staff working document - Accompanying document to the proposal for a directive of the European Parliament and of the Council on labelling of tyres with respect to fuel efficiency and other essential parameters - Impact assessment SEC(2008) 2860, p. 56.

432 OJ L 28, 31.1.2012, p. 24.

433 Progress report on implementation of the Community's integrated approach to reduce CO2 emissions from light-duty vehicles, COM(2010) 656 final.

434 OJ 187, 20.7.1999, p. 42.

435 Directive 2006/38/EC of the European Parliament and of the Council of 17 May 2006 amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures. OJ L 157, 9.6.2006, p.8.

436 Directive 2011/76/EC of the European Parliament and of the Council of 27 September 2011 amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures OJ L 267, 14.10.2011, p.1.

437 Ex-post evaluation of Directive 1999/62/EC, as amended, on the charging of heavy goods vehicles for the use of certain infrastructures. Commission staff working document SWD(2013) 1 final.

438 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Clean Power for Transport: A European alternative fuels strategy, COM (2013) 17 final.

oil as energy source in all modes of transport and a proposal for a Directive on the deployment of alternative fuels infrastructure[439]. The Directive requires Member States to adopt national policy frameworks for the market development of alternative fuels and their infrastructure, sets binding targets for the build-up of alternative fuel infrastructure, including common technical specifications, and defines the method of fuel labelling at refuelling points and on vehicles to ensure clarity in the consumer information on vehicle/fuel compatibility.

Minimum infrastructure shall be provided, differentiated according to needs and technological maturity, for electricity, hydrogen, and natural gas (in gaseous form as Compressed Natural Gas (CNG), and in liquid form as Liquefied Natural Gas (LNG):

- Electricity: 8 million charging stations for 4 million EVs with 10% publicly accessible. Individual MS binding target level calculated on car stock, urbanisation rate and EV stock. Total cost: € 8 billion. Infrastructure put in place by 31 December 2020. Common standard for Type 2 (AC) and Type 2 Combo (DC).
- Hydrogen: MS which already have hydrogen infrastructure in place at the date of entry into force of the directive shall ensure a sufficient number of publicly accessible refuelling stations available, not exceeding 300 km, to allow circulation of hydrogen vehicles within the entire national territory by 31 December 2020 at the latest. Total cost: € 230 million.
- LNG for Road Transport: One station every 400 km in the TEN-T Core Network which is publicly accessible. Total cost: € 60 million.
- CNG: MS shall ensure that a sufficient number of publicly accessible refuelling points are available, with a maximum distance of 150 km, to allow the circulation of CNG vehicles union-wide by 31 December 2020. Total cost: € 164 million.
- LNG for Waterborne Transport: MS shall ensure that publicly accessible LNG refuelling points for maritime and inland waterway transport are provided in all of the maritime ports of the TEN-T core network by 31 December 2020 and in all inland ports of the core network by 31 December 2025. Total cost: € 2 billion.

Modelling carried out in the course of the impact assessment[440] for the proposed Directive suggests that the proposed measures will reduce CO_2 emissions from transport by up to 0.3% in 2020 and by up to 4.6% in 2050, compared to the baseline scenario. With this initiative the Commission intends to provide a sufficient infrastructure network for alternative fuels across the EU. The availability of infrastructure will enhance the take-up of the alternative fuelled transport systems market and the competitiveness of the European industry, so as to promote economic growth and employment. The initiative also aims to break the dependence on oil and contribute to the achievement of the **60% GHG** emission reduction target of the transport sector by 2050.

439 Proposal for a Directive of the European Parliament and of the Council on the deployment of alternative fuels infrastructure, COM(2013) 18 final.

440 Impact assessment accompanying the document „Proposal for a Directive on the deployment of alternative fuels infrastructure“, Commission staff working document, SWD(2013) 5 final.

4.4.13. Clean Vehicles Directive (2009/33/EC)

Directive 2009/33/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of clean and energy-efficient road transport vehicles[441] aims at a broad market introduction of environmentally-friendly vehicles. The Directive requires that energy and environmental impacts linked to the operation of vehicles over their whole lifetime, including CO_2 emissions, are taken into account in public procurement decisions. This also applies to contracting entities as defined by the public procurement Directives and to public transport operators as defined by the Regulation on public passenger transport service.

The Directive requires that lifetime operational energy consumption, emissions of carbon dioxide (CO_2), and emissions of oxides of nitrogen (NO_X), non-methane hydrocarbons (NMHC) and particulate matter (PM) are taken into account. For the first time the Clean Vehicle Directive has thereby introduced sustainability obligations into public procurement law for the whole EU.

Two options are offered to meet the requirements: setting technical specifications for energy and environmental performance, or including energy and environmental impacts as award criteria in the purchasing procedure. If the impacts are monetised for inclusion in the purchasing decision, common rules shall be followed, as defined in the Directive for calculating the lifetime costs linked to the operation of vehicles.

The Directive is expected to result in a wider deployment of clean and energy efficient vehicles in the longer term. Increased sales will help reduce costs through economies of scale, resulting in progressive improvement in the energy and environmental performance of the whole vehicle fleet.

The impact assessment of the Clean Vehicles Directive proposal[442] showed that public procurement of clean efficient vehicles will result in savings of up to 1.9 million tonnes of CO_2 emissions per year in 2017 compared to the baseline scenario.

The first report on the application of the Directive[443] was published by the Commission on 18 April 2013. However, delayed transposition of the Clean Vehicle Directive by most Member States and lack of reporting obligations hampered this first assessment. Thus, it has not yet been possible to undertake verification of the impacts foreseen in the impact assessment.

4.4.14. Roadmap to a Single European Transport Area

The Commission periodically reviews EU transport policy in white papers, which take a global look at the developments in the transport sector, its future challenges and the policy initiatives that need to be considered. The first white paper in 1992 was essentially dedicated to market opening, while the 2001 white paper focused on managing transport growth by a more balanced use of all transport modes.

Based on an evaluation of developments in the recent past and on an assessment of current trends in the accompanying impact assessment[444], the latest white paper of

441 OJ L 120, 15.5.2009, p.5.

442 Gargani, F. (2007): Impact assessment on a new approach for the Cleaner and More Energy Efficient Vehicles Directive Proposal, PriceWaterhouseCoopers Advisory.

443 Report from the Commission (…) on the application of Directive 2009/33/EC on the promotion of clean and energy efficient road transport vehicles, COM 2013(214).

444 Impact Assessment - Accompanying document to the White Paper Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. SEC(2011) 358 final.

2011[445] "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system" indicates that the EU transport system has already improved in many ways (e.g. further market openings, increased security, and passenger rights) but there is no structural change to reduce oil dependency and GHG emissions in the transport sector. Commission modelling analysis has shown that transport should reduce its GHG emissions in 2050 by around 60% below 1990 levels to meet the objectives of the climate policy. However, considering business as usual, the emissions in 2030 are expected to be 25% higher than in 1990.

The 2011 White Paper, which forms an integral part of the "Resource Efficiency" initiative of the Commission, defines a long-term strategy to achieve a competitive and resource efficient transport system and presents a set of 10 goals to achieve the 60 % GHG emission reduction target for 2050. These goals can be grouped into three categories:

- Developing and deploying new and sustainable fuels and propulsion systems
- Optimising the performance of multimodal logistic chains, including by making greater use of more energy-efficient modes
- Increasing the efficiency of transport and of infrastructure use with information systems and market-based incentives

Implementing this long-term strategy requires an efficient framework for transport users and operators, an early deployment of new technologies and the development of adequate infrastructure. The white paper aims at a transport system with better integration between modes, fewer barriers to market entry, less dependency on oil and coherent infrastructure design. ICT and clean vehicles have been indicated as technical priorities, as well as the need for smarter pricing of infrastructure usage and better exploitation of rail transport. To achieve this, the white paper puts forward a list of 40 concrete initiatives for the next decade in four key areas:

- Internal market: Create a genuine Single European Transport Area by eliminating all residual barriers between modes and national systems.
- Innovation: EU research needs to address the full cycle of research, innovation and deployment in an integrated way.
- Infrastructure: EU transport infrastructure policy needs a common vision and sufficient resources. The costs of transport should be reflected in its price in an undistorted way.
- International: Opening up third country markets in transport services, products and investments continues to have high priority.

The Commission will prepare appropriate legislative proposals until 2020. Two years after adoption of the white paper, the Commission has already adopted significant proposals on about half of the initiatives.

445 White Paper - Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. COM(2011) 144 final.

4.4.15. *International maritime transport*

On 28 June 2013, the European Commission adopted a Communication[446] setting out a strategy for progressively including greenhouse gas emissions from maritime transport in the EU's policy for reducing its overall emissions. The strategy consists of the following consecutive steps:

- Establishing a system for monitoring, reporting and verifying (MRV) of CO_2 emissions;
- Setting reduction targets for the maritime transport sector;
- Applying further measures, including market-based instruments, in the medium to long term.

Relating to the first of these three steps, the Commission proposed a Regulation[447] establishing an EU-wide MRV system for large ships. This system would cover all ships over 5 000 gross tons that use EU ports, irrespective of where the ships are registered.

According to the proposed Regulation, ship owners will have to monitor and report the verified amount of CO_2 emitted by their ships on voyages to, from and between EU ports, Owners will also have to provide certain other information, such as data to determine the ships' energy efficiency.

It is proposed that the rules apply from 1 January 2018. They are designed to support a staged approach towards setting global energy efficiency standards for existing ships, as supported by several members of the International Maritime Organisation.

In an impact assessment[448] accompanying the proposal, several policy options – from an MRV system to levies and to emission trading schemes – were assessed. Under the MRV option, CO_2 emissions from the maritime transport sector are expected to be 2% lower than the baseline in 2030. Various levy options are expected to result in in-sector emission reductions of up to 16% by 2030, and a maritime emission trading scheme and an emissions reduction fund are expected to deliver emission reductions of 16 to 21% by 2030, compared to the baseline. These reductions are equivalent to an emission reduction of up to 10 % by 2030 compared to 2005 levels.

Given the large cost-effective abatement potential of the sector, the above mentioned emission reductions would lead to net cost savings for the maritime transport sector of up to € 12 billion per year (in 2030) for the EU scope. Other expected impacts are the creation of additional jobs in ship yards and the maritime supply industry as well as health benefits due to reduced emissions of SO_X, NO_X and particulate matter.

4.4.16. *Policies and measures no longer in place*

There are no policies and measures (PaMs) no longer in place in the transport sector but there are directives and regulations included in the NC5 which have been replaced/repealed by new EU legislation. *Table [BR1] 4-3* shows the correspondence

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446 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Integrating maritime transport emissions in the EU's greenhouse gas reduction policies. COM(2013) 479 final.

447 Proposal for a Regulation of the European Parliament and of the Council on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport and amending Regulation (EU) No 525/2013. COM(2013) 480 final.

448 Impact Assessment – Part 1 Accompanying the document Proposal for a Regulation of the European Parliament and of the Council on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport and amending Regulation (EU) No 525/2013. Commission staff working document SWD(2013) 237 final/2.

between "old" legislation and "new" legislation. Note that sometimes the content of the old legislation has been updated in more than one new piece of legislation. In this case the table includes the reference to the "main" new piece of legislation which replaces/repeals the old piece of legislation.

Table [BR1] 4-3 PaMs included in NC5 and corresponding PaMs included in NC6

PaM listed in NC5	**Corresponding PaM in NC6**
TR1 - Directive on promotion of biofuels (Directive 2003/30/EC)	Renewable Energy Directive (2009/28/EC)
TR2 - Fuel Quality Directive (Directive 2009/30/EC)	Fuel Quality Directive (2009/30/EC)
TR3 - (New) Renewable Energy Directive (Directive 2009/28/EC) (transport measures)	Renewable Energy Directive (2009/28/EC)
TR4 - Taxation of energy products and Electricity (Directive 2003/96/EC)	Moved to chapter on cross-cutting PaMs
TR5 - Infrastructure charging for heavy goods vehicles (Directive 2006/38/EC)	Infrastructure charging for heavy goods vehicles (Directive 2011/76/EU)
TR6 - Voluntary agreements with European, Japanese and Korean car manufacturers	Regulation on CO_2 emissions from cars (443/2009)
TR7 - Strategy for car CO_2 & Regulation (EC) No 443/2009	Strategy to reduce CO_2 from passenger cars and light-commercial vehicles (COM/2007/19) Regulation on CO_2 emissions from cars (443/2009)
TR8 - EURO 5&6 standards (Regulation (EC) No 715/2007)	Euro 5 and 6 Standards (Regulation (EC) No 692/2008) Euro VI Standard for heavy duty vehicles (Regulation (EC) No 595/2009)
TR9 - Tyre Labelling	Environmental performance requirements for motor vehicles and tyres (Regulations (EC) 661/2009, (EC) 1222/2009, EC 1235/2011, EC 228/2011 and (EU) 65/2012)
TR10 - Rolling Resistance Tyres (Regulation (EC) No 1222/2009)	
TR11 - Thematic Strategy on Urban Environment	Roadmap to a Single European Transport Area
TR12 - Directive on the promotion of clean and energy efficient road transport vehicles (Directive 2009/33/EC)	Clean Vehicles Directive (2009/33/EC)
TR13 - Freight Logistics Action Plan	Roadmap to a Single European Transport Area
TR14 - Aviation EU ETS (Directive 2008/101/EC)	Moved to chapter on cross-cutting PaMs
TR15 - Emissions from air conditioning systems in motor vehicles (Directive 2006/40/EC)	Moved to industry chapter

4.5. Sectoral policies and measures: Industrial processes

4.5.1. Overview

The following policies and measures are covered in this section:

- Regulation on certain fluorinated greenhouse gases (EU F gas Regulation No. 842/2006)
- Proposed revision of the F-Gas Regulation
- Emissions from air conditioning systems in motor vehicles (MAC-Directive 2006/40/EC)
- Industrial Emission Directive (2010/75/EU)
- Ecodesign Framework Directive (Directive 2009/125/EC)

The EU Emissions Trading Scheme is covered in section 4.2.2.

An overview table of these measures including information on their impact on CO_2 emissions can be found in CTF Table 3 in the CTF Appendix.

4.5.2. Regulation on certain fluorinated greenhouse gases (EU F-gas Regulation No 842/2006)

To control emissions from F-gases the European Union adopted two legislative acts in 2006: the Directive 2006/40/EC of the European Parliament and of the Council of 17 May 2006 relating to emissions from air conditioning systems in motor vehicles and amending Council Directive 70/156/EEC[449] (further referred to as MAC Directive), and the Regulation (EC) No. 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenhouse gases[450] (further referred to as F-gas Regulation). The objective of the F-Gas Regulation is to contain, prevent and thereby reduce emissions of fluorinated greenhouse gases covered by the Kyoto Protocol. The F-gas Regulation follows two tracks of action:

- Improving the prevention of leaks from equipment containing F-gases. Measures comprise: containment of gases and proper recovery of equipment; training and certification of personnel and of companies handling these gases; labelling of equipment containing F-gases; reporting on imports, exports and production of F-gases (Articles 3, 4, 5, 6 and 7).
- Avoiding F-gases in some applications for which environmentally superior alternatives are cost-effective. Measures include restrictions on the placing on the market of certain products and equipment containing F-gases and certain use restrictions (Articles 8 and 9).

The Regulation has been supplemented by ten implementing acts or "Commission Regulations", which stipulate amongst other things reporting format, form of labels, standard leaking checking requirements, training of companies and personnel. Furthermore, reporting provisions have been introduced to facilitate monitoring of the Regulation's measures and ensure that its objectives are being met.[451]

449 OJ L 161, 14.6.2006, p.12.

450 OJ L 161, 14.6.2006, p.1.

451 Commission Regulation (EC) No 1493/2007 of 17 December 2007, OJ L 332, 18.12.2007

In 2012 the European Commission proposed a revision of the F-gas Regulation to tighten its requirements (section 4.5.34.5.3).

In 2011 a study was published assessing the effectiveness of the F-Gas regulation[452] summarised in a Communication of the Commission[453]. It was found that the use and marketing restrictions (Articles 8 and 9) introduced by the Regulation achieved emission reductions of close to 3 million tonnes of CO_2 equivalents by the end of 2010. However, the potential for further reductions in the applications covered by those restrictions is almost exhausted (section 4.1).

The evaluation of the effects of the containment and recovery provisions (Articles 3 and 4) was hampered by a lack of reliable and sufficiently long time-data series (at the time of study, i.e. 2010); however, a significant reduction of the leakage rates of affected equipment prior to 2010 seemed unlikely. If fully applied, a substantial reduction of leakage rates during the operation and end-of-life of affected equipment is expected, leading to emissions savings (section 4.1).

Table [BR1] 4.4 Achieved (by 2010) and expected emission reductions due to F-gas Regulation and MAC Directive (in kt CO_2 eq).

		2008	2009	2010	2015	2020	2030	2050
MAC Directive		0	0	0	3 419	13 150	40 965	49 916
F-Gas Regulation	Art 3 and Art 4	0	0	0	24 357	29 478	35 609	38 815
	Art 8 and Art 9	909	2 687	2 861	3 012	3 223	3 750	4 616
Total		**909**	**2 687**	**2 861**	**30 787**	**45 850**	**80 325**	**93 347**

Source: Öko-Recherche GmbH et al., 2011: Preparatory study for a review of Regulation (EC) No. 842/2006 on certain fluorinated greenhouse gases

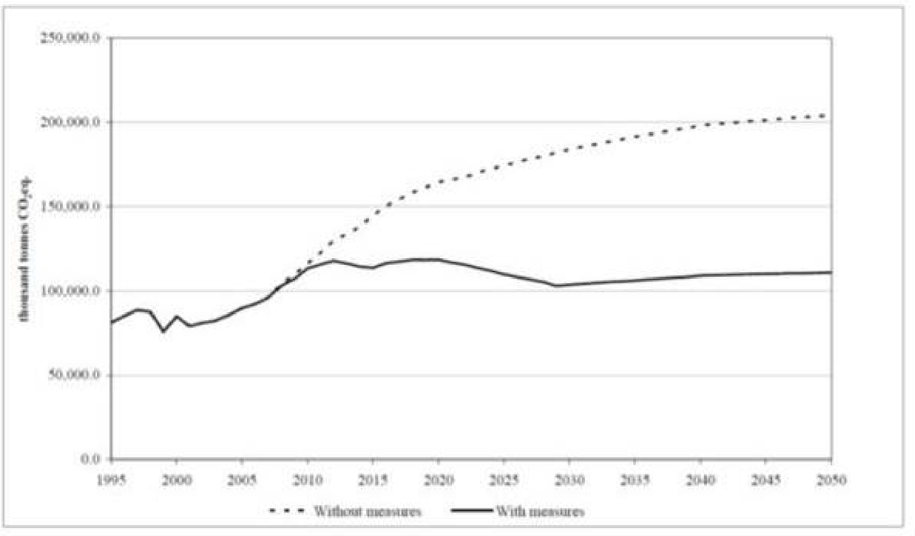
Commission Regulation (EC) No 1494/2007 of 17 December 2007, OJ L 332, 18.12.2007
Commission Regulation (EC) No 1516/2007 of 19 December 2007, OJ L 335, 20.12.2007
Commission Regulation (EC) No 1497/2007 of 18 December 2007, OJ L 333, 19.12.2007
Commission Regulation (EC) No 303/2008 of 2 April 2008, OJ L 92, 3.4.2008
Commission Regulation (EC) No 304/2008 of 2 April 2008, OJ L 92, 3.4.2008
Commission Regulation (EC) No 305/2008 of 2 April 2008, OJ L 92, 3.4.2008
Commission Regulation (EC) No 306/2008 of 2 April 2008, OJ L 92, 3.4.2008
Commission Regulation (EC) No 307/2008 of 2 April 2008, OJ L 92, 3.4.2008
Commission Regulation (EC) No 308/2008 of 2 April 2008, OJ L 92, 3.4.2008

452 Öko-Recherche GmbH et al., 2011: Preparatory study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases. http://ec.europa.eu/clima/policies/f-gas/docs/2011_study_en.pdf

453 Report from the Commission on the application, effects and adequacy of the Regulation on certain fluorinated greenhouse gases (Regulation (EC) No 842/2006). COM(2011) 581. http://ec.europa.eu/clima/policies/f-gas/docs/report_en.pdf

Figure [BR1] 4-4 shows past and projected F-gas emissions in the EU without and with measures laid down in the F-gas Regulation and the MAC Directive. Without the legislation, emissions would have grown to twice the levels seen today, while the legislation will keep emission levels stable at ca. 110 million CO_2 eq.

Figure [BR1] 4-4 Projections of F-gas emissions in the EU without and with the measures in the F-gas Regulation and the MAC Directive.



Source: Öko-Recherche GmbH et al., 2011: Preparatory study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases

With regard to the cost-effectiveness of the F-gas Regulation, abatement costs of 40.8 €/t CO_2 eq by 2015 and 41.0 €/t CO_2 eq by 2030 have been calculated on the basis of the existing legislation. Total costs for and from the implementation and application of the F-gas Regulation were estimated for industry, operators and authorities.

4.5.3. Proposed revision of the F-Gas Regulation

The current F-gas Regulation mainly focuses on reducing emissions of F-gases during the lifetime of equipment and its end-of-life treatment while it hardly restricts the use of F-gases in new equipment. At the same time, alternatives to F-gases that are safe and energy-efficient are already available today in nearly all fields of application.[454]

In November 2012 the European Commission proposed a revision[455] of the F-gas Regulation that would tighten its requirements. This was preceded by a review of the adequacy of the Regulation[456], a public consultation in 2011 and an open stakeholder conference in 2012 on options for strengthening EU measures to reduce F-gas emissions in order to contribute to the transition to a low-carbon economy.

The new proposal anticipates bold steps to limit the use of F-gases in new equipment. The main new element is a phase-down measure that from 2015 would limit the total amount of HFCs that can be sold in the EU stepwise in order to reach one fifth of today's sales by 2030. In addition, F-gases would be banned in some equipment, such as

454 Öko-Recherche GmbH et al., 2011: Preparatory study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases.

455 Proposal for a Regulation of the European Parliament and of the Council on fluorinated greenhouse gases, COM (2012) 643 final, Brussels

456 Report from the Commission on the application, effects and adequacy of the Regulation on certain fluorinated greenhouse gases (Regulation (EC) No 842/2006), COM(2011) 581 final

household fridges, for which less harmful alternatives are widely available on the market today.

Existing legal requirements, such as the control of leaks, proper servicing of equipment and recovery of the gases at the end of the equipment's life are maintained and strengthened in the new proposal.

The proposal, mostly due to the phase-down approach, would save a further 72 Mt CO_2 eq by 2030 or two-thirds of today's emissions[457]. Cumulatively, an additional 625 million CO_2 eq would be saved from 2015 until 2030 (in addition to the savings resulting from existing legislation).

Overall effects on GDP (max. +/- 0.006%) and employment would be small. Administrative costs would be kept relatively low (total administrative costs of around € 2 million a year for a phase-down). This is because the reporting scheme under Regulation (EC) No. 842/2006 already provides most of the data needed to implement any policy options in the future. Average abatement costs are low (16 €/t CO_2 eq).

4.5.4. Emissions from air conditioning systems in motor vehicles (MAC-Directive 2006/40/EC)

Directive 2006/40/EC of the European Parliament and of the Council of 17 May 2006 relating to emissions from air conditioning systems in motor vehicles and amending Council Directive 70/156/EEC[458] aims at reducing emissions of specific fluorinated greenhouse gases in the air-conditioning systems fitted to passenger cars and light commercial vehicles.

The main objectives of the Directive are:

- the control of leakage of fluorinated greenhouse gases with a global warming potential (GWP) higher than 150 in MACs;
- the prohibition of MACs using those gases from a certain date onwards

The MAC Directive lays down the requirements for the EC type approval or national type-approval of vehicles as regards emissions from, and the safe functioning of, air-conditioning systems fitted to vehicles. It also stipulates provisions on retrofitting and refilling of such systems.

The Directive is enforced in two phases:

- The first phase: since 21 June 2008 manufacturers have been unable to obtain a type approval for a new type of vehicle if fitted with MACs designed to contain F-gases with a GWP higher than 150 leaking more than 40 grams per year (one evaporator systems) and 60 grams per year (dual evaporator systems). As of 21 June 2009 this also applies to all new vehicles having been type-approved in the past.
- The second phase is the complete ban of MACs designed to use the above mentioned gases. This ban has been effective in principle for new types of vehicles (the manufacturers are unable to obtain a type approval for a new type

457 Executive summary of the impact assessment “Review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases”, SWD (2012) 363 final.

458 OJ L 161, 14.6.2006, p.12.

of vehicle if it is fitted with this kind of systems) since 1 January 2011 and will be effective for all new vehicles from 1 January 2017. From that date onwards, new vehicles with these systems cannot be registered or sold, nor enter into service.

The MAC Directive is expected to achieve substantial emission reductions of approx. 13 million tonnes CO_2 equivalents by 2020 and almost 50 million tonnes by 2050.

4.5.5. Industrial Emissions Directive (2010/75/EU)

In December 2007 the Commission proposed a package (Communication[459] and Proposed Directive[460]) to streamline and improve the existing EC policy on industrial emissions. Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control[461] (further referred to as Industrial Emissions Directive – IED) entered into force on 6 January 2011 and had to be transposed into national legislation by Member States by 7 January 2013.

The directive is a recast of seven existing pieces of legislation aiming at achieving significant benefits to the environment and human health by reducing polluting emissions to the atmosphere, water and soil, as well as waste from industrial and agricultural installations across the EU, in particular through better application of Best Available Techniques (BAT).

As of 7 January 2014 the Industrial Emissions Directive will replace:

- Directive 78/176/EEC on titanium dioxide industrial waste
- Directive 82/883/EEC on the surveillance and monitoring of titanium dioxide waste;
- Directive 92/112/EEC on the reduction of titanium dioxide industrial waste;
- Directive 1999/13/EC on reducing emissions of volatile organic compounds (VOCs);
- Directive 2000/76/EC on waste incineration;
- Directive 2008/1/EC concerning integrated pollution prevention and control.

As of 7 January 2016 the Industrial Emissions Directive will replace:

- Directive 2001/80/EC on the limitation of emissions of certain pollutants from large combustion plants.

The directive focuses on an integrated approach to prevention and control of emissions into air, water and soil, to waste management and to accident prevention. Greenhouse gas emissions will be affected by the use of techniques increasing energy efficiency.

The IED is the successor directive of the IPPC Directive, which aims at minimizing pollution from various industrial sources throughout the European Union. The directive addresses operators of more than 50 000 industrial installations (combustion plants (≥ 50 MW), waste incineration or co-incineration plants, certain installations and activities

459 Towards an improved policy on industrial emissions. COM(2007) 843 final.

460 Proposal for a Directive of the European Parliament and of the Council on industrial emissions (integrated pollution prevention and control). COM(2007) 844 final.

461 OJ L 334, 17.12.2010, p.17.

using organic solvents, installations producing titanium dioxide) operating activities covered by Annex I of the IED (energy industries, production and processing of metals, mineral industry, chemical industry, waste management, rearing of animals, etc.). These operators are required to obtain an integrated permit from the competent authorities in the EU countries. The permits must take into account the whole environmental performance of the plant, covering, for example, emissions to air including emission limits for polluting substances, water and land, generation of waste, use of raw materials, energy efficiency, noise, prevention of accidents, and restoration of the site upon closure.

The directive will lead to significant benefits for the environment and human health by reducing harmful industrial emissions across the EU, in particular through better application of Best Available Techniques. For the large combustion plants alone it will achieve net benefits of € 7-28 billion per year, including the reduction of premature deaths and years of life lost by 13 000 and 125 000 respectively[462].

The IED affects climate change in two ways:

- directly by regulating non-CO_2 greenhouse gases (CH_4, N_2O, fluorinated gases) to the extent they are not covered by the ETS and short-lived climate forces such as black carbon; and
- indirectly through energy efficiency measures and by making fuel switch more attractive;

by addressing CO (weak direct greenhouse gas) and indirect greenhouse gases (NOx, SOx, NMVOC) which produce the tropospheric greenhouse gas ozone via photochemical reactions in the atmosphere. The impact of reduced air emissions on climate change is complex and manifold depending on the air pollutant. CO and NOx react with other gaseous species in the atmosphere to form ozone[463]. The reduction of particles such as sulphates, nitrates and organic carbon will reduce global dimming hence impacting negatively on climate change.[464] CO, NOx and VOCs reduce the life-time of CH_4 via fast photochemistry of the hydroxyl free radical of OH radicals. It is well established that urban air pollution control policies are beneficial for human health and downwind ecosystems. As far as ancillary benefits are concerned, calculations suggest that air pollution policies may have only a small influence, either positive or negative, on mitigation of global-scale climate change[465].

The streamlining of permitting, reporting and monitoring requirements as well as a renewed cooperation with Member States to simplify implementation will lead to a reduction of unnecessary administrative burden of between € 105 and € 255 million per year[466].

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462 Summary of the Impact Assessment accompanying the Proposal for a Directive of the European Parliament and of the Council on industrial emissions (integrated pollution prevention and control) (Recast). SEC(2007) 1682.

463 V. Ramanathan, Y. Feng (2009): Air pollution, greenhouse gases and climate change: Global and regional perspectives. Atmospheric Environment 43 (2009) 37–50.

464 Rob Swart, Markus Amann, Frank Raes, Willemijn Tuinstra (2004): A Good Climate for Clean Air: Linkages between Climate Change and Air Pollution. An Editorial Essay. Climatic Change, October 2004, Volume 66, Issue 3, pp 263-269.

465 Ronald G. Prinn et al. (2005): Effects of Air Pollution Control on Climate. MIT Joint Program on the Science and Policy of Global Change.

466 Summary of the Impact Assessment accompanying the Proposal for a Directive of the European Parliament and of the Council on industrial emissions (integrated pollution prevention and control) (Recast),SEC(2007) 1682.

4.5.6. *Ecodesign Directive (2009/125/EC)*

The Ecodesign Directive provides consistent EU-wide rules for improving the environmental performance of energy related products (ERPs).

For more details see section 4.3.11.

4.5.7. *Interlinkages*

The IED affects the waste and energy sector by reducing the amount of waste from industrial and agricultural installations. Maximising energy efficiency is a basic obligation for any industrial installation which carries out activities listed in Annex I to the Directive.

The proposal for a revised F-gas regulation also aims to ensure consistency in line with work the EU has conducted to encourage ecodesign and energy efficiency. Prohibitions of the placing on the market of specific products and equipment listed in Annex III of the proposed revised F-gas Regulation foresee an exemption for equipment based on lower lifecycle CO_2 emissions established by the ecodesign process.

4.5.8. *Policies and measures no longer in place*

Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control was repealed by Industrial Emission Directive (2010/75/EU) as of 7 January 2014 (cf. section 4.5.5).

4.6. Sectoral policies and measures: Agriculture

4.6.1. *Overview*

This chapter lists the most relevant climate change mitigation actions in the agriculture sector. The following areas of action are part of the Common Agricultural Policy (CAP):

- Agricultural Market and Income support (1st pillar of CAP)
- Rural Development Policy (2nd pillar of CAP)

In addition to the CAP, two environmental policy areas are described in this section, which are directly relevant to climate mitigation in agriculture:

- Soil Thematic Strategy
- Nitrates Directive

In addition to the policies and measures listed above, the Industrial Emissions Directive regulates the emissions of major pollution sources, including large agricultural facilities. For details on this Directive, please see section 4.5.5.

Agricultural land use is also included in LULUCF, please see section 4.7.

An overview of the measures can be found in CTF Table 3 in the CTF Appendix.

The European Common Agriculture Policy (CAP) is one of the main drivers of EU agricultural development. It was launched in 1962 and addresses many challenges: supporting food security, fair income for farmers, agricultural productivity, sustainable management of natural resources and climate change.

Since the eighties, the CAP has gone through a pathway of important reforms. The major ones are: 1984 (targeting surplus production), 1992 (shift from market support to producer support), Agenda 2000 (decoupling of support from production by introducing direct area payments granted to farmers on the condition of cross compliance[467]). The current policy framework for the period 2007-2013, reviewed in 2009, incorporates sustainability objectives, including mitigation efforts.

The CAP has two different set of policy instruments called pillars: the first one includes annual direct income support for farmers and measures aimed at better functioning of markets, the second pillar supports the development of rural areas on the basis on a multi-annual programming approach (rural development programmes) tailored to national and regional specificities.

In June 2013, a political agreement on the new legal framework for the CAP for the period 2014-2020 has been agreed on the basis of the proposals by the European Commission of October 2011[468]. The new CAP aims to achieve three basic objectives: viable food production, sustainable management of natural resources and climate action, and balanced territorial development of rural areas. The new CAP will further enhance the existing policy framework for sustainable management of natural resources on which agricultural activity depends, and which agricultural activity influences, contributing to both climate change mitigation and enhancing the resilience of farming to the threats posed by climate change and variability.

4.6.2. Agricultural Market and Income support (1st pillar of CAP)

Environmental considerations, including climate change mitigation, have been integrated into the CAP. The following actions under the first pillar, *inter alia*, contribute to reducing greenhouse gas emissions of the agriculture sector[469]:

- Cross-compliance links financial support via direct area payments to the respect of environmental and other regulatory standards, as well as the maintenance of agricultural land in Good Agricultural and Environmental Conditions (GAEC). Ensuring respect of Nitrates Directive provisions, protection of permanent grasslands, soil protection provisions, obligation to establish and maintain buffer strips along the water courses are important for reducing greenhouse gas emissions from agriculture and protecting organic carbon stocks in agricultural soils.
- Within the operational programmes in the fruit and vegetables sector, producers and producers' organisations can receive support for investments aimed at energy savings, generation and use of renewable energies, and introduction of co-generation systems.

At present, no comprehensive quantified estimates of the impact of current and future actions under the first pillar of the CAP on greenhouse gas emissions are available.

The recent reform of the CAP has introduced new elements contributing to a low emissions agriculture sector mainly a new mandatory 'greening' component of direct

467 Cross-compliance is a mechanism that links direct payments to compliance by farmers with basic standards concerning the environment, food safety, animal and plant health and animal welfare, as well as the requirement of maintaining land in good agricultural and environmental condition. (For further information see: http://ec.europa.eu/agriculture/envir/cross-compliance/index_en.htm,).

468 Legal proposals for the CAP after 2013: http://ec.europa.eu/agriculture/cap-post-2013/legal-proposals/index_en.htm; accessed 25 July 2013

469 The role of European agriculture in climate change mitigation. SEC(2009) 1093 final.

payments. In order to obtain up to 30% of direct payments farmers would be obliged from 2015 onwards to undertake certain environmental actions going beyond cross compliance requirements on their farms, such as protection of permanent pasture, respecting minimum crop diversification, and establishing "ecological focus areas" on at least 5% of the arable land. The “"ecological focus areas”" can include non-farmed land, green features such as for example hedges, groups of trees, ponds, or land in management beneficial for mitigation and production of renewable energies such as agro-forestry, unfertilised short rotation coppice or catch crops.

4.6.3. Rural Development (2nd Pillar of CAP)

The EU's rural development (RDP) has evolved as part of the further development of the CAP, from a policy dealing with the structural problems of the farming sector to a policy addressing the multiple roles of farming in society and, in particular, challenges faced in its wider rural context. The Agenda 2000 established rural development as the 2nd pillar of the CAP, to accompany the further reform of market policy[470].

Rural development represents the second pillar of the CAP, and receives at present about a fourth of the total budget allocated to the CAP.

Under a common legislative framework on support for rural development[471],Member States draw up and co-finance multiannual rural development programmes (RDPs), at national or regional level, choosing those measures that suit the needs of their rural areas best and taking into account EU priorities. These programmes are then approved by the Commission by means of an implementing act. Currently, the 2007-2013 rural development programmes (RDPs) are in final stages of implementation, with the completion of all the actions supported under the programmes foreseen for the end of 2015.

In the current RDPs, the following actions, *inter alia*, are the most important in terms of their contribution to reducing agricultural GHG and protecting and enhancing organic soil carbon stocks[472]:

- Incentives for reduction of CH_4 and NO_2 emissions are provided through support measures aimed at improving management of animal waste
- Measures supporting specific land management practices, mainly through agri-environmental schemes, targeted to more efficient use of fertilisers and to improved soil management are important for reducing nitrous oxide emissions. In addition, measures which support erosion prevention and build up of soil organic matter help reducing emissions from agricultural soils and contribute to soil carbon sequestration.
- Improvement of energy efficiency, renewable energy generation and use, including biomass, can be supported through investment measures available to farmers, small and medium enterprises in agri-food industry, and rural communities.

Forestry measures which are also supported through RDP are presented in section 4.7.2.

470 Factsheet The EU rural development policy 2007-2013, http://ec.europa.eu/agriculture/publi/fact/rurdev2007/en_2007.pdf,.

471 Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD)

472 The role of European agriculture in climate change mitigation, SEC(2009) 1093 final.

The legal framework for the EU Rural Development for 2014-2020 has been reviewed as part of the political agreement for the CAP reform (June 2013); the new generation of programmes will be based on the revised legal provisions. The priorities set for the policy framework reflect the increased importance of a more sustainable development of agricultural activities and rural areas, which two of them focused on environment and climate mitigation and adaptation objectives. The objectives of the new rural development support are:

- Foster knowledge transfer and innovation
- Enhance competitiveness of all types of agriculture
- Promote food chain organisation and risk management
- Restore, preserve and enhance ecosystems dependent on agriculture and forest
- Promote resource efficiency, low carbon and climate resilient agriculture
- Promote social inclusion, economic development in rural areas

The increased strategic emphasis on addressing climate change is the most important element of the future rural development, with mitigation and increasing resilience to climate change as a cross-cutting objective that needs to be considered across all priorities and actions. Similarly to the current period, the proposal for the 2014-2020 period[473] lists a number of individual measures from which Member States will be able to choose. The scope of the measures has been enlarged, with addition of new forms of support for cooperation in different areas (economic, environmental and social) between a wide range of potential beneficiaries, further incentives for actions undertaken by groups of farmers, and the horizontal priority of fostering knowledge and innovation, including action over climate change.

The Common Monitoring and Evaluation Framework of the EU Rural Development takes into account monitoring and evaluation of the measures addressing climate change, both mitigation and improving resilience of agriculture to the climate change and variability. Based on the results of monitoring of RDPs for the period 2007-2011 support for such measures was provided through RDPs on 31.8 million hectares, representing about 18% of the Total Agricultural Area of the EU. This includes the area supported through forestry measures under RDPs, see section 4.7.2.

The ex-post evaluation of the RDPs will estimate the total production of renewable energy from agriculture and forestry supported via RDPs, as well as change in the GHG emissions from agriculture. However, no comprehensive methodology allowing for accurate monitoring of only mitigation impact of the measures of the RDPs is available at present.

It is proposed that the Common Monitoring and Evaluation System set up for the whole of the CAP (both 1st and 2nd pillar) for the period 2014-20 will refine monitoring and evaluation of results of climate mitigation actions under this policy. E.g. for the RDPs further indicators are being developed, such as level of soil organic matter in arable soils, reduction in energy use by supported farms and enterprises, reduction in emissions

473 Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on support for rural development by the European Agricultural Fund for Rural Development (EAFRD). COM(2011) 627 final/2.

of methane and nitrate dioxide, and proportion of agricultural and forestry land subject to management measures contributing to carbon sequestration.

4.6.4. Soil Thematic Strategy

Soil is relevant for GHG emissions as a carbon pool that can act as a significant sink or source of carbon. The global soil carbon pool contains 1 500 gigatonnes (Gt) of soil organic and inorganic carbon. Many management interventions lead to a reduction of carbon stock and thus CO_2 emissions. Reducing these emissions can be a potent mitigation measure, and helps maintain soil productivity and resilience. Carbon sequestration in agricultural soils can also make an important contribution to climate change mitigation. Some sources estimate this to be around 2 Gt of carbon per year. As part of the Climate Change Programme, the potential of soils for carbon sequestration was estimated to be equivalent to 1.5-1.7% of the EU's anthropogenic CO_2 emissions during the first commitment period of the Kyoto Protocol[474].

The European Commission adopted a Soil Thematic Strategy in September 2006[475], which was preceded by an extensive consultation process which had started in 2002. The Strategy tackles the full range of threats associated with soil degradation and creates a common framework for the protection of soil.

The general objectives of the Soil Thematic Strategy are:

- Preventing further soil degradation and preserving the soil's functions:
  - when soil is used and its functions are exploited, action has to be taken for soil use and management patterns, and
  - when soil acts as a sink/receptor of the effects of human activities or environmental phenomena, action has to be taken at source.
- Restoring degraded soils to a level of functionality consistent at least with current and intended uses, thus also considering the cost implications of the restoration of soil.

In 2006 the European Commission presented a proposal for a Soil Framework Directive[476], which is still being negotiated. The main challenge is that soil protection is a cross-cutting issue and therefore integrated in different EU and national policies. At Member State level, approaches to soil protection vary from one country to another. The proposed Directive aims at establishing a common strategy for the protection and sustainable use of soil based on the principles of integration of soil concerns into other policies, preservation of soil functions within the context of sustainable use, prevention of threats to soil and mitigation of their effects, as well as restoration of degraded soils to a level of functionality consistent at least with the current and approved future use[477].

The Soil Thematic Strategy is based on four pillars[478]:

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474 Thematic Strategy for Soil Protection, Impact Assessment of the Thematic strategy on soil protection, SEC(2006)620, page 13.

475 Thematic Strategy for Soil Protection, Impact Assessment of the Thematic strategy on soil protection, SEC(2006)620.

476 Proposal for a Directive of the European Parliament and of the Council establishing a framework for the protection of soil and amending Directive 2004/35/EC, COM(2006) 232 final..

477 Factsheet: Soil- a key resource for the EU, European Commission, Brussels, September 2010.

478 Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, The implementation of the Soil Thematic Strategy and on-going activities, COM(2012) 46 final.

Press release, Commission calls for stronger response to soil degradation, European Commission, Brussels, 13th February 2013.

- Awareness raising: As soil degradation generally goes unnoticed, measures to raise awareness of soil functions and their fundamental importance are taken, which will help to ensure that soil protection will be considered in all actions that are taken.
- Research: Under the 7th Framework Programme for research around 25 projects have been funded specifically to address soil issues and help complete a knowledge basis for action.
- Integration: The Commission succeeded in integrating soil protection in different EU policies: e.g. Common Agricultural Policy, Industrial Emission Directive, Cohesion Policy, state aid for the remediation of soil contamination.
- Legislation: As the objective is to provide a common framework, an adoption of the proposed Soil Framework Directive from 2006 would be a major step forward. But a decision on this has not yet been taken by the Council.

An estimation of the mitigation impact based on existing literature is not available due to a lack of reliable data; in addition, conducting an assessment of future developments (sealing of soils, land use changes, erosion, etc.) has proved to be rather difficult.

The impact assessment under the Strategy focuses on the costs of soil degradation, and examines different policy options for their costs and benefits. Quantitative estimates of changes in soil carbon pools as a result of specific policies are not included.

4.6.5. Nitrates Directive

Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources[479] (further referred to as Nitrate Directive) is one of the earliest pieces of EU legislation aimed at preventing water pollution and improving water quality. The Nitrates Directive forms an integral part of the Water Framework Directive and is one of the key instruments in the protection of waters against agricultural pressures.

The purpose of the Water Framework Directive[480] is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. Its objective is to get polluted waters clean and to ensure that clean waters are kept clean. It is designed to manage water quality, and water quantity (especially for groundwater), by also involving the citizens through public participation.

While nitrogen is a vital nutrient that helps plants and crops to grow, high concentrations are harmful to people and nature. The agricultural use of nitrates in organic and chemical fertilizers has been a major source of water pollution in Europe. Annual N fertilizer consumption in the EU is currently about 11 million tonnes – almost 30% below the peak of twenty five years ago. The average mineral N fertilizer use in 2008–2010 decreased by 6% compared to that in 2006–2007. Since 2010, N fertilizer use has remained stable[481]. Generally, farming remains responsible for over 50% of the total nitrogen discharge into surface waters[482].

479 OJ L 375, 31.12.1991, p.1.

480 Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

481 Source: Eurostat and Fertilizers Europe.

482 Factsheet: The EU Nitrates Directive, European Commission, Brussels, January 2010.

In order to meet its objective, the Nitrates Directive contains different actions and measures to be elaborated and implemented by the Member States, like monitoring of waters, identification of nitrates vulnerable zones (NZV), establishment of Codes of Good Agricultural Practices (CGAP) and implementation of actions plans.

These measures must ensure that, for each farm or livestock unit in the vulnerable zones, the amount of N applied in livestock manure to the land each year – including that deposited directly by grazing animals – shall not exceed 170 kg/ha.

Every four years the MS shall submit a report to the European Commission on their progress in implementation of measures and actions..

On the basis of the report received by Member States, the Commission publishes a summary report. The latest summary report is available for the period 2004-2007[483]; an update, relating to the reporting period 2008-2011, is expected in mid-2013.

Between 2000 and 2010, N_2O emissions from agricultural soils in the EU-27[484] saw a 10% decrease. The implementation of the Nitrate Directive contributed to this decrease. In particular, in a project report from Alterra[485], two scenarios were compared (with and without the Directive). According to this comparison, the total N_2O emission in EU-27 was 3.1% higher without Nitrates Directive than with it in 2000. In 2008, the effect increased to 6.3%. In particular, implementation of the Directive has decreased the N fertilizer input and the N excretion of dairy cattle, thus resulting in a decrease of N_2O emissions. The report also states that a further decrease in N emissions in the near future is expected as the implementation of measures set out in the Nitrates Directive is expected to increase because i) the area designated as NVZs ("Nitrate Vulnerable Zones") in EU-27 is expected to increase and ii) the time schedules for the measures foreseen in the Action Programmes will become stricter (e.g. fertilizer application standards).

Likewise, implementation of the Nitrates Directive has contributed to the establishment of better manure management systems in Europe, contributing to a reduction of greenhouse gases emissions originating from this sector.

4.6.6. Interlinkages

The two pillars of the CAP are strongly strongly interrelated; for instance. cross compliance provisions apply to income support as well as many land based payment payments under rural development. Agricultural development is part of many policies (like health, enterprises, economy, and environment), but considered under the aspect of overlaps with other UNFCCC sectors: energy generation und energy use, forestry and land use change and waste have to be mentioned.

In terms of interlinkages the energy sector is of relevance when the agricultural sector provides renewable energy (e.g. biogas) and material (e.g. biomass) which contribute positively to climate change mitigation if used to substitute fossil sources of energy and

483 Report from the Commission to the Council and the European Parliament on implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources based on Member State reports for the period 2004-2007, SEC (2011) 909.

484 Source: EEA dataviewer, accessed 28th March 2013.

485 The impact of the Nitrates Directive on gaseous N emissions, Effects of measures in nitrates action programme on gaseous N emissions, Contract ENV.B.1/ETU/2010/0009, Wageningen, 2010.

energy intensive material, and the generation and use of renewable energy in agriculture, agri-food sector and rural areas are supported under pillar II of the CAP.

The **Soil Thematic Strategy** is relevant for biodiversity, water, waste and chemical management. In the Environmental Impact Assessment Directive, due to be reviewed soon, soil protection will be considered as well. Within the agriculture sector, the CAP measure also aim for prevention of soil erosion and maintaining and increasing organic matter in soils. A sustainable management of forest, as aimed for by the EU Forest Strategy, also contributes positively to an increase of the soil carbon pool.

The **Nitrates Directive** is closely linked with other EU policies which are relevant for climate change mitigation, such as the Common Agricultural Policy and the Water Framework Directive. The Common Agricultural Policy backs up the implementation of Nitrates Directive through the cross compliance conditions for receiving direct support and positive measures aimed at improved management of animal waste and reduction in use of synthetic fertilisers under RDPs. For example, several Member States have included nutrient management measures, such as reduction in use of synthetic nitrogen fertilisers or wider buffer strips around water courses in the agri-environmental schemes for which farmers can receive remuneration for their contribution to curb nitrate pollution beyond what is legally required.

There is also a link with the National Emission Ceilings Directive, which sets ceilings for NH_3 emissions; thus, efforts which are undertaken in accordance with the Nitrates Directive will also support the reduction of ammonia emissions.

4.6.7. Policies and measures no longer in place

Currently, no EU policies and measures in the agricultural sector are to be mentioned as no longer in place.

4.7. Sectoral policies and measures: Land use, land use change and forestry

LULUCF (Land use, land use change and forestry) policies target emissions and removals resulting from activities related to land use and land-use change on forest land, cropland, grassland, wetlands, settlement areas, and on other land. So, these activities have a strong link with the agriculture sector (see section 4.6) and cover much more than forestry.

While the Treaty on the Functioning the EU makes no reference to specific provisions for an EU forest policy, the EU has a long history of contributing through its policies to implementing sustainable forest management and to Member States' decisions on forests.

The following policies have not been included in the list of policies described in separate chapters below as their impact on climate change mitigation in this sector is estimated to be rather low within the EU:

- EU Biodiversity Strategy to 2020: Strategy with the aim of halting the loss of biodiversity and improving the state of Europe's species, habitats, ecosystems and the services they provide over the next decade: Target 3 of the strategy – "Increase the contribution of agriculture and forestry to maintaining and enhancing biodiversity" – is the most relevant target for climate change mitigation and will help to protect forests and promote an environmentally friendly agriculture.

- EU Timber Regulation[486]: This new piece of legislation prohibits the placing of timber on the EU market if it is illegally harvested. To achieve this, it sets out procedures which those who trade timber within the EU must put in place to minimize the risk of illegal timber being sold. It will thus help to fight deforestation, climate change and biodiversity loss.
- The EU Action Plan for Forest Law Enforcement, Governance and Trade (FLEGT): the basis for the EU Timber Regulation. It specifies a number of measures aimed at excluding illegal timber from markets, improving the supply of legal timber and increasing the demand for responsible wood products. A central element of the EU's strategy to combat illegal logging are trade accords with timber exporting countries, known as Voluntary Partnership Agreements, in order to ensure legal timber trade and to support good forest governance in the partner countries.
- The European Forest Fire Information System (EFFIS) supports the services in charge of the protection of forests against fires in the EU countries and provides the European Commission services and the European Parliament with updated and reliable information on wildland fires in Europe. EFFIS provides assessments from pre-fire to post-fire phases, thus supporting fire prevention, preparedness, fire fighting and post-fire evaluations. These actions will contribute to the protection of forests from fire, and thereby reduce carbon losses.

On international level the so-called "FOREST EUROPE" initiative (formerly known as "The Ministerial Conference on the Protection of Forests in Europe") is driving the political process for the sustainable management of the continent's forests. FOREST EUROPE develops common strategies for its 46 member countries and the European Union on how to protect and sustainably manage forests. Since 1990, the collaboration of the ministers responsible for forests in Europe has had a great economic, environmental and social impact on national and international levels. FOREST EUROPE has led to achievements such as the guidelines, criteria and indicators for sustainable forest management[487]. At the FOREST EUROPE Ministerial Conference held in Oslo on 14-16 June 2011, ministers responsible for forests decided on the elaboration of a legally-binding agreement (LBA) on forests in the pan-European region. The negotiations to establish the LBA are currently on-going. The LIFE+ funding programme[488] (see further description in section 8.2.1.2 of EU's 6th National Communication) also covers forest related projects, as it replaces the former Forest Focus Programme. The programme covers topics like biodiversity, climate change, carbon sequestration, soils and protective functions of forests. Thereby projects funded by this financial instrument contribute to sustainable forest management.

The following policies and measures are covered in this section:

- EU Forest Strategy

486 Regulation (EU) No 995/2010 of the European Parliament and of the Council of 20 October 2010 laying down the obligations of operators who place timber and timber products on the market.

487 Source: http://www.foresteurope.org/about_us/foresteurope, accessed 6 May 2013.

488 Regulation (EC) No 614/2007 of the European Parliament and of the Council of 23 May 2007 concerning the Financial Instrument for the Environment (LIFE+) -

- Forestry measures within Rural Development Plan
- LULUCF Accounting

An overview of the measures including information on their impact on CO_2 emissions can be found in CTF Table 3 in the CTF Appendix.

4.7.1. EU Forest Strategy

In September 2013 the Commission has adopted a new EU Forest Strategy[489] responding to the new challenges facing forests and the forest sector in the Horizon 2030. The Strategy emphasises a holistic view of forests, and promote sustainable forest management (SFM) and the multifunctional role of forests, improving competitiveness and job creation, particularly in rural areas, while ensuring the protection and provision of ecosystem services that depend on forests. The Strategy is based on three principles:

- Sustainable forest management and the multifunctional role of forests, delivering multiple goods and services in a balanced way and ensuring forest protection;
- Resource efficiency, optimising the contribution of forests and the forest sector to rural development, growth and job creation.
- Global forest responsibility, promoting sustainable production and consumption of forest products.

It has a mid-term 2020 target "to ensure and demonstrate that EU forests are managed according to sustainable forest management principles and that the EU's contribution to promoting sustainable forest management and reducing deforestation at global level is strengthened, thus:

- \- contributing to balancing various forest functions, meeting demands, and delivering vital ecosystem services and;
- \- providing a basis for forestry and the whole forest-based value chain to be competitive and viable contributors to the bio-based economy.

The Strategy highlights that forests are not only important for rural development, but also for the environment - especially for biodiversity, for forest-based industries, bioenergy and in the fight against climate change. A mid-term review is foreseen in 2018.

Earlier developments include the 1998 EU Forestry Strategy and the 2006-2011 Forest Action Plan.

In 1998, the EU Council adopted an EU Forestry Strategy[490] which positions the application of sustainable forest management and the multifunctional role of forests as its overall principles. The Strategy was reviewed in 2005, and the Commission presented an EU Forest Action Plan in 2006 as the main instrument for implement the EU Forest Strategy. It covered activities from 2007 to 2011.The EU Forest Plan's four objectives are to:

- improve the long-term competitiveness of the forest sector and to enhance the sustainable use of forest products and services;

489 Communication on a new EU Forest Strategy: for forests and the forest-based sector COM(2013) 659 final

490 Council Resolution of 15 December 1998 on a forestry strategy for the European Union (1999/C 56/01).

- maintain and appropriately enhance biodiversity, carbon sequestration, integrity, health and resilience of forest ecosystems at multiple geographical scales;
- contribute to the quality of life by preserving and improving the social and cultural dimensions of forests; and
- improve coherence and cross-sectoral cooperation in order to balance economic, environmental and socio-cultural objectives at multiple organizational and institutional levels.

In terms of GHG mitigation, the second objective is of special relevance as it targets the carbon sink capacity of forests. For more information on the respective key action, see section 4.7.3, below).

In the Forest Action Plan[491] several key actions clearly refer to climate change mitigation:

- Key action 4: Promote the use of forest biomass for energy generation
- Key action 6: Facilitate EU compliance with the obligations on climate change mitigation of the UNFCCC and its Kyoto Protocol and encourage adaptation to the effects of climate change
- Key action 9: Enhance the protection of EU forests
- Key action 17: Encourage the use of wood and other forest products from sustainably managed forests.

Mitigation impacts have not been estimated as there are many policies that influence forestry activities and it is almost impossible to determine the mitigation potentials of one particular policy.

4.7.2. Forestry measures within Rural Development measures

Forestry is an integral part of rural development; support for sustainable and climate-friendly land use should encompass forest area development and sustainable management of forests. During the 2007-2013 programming period (see also section 4.6.3), a variety of measures were adopted covering different types of support for forestry investments and management.

Rural development programmes offer a range of possibilities for supporting sustainable forest management and the multifunctional role of forests, through measures aiming at:

- improving the long-term competitiveness of the sector,
- protecting and enhancing of natural resources and
- preserving high natural value forestry systems [492].

Eight measures in the current rural development framework are specifically focused on forestry[493].

491 Communication from the Commission to the Council and the European Parliament on an EU Forest Action Plan, COM(2006)302 final.

492 ENRD 2012: Thematic Information Sheets 2007-2011, Nr. 06: Supporting Forestry, European Network for Rural Development (ENRD), updated in December 2012.

- Measure 122 – Improvement of the economic value of forests
- Measure 221 – First afforestation of agricultural land
- Measure 222 – First establishment of agro-forestry systems on agricultural land
- Measure 223 – First afforestation on non-agricultural land
- Measure 224 – Natura 2000 payments
- Measure 225 – Forest-environment payments
- Measure 226 – Restoring forestry potential and introducing prevention actions
- Measure 227 – Non-productive investments (forestry)

These eight forestry measures account for a budget of around € 9 billion for 2007-2013. The EAFRD contribution amounts to around € 5 billion. This allocation accounts for 5.8% of the total public expenditure (€ 154 billion) on rural development for 2007-2013 in the EU-27 level.

An estimation of the expected mitigation impact up to 2020 cannot be provided, but the proposed regulation will clearly contribute to the achievement of the objectives of the EU climate and energy package adopted in 2008. As regards the EU-wide overall 10 % reduction in the 2005-2020 period for sectors not covered by the ETS, the carbon sink function of forests is essential, along with the potential for forest biomass-based energies to replace fossil fuels, which would contribute to a decrease in emissions in the energy use sector.

Forestry has also been integrated in the rural development regulation for the period 2014-2020[494], which provides increased possibilities to support the mitigation potential of forests as well as adaptation; new types of support includes for instance actions for mobilising wood, support to producer groups, conservation and promotion of genetic resources, and preventive actions against pests and diseases.

4.7.3. LULUCF accounting

Greenhouse gas emissions and removals from LULUCF activities are reported to the UNFCCC, but only partially accounted for. According to Article 3.3 of the Kyoto Protocol net carbon changes due to afforestation and deforestation since 1990 can be accounted for; carbon stock changes due to forest management can be accounted for as well, up to a nationally defined cap (Article 3.4 of the Kyoto Protocol).

When the EU Climate and Energy Package was agreed upon in 2008-2009, CO_2 emissions and removals resulting from LULUCF activities were not included, mainly due to a lack of accounting rules at the time. A process of dealing with this accounting deficiency was started in 2010, and in March 2012 a proposal for a decision was put forward by the European Commission[495].

In April 2013, the decision on accounting rules on greenhouse gas emission and removals resulting from activities relating to land use, land-use change and forestry and

493 ENRD 2012: Thematic Information Sheets 2007-2011, Nr. 06: Supporting Forestry, European Network for Rural Development (ENRD), updated in December 2012.

494 Proposal for a regulation of the European Parliament and of the Council on support or rural development by the European Agricultural Fund for Rural Development (EAFRD), COM(2011)627 final/2.

495 Proposal for a Decision of the European Parliament and of the Council on accounting rules and action plans on greenhouse gases and removals resulting from activities related to land use, land use change and forestry, COM(2012) 93 final.

on information concerning actions relating to those activities has been adopted[496]. It provides the basis for a formal inclusion of the LULUCF sector in the EU's emission reduction targets, and ensures a harmonized legal framework across Member States, allowing the collection of reliable data by robust accounting and reporting in a standardized way. These data will be needed when LULUCF mitigation potentials are to be included in emission reduction targets as a second step after the setting the accounting rules.

The decision is in accordance with the UNFCCC framework, and based on the international rules for the second commitment period negotiated in Durban 2011 but will go further in enhancing environmental integrity and the completeness of accounting.

The objective of the Decision is to lay down rules for the accounting in the LULUCF sector in order to make use of the mitigation potential of the LULUCF sector by increasing the visibility of mitigation efforts in agriculture, forestry and related industries. It sets out the obligation for Member States to provide information on their LULUCF actions to limit or reduce emissions and to maintain or increase removals.

Besides accounting rules, Member States are required to draw up information on their current and future LULUCF actions to limit or reduce emissions and maintain or increase removals (Art.10). The decision describes clearly which information is to be included in these reports (e.g. trends, projections, appropriate measures). The reports must be submitted by mid-2014, and must cover the period up to 2020 (end of first accounting period). The information on LULUCF actions is needed for four reasons[497]:

- to ensure that Member States include LULUCF in their wider climate change mitigation strategies;
- to raise the awareness and profile of such measures and their benefits;
- to enable a follow-up of trends in emissions and removals of carbon in the sector; and
- to complement and balance national renewable energy action plans as well as to develop adequate incentive structures, especially in the future Common Agricultural Policy.

The accounting rules do not have a direct influence on the mitigation of climate change, but will trigger policies which contribute to sustainable land and forest use, and increasing carbon stocks. A quantification of the impact is not possible.

4.7.4. Interlinkages

Due to the forest's socio-economic and environmental functions, interlinkages are given to other areas like agriculture, energy, climate, enterprise, etc. Interlinkages with measures of various fields are given:

- Energy-related measures: as forests are producing biomass, which can be used to replace fossil fuels

496 Decision No 529/2013/EU of the European Parliament and of the Council of 21 May 2013 on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities. OJ L 165, 18.6.2013, p. 80..

497 Questions & Answers on accounting rules and action plans on greenhouse gas emissions and removals resulting from activities related to land use, land use change and forestry (LULUCF), MEMO/12/176, March 2012, Brussels.

- Agriculture-related measures: especially the rural development policy, as it targets agricultural land as well as forests
- Soil- & water-related measures: forests contribute to prevent soil degradation and protect water resources
- Industry-related measures, if wood is used to substitute other raw materials, like metal, concrete or plastics.

4.7.5. Policies and measures no longer in place

The Forest Focus Regulation[498] ended in 2006, without follow-up.

4.8. Sectoral policies and measures: Waste

4.8.1. Overview

The direct and indirect benefits for climate change mitigations are directly correlated with the application of the waste hierarchy promoted by the Waste Framework Directive 2008/98 (Article 4). In other words, prioritization on the basis of the hierarchy delivers the best results for climate mitigation.

As a priority, the biggest reduction potential resides in waste prevention and sustainable consumption by the reduction in resource use, production patterns, transport, logistics and consumption behaviour along the chain.

Next, preparing for the re-use and recycling of waste has an important impact in substituting the extraction and transformation of primary raw materials as well as related transport.

Finally, climate-relevant policies and measures relating to solid waste disposal, biological treatment of waste, waste incineration and open burning of waste, as well as wastewater treatment and discharge, are relevant. One of the most relevant GHGs from this sector is methane (CH_4), which mainly arises from the treatment and disposal of solid waste. N_2O mainly arises from waste water treatment. CO_2 resulting from the combustion of non-fossil waste is not accounted for because of the biogenic origin of the waste. Emissions from the burning of waste containing fossil carbon are accounted for, either in this sector if the energy is not recovered, or in the energy sector if it is recovered.

The following policies and measures are covered in this section:

- Waste Framework Directive
- Landfill Directive
- Waste Incineration Directive
- EU policies targeting waste streams
- Management of Biodegradable Waste
- Urban Waste Water Directive.

498 Regulation (EC) No 2152/2003 of the European Parliament and of the Council of 17 November 2003 concerning monitoring of forests and environmental interactions in the Community (Forest Focus); OJ L 324, 11.12.2003, p. 1–8

An overview of the measures including information on their impact on CO_2 emissions can be found in CTF Table 3 in the Appendix.

4.8.2. Waste Framework Directive

In 1975, the first piece of legislation providing a framework for waste management was published (Council Directive 75/442/EEC of 15 July 1975 on waste[499]), which laid down the principles of waste management: (1) prevention of waste, (2) recovery of waste, and (3) its use as a source of energy.

In 2005, the Commission adopted a thematic strategy[500] which set the long-term goal for the EU to become a recycling society that seeks to avoid waste and uses waste as a resource. In 2006, this was followed by a new Waste Directive, the Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste[501], repealing the Directive of 1975.

In 2008, Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives[502] (further referred to as Waste Framework Directive) came into force, establishing a legal framework for the management of waste to cope with the challenge of decoupling economic growth from waste generation and promoting strict hierarchy of intervention for waste prevention and management.

The thematic strategy was reviewed in 2011[503]. The conclusion of the review was that significant progress has been achieved, e.g. that municipal solid waste generation has stabilized, overall waste recycling has increased, energy recovery from waste has also increased and less waste has been sent to landfills. However, even if more than 80% of waste is recycled in some Member States, indicating the possibilities of using waste as one of the EU's key resources, there are large differences between the Member States in terms of recycling performance and projections of waste generation and treatment trends indicate that without additional measures, waste generation is expected to increase by 7% from 2008 to 2020, which suggests a need for further consolidation of EU waste policies.

The Roadmap to a Resource Efficient Europe (COM(2011) 571), published in September 2011, outlines how we can transform Europe's economy into a sustainable one by 2050. It proposes ways to increase resource productivity and decouple economic growth from resource use and its environmental impact. It illustrates how policies interrelate and build on each other. The Roadmap includes a set of concrete waste-related proposals and aspirational objectives ("milestones") to be achieved by 2020:

- waste generated per person should be in decline;
- recycling and re-use should be at their maximum level;
- incineration should be limited to non-reusable or recyclable materials; and

499 OJ L 194, 25.7.1975, p.39..

500 Taking sustainable use of resources forward: A Thematic Strategy on the prevention and recycling of waste. COM(2005) 666 final.

501 OJ L 114, 27.4.2006, p.9.

502 OJ L 321, 22.11.2008, p.3.

503 Report from the Commission to the European Parliament, the Council the European Economic and Social Committee and the Committee of the Regions on the Thematic Strategy on the prevention and recycling of waste, COM(2011) 13 final.

- last but not least, landfilling should be virtually eliminated as a waste management option.

These objectives are also now transposed in the 7th Environment Action Programme (EAP), currently under discussion with the Council and the European Parliament.

Taking as a basis the aspirational objectives, the Commission is launching a review of key targets in EU waste legislation (in line with the review clauses in the Waste Framework Directive, the Landfill Directive and the Packaging Directive). The results of this review will be presented in 2014.

Directive 2008/98/EC sets out the basic concepts and definitions related to waste management, such as definitions of waste, recycling and recovery. It explains when waste ceases to be waste and becomes a secondary raw material (so-called end-of-waste criteria) and how to distinguish between waste and by-products. The Directive lays down some basic waste management principles[504]. it requires that waste be managed without endangering human health and harming the environment, and in particular without risk to water, air, soil, plants or animals, without causing a nuisance through noise or odours, and without adversely affecting the countryside or places of special interest. Waste legislation and policies in the EU Member States should contain provisions for waste management which are in accordance with the priority order of the following waste management hierarchy:

Figure [BR1] 4-5 Waste principles

Source: http://ec.europa.eu/environment/waste/framework/index.htm.

The Directive introduces the "polluter pays principle" and the "extended producer responsibility". It contains provisions on hazardous waste and waste oils (thereby repealing old Directives on hazardous waste and waste oils with effect from 12 December 2010), and includes two new recycling and recovery targets to be achieved by 2020: re-use and recycling of at least 50% of certain waste materials from households and other origins similar to households, and re-use, recycling and other recovery of at least 70% of construction and demolition waste. The Directive requires that Member States adopt waste management plans and waste prevention programmes.

504 Source of information: http://ec.europa.eu/environment/waste/framework/index.htm, accessed 26 April 2013)

Following the hierarchy as set in Article 4 of the Waste Framework Directive proves to deliver the best results for climate mitigation, with waste prevention as a priority and the main contributor followed by preparing for re-use and recycling of waste for their impact in substituting the extraction and transformation of primary raw materials as well as related transport. Also as a result of the implementation of the waste hierarchy and the requirements for separate collection for bio-waste (Article 22), an important direct benefit for climate change mitigation could be achieved if biodegradable waste was no longer landfilled because during the decomposition of biodegradable waste methane is produced. Measures for landfill gas capturing and flaring are increasingly implemented, although they cannot completely avoid the release of CH_4 into the atmosphere.

Due to this Directive, the disposal and landfilling of bio-waste is gradually decreasing, and so are methane emissions.

The ARCADIS project[505] assessed different options to improve the management of bio-waste in the EU. Under the assumption of high prevention and recycling rates, a reduction of 40.1 million t CO_2 eq (excluding biogenic CO_2) for the EU by 2020 is projected.

4.8.3. Landfill Directive

In 1999, Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste[506] entered into force; Member States had to transpose it into national law by 2001.

Preceding relevant EU legislation were Council Decision 2003/33/EC which established the criteria and procedures for the acceptance of waste in landfills, and the Waste Framework Directive of 1975 (see above).

Studies on the implementation of the Directive in the EU, undertaken in 2005 and 2007[507], show that Member States had made strong efforts to bring their existing landfills in line with the requirements of the EU Landfill Directive. However, the studies also concluded that further efforts are still needed in several Member States (e.g. to eliminate illegal disposal sites).

The objective of the Landfill Directive is to prevent or reduce as far as possible negative effects on the environment resulting from the landfilling of waste - e.g. pollution of surface water, groundwater, soil and air, and the greenhouse gas effect – by introducing stringent technical requirements for waste and landfills.

The Landfill Directive defines the different categories of waste (municipal waste, hazardous waste, non-hazardous waste and inert waste) and applies to all landfills, defined as waste disposal sites for the deposit of waste onto or into land. Landfills are divided into three classes:

- landfills for hazardous waste;
- landfills for non-hazardous waste;
- landfills for inert waste.

505 Assessment of the Options to Improve the Management of Bio-Waste in the European Union, Study contract Nr 07.0307/2008/517621/ETU/G4 European Commission, DG ENV,ARCADIS Project number – 11/004759,Version C | 12-02-2010, available at: http://ec.europa.eu/environment/waste/compost/pdf/ia_biowaste%20-%20final%20report.pdf.

506 OJ L 182, 16.7.1999, p. 1.

507 European Commission, DG Environment. Follow-up study on the implementation of Directive 1999/31/EC on the landfill of waste in EU-25, Final Report - Findings of the Study, June 2007.

Successive targets are introduced to reduce the landfilling of biodegradable municipal waste. By 2016, biodegradable waste going to landfills must be reduced to 35 %[508] of the total amount (by weight) of biodegradable waste produced in 1995. This measure is designed to lead to decreasing amounts of degradable organic carbon being deposited, and contributes efficiently to decreasing methane production during the decomposition of waste.

In addition, the directive includes the requirement to collect landfill gas from all landfills receiving biodegradable waste. The landfill gas should be used to produce energy; if this is not possible it must be flared.

An EEA report[509] states that a net emission reduction from municipal solid waste management of 48 million tonnes CO_2 eq could be achieved between 1995 and 2008. In the business-as-usual scenario considering reduced landfilling, combined with increased recycling leads to a dramatic increase in avoided emission due to recycling and energy recovery operations. Net emissions in 2020 would be 44 million tonnes less than in 2008.

A second scenario considers the full implementation of the Landfill Directive (assuming that all countries meet the Landfill Directive's targets on reducing landfilling of biodegradable municipal waste), which leads to a net reduction of 62 million tonnes CO_2 eq compared to 2008.

4.8.4. Waste Incineration Directive

Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste[510] (further referred to as Waste Incineration Directive) came into force on 4 December 2000 to prevent or reduce the negative effects on the environment caused by the incineration of waste. In 2011, the Industrial Emissions Directive (IED) came into force, which brings together seven directives related to industrial emissions. One of these seven directives is the Waste Incineration Directive, which will be replaced by the IED from 7 January 2014 onwards. The IED applies to waste incineration or co-incineration plants, and stipulates environmental requirements. For further information on the Industrial Emission Directive, see section 4.5.5.

In addition, the Integrated Pollution Prevention and Control (IPPC) Directive applied to some waste management activities in the past (e.g. the treatment or storage of waste for disposal), but these activities are now also covered in the IED.

The objective of the Waste Incineration Directive is to prevent or to limit as far as practicable negative effects on the environment from the incineration and co-incineration of waste, in particular pollution by emissions into air, soil, surface water and groundwater, and the resulting risks to human health.

Waste incineration plants are dedicated to the thermal treatment of waste with or without recovery of the combustion heat generated. In co-incineration plants waste is used as a regular or additional fuel for the generation of fuel or the production of material products; unlike incineration plants, the main purpose of which is waste treatment.

508 Under certain conditions fulfilment of the targets may be postponed by a maximum of four years.

509 European Environment Agency (EEA) (2011). Waste opportunities: past and future climate benefits from better municipal waste management in Europe. Report no. 3/2011.

510 OJ L 332, 28.12.2000, p. 91..

The IED requires that each plant has a permit ensuring compliance with the operator's basic obligations and environmental quality standards, such as emission limit values for polluting substances. Environmental inspections are prescribed for all installations. They have to be carried out by a competent authority.

It is assumed that the regulations on waste incineration (either Waste Incineration Directive or IED) will have a comparatively small impact on climate change, given that emission limits apply to air pollutants. But as air pollutants and greenhouse gases are interacting, indirect impacts on climate change will occur, but they cannot be quantified.

It is not clear to what extent regulations concerning waste incineration will influence the waste treatment choices: as an alternative for the treatment of non-recyclable or residual waste, if they lead to increased waste incineration instead of waste disposal on landfill sites CH_4 emissions will be avoided as these occur during biological decomposition in landfills.

4.8.5. EU policies targeting waste streams

In this section policies are grouped together which target different waste streams; the GHG reduction potential may become only visible in the whole life-cycle when emissions are avoided during primary production or due to less waste generation. Therefore, the policies mentioned in this section are not so significant for emissions reductions in the waste sector but are of importance for other sectors, e.g. transport, industry or energy.

The following list includes directives targeting specific waste streams which contribute to decreasing waste generation and less harmful substances in waste:

- **Packaging Waste Directive**: European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste[511];
- **WEEE Directive**: Directive 2012/19/EC of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment[512] and Directive 2012/18/EC of the European Parliament and of the Council of 4 July 2012 the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC[513];
- **End-of-life Vehicle Directive**: Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of-life vehicles[514];
- **Motor Vehicles Directive**: Directive 2005/64/EC of the European Parliament and of the Council of 26 October 2005 on the type-approval of motor vehicles with regard to their re-usability, recyclability and recoverability and amending Council Directive 70/156/EEC[515];
- **Disposal of spent batteries and accumulators**: Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and

511 OJ L 365, 31.12.1994, p.10.

512 OJ L 197, 24.7.2012, p. 38.

513 OJ L 197, 24.7.2012, p. 1.

514 OJ L 269, 21.10.2000, p.34.

515 OJ L 310, 25.11.2005, p.10.

accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC[516].

The overall aim of the policies listed above is to promote recycling, re-use and other forms of waste recovery in order to minimize waste generation and save primary resources. In terms of climate change mitigation the benefits are most relevant for the energy and industrial processes sectors in which GHG emissions are expected to be reduced through lower energy and resource use in primary production.

The Packaging Directive (94/62/EC) provides for measures aimed at limiting the production of packaging waste and promoting recycling, re-use and other forms of waste recovery. Final disposal of packaging waste should only be used as a last resort. Member States are required to introduce systems for the return and/or collection of used packaging to meet the targets set out in the Directive. In 2004, the Directive was reviewed to provide criteria clarifying the definition of the term 'packaging' and increase the targets for recovery and recycling of packaging waste. In 2005[517], the Directive was revised again to allow new Member States transitional periods for attaining the recovery and recycling targets.

The **WEEE Directive** (2012/19/EU) requires Member States to take measures to encourage producers to design and produce electrical and electronic equipment which take into account and facilitate dismantling and recovery. Separate collection and recovery systems for WEEE shall be set up to fulfil given minimum collection rates for 2016 and 2019. Member States shall prohibit the disposal of separately collected WEEE and ensure that all separately collected WEEE undergoes proper treatment.

The **End-of-Life Vehicles Directive** (2000/53/EC) aims to reduce the amount of waste produced from vehicles when they are scrapped and to increase re-use, recycling and other forms of recovery of end-of-life vehicles and their components. In order to achieve these two objectives, the EU lays down new requirements for European vehicle manufacturers, which should design vehicles which are easy to recycle.

The **Directive on Reusing, Recycling and Recovering of Motor Vehicles** (2005/64/EC) builds on the End-of-Life Vehicles Directive. The provisions of this Directive will apply from 15 December 2008 for new types of vehicles put on the market, and from 15 July 2010 for models already in production.

The **Battery Directive** (2006/66/EC) concerns the disposal of spent batteries and accumulators and prohibits the placing on the market of most batteries and accumulators with a certain mercury or cadmium content and establishes rules for the collection, recycling, treatment and disposal of batteries and accumulators. Member States must take measures to ensure that a high proportion of spent batteries and accumulators are recycled.

An estimate of the mitigation impact of the policies mentioned would mostly consider the saved CO_2 reduction during primary production. Due to a lack of data, such an estimate is not available.

516 OJ L 266, 26.9.2006, p.1.

517 Directive 2005/20/EC of the European Parliament and of the Council of 9 March 2005 amending Directive 94/62/EC on packaging and packaging waste. OJ L 70, 16.3.2005, p. 17.

4.8.6. *Management of biodegradable waste*

Several EU legal instruments address the treatment of biodegradable waste (bio-waste): (1) The Landfill Directive requires Member States to reduce the biodegradable waste being deposited on landfills; (2) the Waste Framework Directive also contains specific elements related to bio-waste and (3) the Industrial Emission Directive lays down principles for controlling bio-waste treatment and incineration plants.

In 2008, a Green Paper on the Management of bio-waste in the EU[518] analysed whether there was a need for additional Community action to further develop the management of bio-waste. The Green Paper was followed by an Impact Assessment[519] assessing the different policy options. In 2010, the European Commission communicated future steps in bio-waste management[520] to enforce the use of the potential of bio-waste as a renewable source of energy and recycled material.

In 2011, a project[521] analysed the feasibility of setting bio-waste recycling targets in the EU by assessing different target scenarios and undertaking cost-benefit analyses. It was also discussed whether these targets should be recycling or collection targets.

Food waste is highlighted as a key priority in the Roadmap for a Resource-Efficient Europe[522]. The food and drink value chain in the EU causes 17% of our direct greenhouse gas emissions. However, in the EU alone, we waste 90 million tonnes of food every year or 180 kg per person. Much of this is food which is still suitable for human consumption. A combined effort by farmers, the food industry, retailers and consumers through resource-efficient production techniques, sustainable food choices (in line with the WHO recommendations on the amount of animal proteins, including meat and dairy products, consumed per person) and reduced food waste can contribute to improving resource efficiency and food security at a global level. The roadmap sets the following milestone: "By 2020, incentives to healthier and more sustainable food production and consumption will be widespread and will have driven a 20 % reduction in the food chain's resource inputs. Disposal of edible food waste should have been halved in the EU."

Currently Member States follow different strategies to manage their bio-waste. Some opt for recovery before incineration, others for composting, but still a notable amount of bio-waste is landfilled; which goes against the “waste hierarchy” set out in the Waste Framework Directive. Member States should take measures to prevent bio-waste and promote separate collection and biological treatment of waste, so that landfilling becomes the last option.

A further increase in composting and biogas production of bio-waste is expected in the years ahead, offering interesting potentials. It is likely that a target for biological treatment would have to go hand-in-hand with enhanced separate collection systems to ensure good quality of compost and digestate.

518 Green Paper on the management of bio-waste in the European Union, COM(2008) 811 final.

519 Assessment of the options to improve the management of bio-waste in the European Union, study contract NR 07.0307/2008/517621/ETU/G4, EC, DG ENV, Study undertaken by ARCADIS & EUNOMIA.

520 Communication from the Commission to the Council and the European Parliament on future steps in bio-waste management in the European Union, COM(2010) 235 final.

521 Assessment of feasibility of setting bio-waste recycling target in EU, including subsidiarity aspects, ENV.G.4/FRA/2008/0112, EC DG ENV, by VITO, Bio Intelligence Service and Arcadis.

522 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Roadmap to a Resource Efficient Europe, COM (2011)571 final,.

The suitability of setting targets is still under discussion, especially because respect for the principle of subsidiarity at Member State level should be ensured. Local conditions will determine the type of biological treatment best suited to a particular country. For example, centralized or decentralized composting or biogas production will depend on the availability of consumers of energy or compost but also on the availability of bio-waste.

The Commission's analysis revealed that - although there are no policy gaps at EU level that would prevent Member States from taking appropriate action - additional supporting action at EU level would be valuable for creating significant economic and environmental advantages for the whole EU.

The study on assessing the feasibility of bio-waste collection targets[521], shows that within the EU GHG emissions could be reduced by 6 million t CO_2 eq by 2020 (excluding biogenic CO_2 emissions), 60% of food waste and 90% of garden waste are separately collected. A second scenario assuming a 36.5% collection ratio by 2020 would lead to emission reductions of 1.5 million t CO_2 eq (excl. biogenic CO_2 emissions). The emission reduction achieved as bio-waste is removed from residual waste treatment facilities, i.e. diverted from landfilling, thereby saving methane emissions; emission savings due to prevention of bio-waste are not included.

4.8.7. Urban Waste Water Treatment Directive

Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment [523] (further referred to as Urban Waste Water Treatment Directive) was adopted by the Council in 1991 and was amended once in 1998. The Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors.

The overall objective of the Directive is to protect the environment from the adverse effect of untreated waste water discharges of domestic and industrial origin. The required collection and appropriate treatment of wastewater contributes to a reduction of indirect N_2O emissions. Depending on the type of treatment - aerobically or anaerobically - CH_4 emissions can also be reduced by means of appropriate abatement measures.

In terms of climate change mitigation, waste water is relevant as a potential source of CH_4 and N_2O emissions. CH_4 is emitted when wastewater is treated or disposed anaerobically. N_2O arises from the nitrogen components in the waste water (such as urea, nitrate, protein), and is released during denitrification and nitrification processes. A distinction is made between indirect N_2O emissions – arising in effluents entering waterways, lakes or the sea – and direct N_2O emissions – arising at waste water treatment plants. The higher the N-elimination during treatment is, the higher the direct N_2O emissions and the lower the indirect N_2O emissions are.

The Directive requires agglomerations of a specified population size to provide collecting systems for urban waste water. It also requires waste water plants to provide biological or an equivalent treatment. If treated wastewater is to be discharged into sensitive areas, more stringent treatment is required. The discharge of industrial waste water (and its treatment) is also regulated and requires a permit.

523 OJ L 135, 30.5.1991, p.40-52.

As the Directive came into force in 1991 and the relevant dates for implementing specific requirements have already passed, the benefits (in terms of reduced GHG emissions) have already become apparent. No major impact on GHG reductions is expected in the future.

4.8.8. Interlinkages

There are links between all waste policies described in this chapter as the Waste Framework Directive provides a framework for any waste treatment or handling. For this reason, the estimated impacts of single policies probably overlap.

All waste policies supporting waste as a renewable energy source are relevant for the energy sector (i.e. waste incineration, biogas production) and thereby contribute to lower fossil fuel use.

The industry sector is affected when life-cycles of materials or goods are extended in order to save energy and/or primary material and to avoid waste; these are the targets of several waste stream policies.

Agricultural soils can benefit from increased compost production, which is a result of enhanced bio-waste treatment.

The Urban Waste Water Treatment Directive contains references to the sewage sludge regulations[524] for agriculture, but also to other waste policies, especially when it comes to the reuse/disposal of sewage sludge.

4.8.9. Policies and measures no longer in place

The table below lists policies and measures in the waste sector which were repealed by follow-up policies.

Table [BR1] 4.5 Policies and measures no longer in place in the waste sector

Waste Directive 2006/12/EC	Repealed by Waste Framework Directive (Directive 2008/98/EC)
Hazardous waste Directive 91/689/EEC	
Waste Oils Directive 75/439/EEC	
Waste Incineration Directive 2000/76/EC	Repealed by Industrial Emission Directive (2010/75/EU) as of 7th Jan 2014

4.9. Changes in domestic institutional arrangements

4.9.1. Monitoring Mechanism Regulation

Regulation No 525/2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change (Monitoring Mechanism Regulation)[525] was adopted in May 2013,

524 Council Directive 86/278/EEC of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture.

525 OJ L 165, 18.6.2013, p. 13.

repealing Decision No 280/2004/EC (Monitoring Mechanism Decision). The new regulation which entered into force on 8 July 2013 represents an important change to the domestic institutional arrangement for monitoring and reporting of GHG emissions and climate related information in the EU, and evaluation of the progress towards the EU's economy-wide emission reduction target. The new Regulation significantly enhances the EU monitoring mechanism to meet requirements arising from current and future international climate agreements as well as the 2009 climate and energy package.

The main aims of the MMR are to improve the quality of the data reported and assist the EU and Member States with the tracking of their progress towards emission targets for 2013-2020. The revised mechanism improves the current reporting rules by introducing the following new reporting elements[526]:

- Member States' and the EU's reporting on low-carbon development strategies;
- Enhanced information related to GHG inventories;
- Reporting of approximated GHG inventories for the past year by 31 July each year (this will facilitate to obtain an earlier preliminary estimate of GHG emissions of the previous year (year X-1) compared to the regular inventory submission in which the most recent year is X-2);
- The introduction of an EU inventory review;
- The establishment of national and Union systems for the reporting of policies and measures and projections;
- Financial and technical support provided to developing countries;
- Member States' use of revenues from the auctioning of allowances in the EU Emissions Trading Scheme (EU ETS). Member States have committed to spend at least half of the revenue from such auctions on measures to fight climate change in the EU and third countries;
- Member States' adaptation to climate change.

The Monitoring Mechanism Regulation also requires that the European Commission annually completes a report that assesses the progress of the EU and its Member States towards meeting their commitments under the UNFCCC and the Kyoto Protocol.

The implementing acts and delegated acts to be prepared under the Monitoring Mechanism Regulation would enable the implementation of the Monitoring Mechanism Regulation in several of its provisions, specifying in more detail the structure of the information, reporting formats, and submission procedures. These acts would be adopted in early 2014.

4.9.2. Monitoring and reporting under the EU Emission Trading Scheme

The reform of the EU Emission Trading Scheme (ETS, cf. section 4.2.2) in Phase III has resulted in important changes with regards to domestic institutional arrangements for the monitoring and reporting of GHG emissions under the EU ETS. EU ETS MRV will be required to comply with two new Commission Regulations from the Phase III of

526 http://ec.europa.eu/clima/policies/g-gas/monitoring/index_en.htm

the EU ETS onwards, one specific to monitoring and reporting[527] and the other to verification and accreditation.[528] The latter introduces a framework of rules for the accreditation of verifiers to ensure that the verification of operator's or aircraft operator's reports in the framework of the Union's greenhouse gas emission allowance trading scheme is carried out by verifiers that possess the technical competence to perform the entrusted task in an independent and impartial manner and in conformity with the requirements and principles set out in this Regulation. These regulations have direct legal effect in the Member States as there is no need to transpose and implement in national legislation since the provisions apply directly to operators or aircraft operators, verifiers, and accreditation parties. The regulations provide clarity on the roles and responsibilities of all parties (i.e. industrial installations and aircraft operators are required to have an approved monitoring plan) which will strengthen the compliance chain.[529]

With regard to further changes in the framework of the third phase of EU ETS, please refer to section 4.2.2.

4.10. Assessment of the economic and social consequences of response measures

In the EU a wide-ranging impact assessment system accompanying all new policy initiatives has been established[530]. It is based on an integrated approach which analyses both benefits and costs, and addresses all significant economic, social and environmental impacts of possible new initiatives. The impact assessment is thus a key element in the development of the European Commission's legislative proposals. The Commission is required to take the impact assessment reports into account when taking decisions, while the impact assessments are also presented and discussed during the scrutiny of legislative proposals from the Council and the Parliament. This approach ensures that potential economic, social and environmental consequences for various stakeholders (within, but also outside of, the European Union) are identified and assessed within the legislative process.

In general, impact assessments are required for all legislative proposals, but also other important Commission initiatives which are likely to have far-reaching impacts. They are prepared for i) legislative proposals which have significant economic, social and environmental impacts, ii) non-legislative initiatives (white papers, action plans, expenditure programmes, negotiating guidelines for international agreements) which define future policies and iii) certain implementing measures (so-called 'comitology' items) and delegated acts which are likely to have significant impacts. Each year, the Secretariat General, involving the Impact Assessment Board and the Commission departments, screen all forthcoming initiatives and decides for which an impact assessment is needed.

Impact assessments follow a set of key steps (see box below). The impact assessment approach ensures that all relevant expertise within the Commission is used, together with inputs from stakeholders. This also enhances the coherence of initiatives across policy areas and makes the impact assessment system accountable and transparent. All

527 OJ L 181, 12.7.2012, p. 30.

528 OJ L 181, 12.7.2012, p. 1.

529 http://ec.europa.eu/clima/policies/ets/monitoring/documentation_en.htm

530 See http://ec.europa.eu/governance/impact/index_en.htm

impact assessments and all opinions of the Impact Assessment Board on their quality are published online once the Commission has adopted the relevant proposal.

Specific guidelines for the impact assessment have been adopted (European Commission 2009[531]). The guidelines provide in-depth information on when and how to prepare an Impact Assessment, who to involve and how to proceed. The key analytical steps in an Impact Assessment are: i) identifying the problem, ii) defining objectives, iii) developing main policy options, iv) analysing the impacts of the options, v) comparing the options, and vi) outlining policy monitoring and evaluation. As to the assessment of economic, social and environmental consequences, the following key points are to be addressed (see guidelines):

- identify direct and indirect environmental, economic and social impacts and how they occur;
- identify who is affected by these impacts (including those outside the EU) and in what way;
- identify whether there are specific impacts that should be examined (fundamental rights, small and medium-sized enterprises, consumers, competition, international, national, regional);
- assess the impacts in qualitative, quantitative and monetary terms or explain in the IA why quantification is not possible or proportionate;
- consider the risks and uncertainties in the policy choices, including expected compliance patterns.

531 SEC(2009) 92. Impact Assessment Guidelines.

BOX: Key procedural steps for the Commission departments when preparing an impact assessment

1. Planning of impact assessment (IA): Roadmap, integration in the Commission's strategic planning and programming (SPP) cycle and timetable.
2. Work closely with your IA support unit throughout all steps of the IA process.
3. Set up an impact assessment steering group and involve it in all IA work phases.
4. Consult interested parties, collect expertise and analyse the results.
5. Carry out the IA analysis.
6. Present the findings in the IA report.
7. Present the draft IA report together with the executive summary to the Impact Assessment Board (IAB) and take into account the possible time needed to resubmit a revised version.
8. Finalise the IA report in the light of the IAB's recommendations.
9. IA report and IAB opinion(s) go into inter-service consultation alongside the proposal.
10. Submission of IA report, executive summary, IAB opinion(s) and proposal to the College of Commissioners.
11. Transmission of the IA report and the executive summary with the proposal to the other EU institutions.
12. Final IA report and IAB opinion(s) published on dedicated Europa website.
13. In the light of new information or on request from the EP or the Council, the Commission may decide to update the IA report.

(http://ec.europa.eu/governance/impact/ia_key/ia_key_en.htm)

Consulting interested parties is an obligation for every impact assessment and all affected stakeholders should be engaged, using the most appropriate timing, format and tools to reach them. Appropriate consultation tools can be consultative committees, expert groups, open hearings, ad hoc meetings, consultation via the internet, questionnaires, focus groups or seminars/workshops. Existing international policy dialogues are also be used to keep third countries fully informed of forthcoming initiatives, and as a means of exchanging information, data and results of preparatory studies with partner countries and other external stakeholders.

All key strategies and climate policies have been subject to impact assessments as described above. All impact assessments and all opinions of the Impact Assessment Board are published online[532].

4.11. Estimates of emission reductions and removals from LULUCF

In this section, estimates for emission reductions and removals in the land use, land use change and forestry (LULUCF) sector are given according to accounting rules under the UNFCCC and under the Kyoto Protocol respectively.

532 For 2013 and other years, see http://ec.europa.eu/governance/impact/ia_carried_out/cia_2013_en.htm

4.11.1. LULUCF under the UNFCCC

The CTF Appendix includes CTF Table 1 for the EU-15 and for EU-28 which show emissions/removals from LULUCF.

EU-15: The EU-15 LULUCF sector offsets about 5 % of the total emissions ("without LULUCF") in 2011, with values ranging at Member States level from +1.7 % (contributing to national GHG inventory as a source, in Netherlands) to -57.3 % (as sink, in Sweden) (Table [BR1] 4-6, column a). The most important LULUCF category, Forest Land, in 2011 was a net sink for all MS (column b), offsetting 1.3 % of total emissions in Netherlands, 63.9 % in Sweden, and 7.4 % for the whole EU-15. The most significant contributors to the 5A inventory of the EU-15 are France, Sweden and Finland (column c).

Table [BR1] 4-6 Sector 5 LULUCF contributions to total national emissions of EU-15 (Gg CO_2 eq) in 2011

Member State	**Sector 5 over total emission excluding LULUCF**	**Category 5.A over total emissions**	**Member States contribution to EU-15 total for Category 5A**
	(a)	(b)	(c)
Austria	-4.2%	-6.5%	2.0%
Belgium	-1.1%	-3.2%	1.4%
Denmark	-4.7%	-11.4%	2.4%
Finland	-36.7%	-53.7%	13.3%
France	-9.2%	-13.4%	24.1%
Germany	1.0%	-3.6%	12.1%
Greece	-2.2%	-1.8%	0.8%
Ireland	-6.4%	-7.3%	1.6%
Italy	-6.3%	-6.0%	10.9%
Luxembourg	-2.4%	-3.9%	0.2%
Netherlands	1.7%	-1.3%	0.9%
Portugal	-7.6%	-10.9%	2.8%
Spain	-8.3%	-7.2%	9.3%
Sweden	-57.3%	-63.9%	14.5%
United Kingdom	-0.6%	-1.8%	3.7%
EU-15	**-4.8%**	**-7.4%**	**100.0%**

EU-28: The contribution of LULUCF to total emissions also varies for the remaining 13 Member States (see Table [BR1] *4-7*); it ranges from only 1 % (Cyprus) to 149 % (Latvia). EU-15 accounts for almost 80 % of EU-28 removals; Poland has the largest sinks of the remaining 13 Member States accounting for 8.7 % of total EU-28 removals. Overall the LULUCF sector offsets about 6 % of total national GHG emissions in the EU-28.

Table [BR1] 4-7 Sector 5 LULUCF contributions to total national emissions of EU-28 (Gg CO2 eq) in 2011

Member State	LULUCF sector	Total national emissions (without LULUCF)	Share of emissions offset by LULUCF sector	Member States contribution to EU-28 total for LULUCF
EU-15	-173 992	3 630 657	-5%	79.3%
Bulgaria	-7 979	66 133	-12%	1.4%
Cyprus	-76	9 154	-1%	0.2%
Croatia	-7 032	28 256	-25%	0.6%
Czech Republic	-7 959	133 496	-6%	2.9%
Estonia	-4 263	20 956	-20%	0.5%
Hungary	-3 787	66 148	-6%	1.4%
Latvia	-17 179	11 494	-149%	0.3%
Lithuania	-10 483	21 612	-49%	0.5%
Malta	-60	3 021	-2%	0.1%
Poland	-21 912	399 390	-5%	8.7%
Romania	-25 305	123 346	-21%	2.7%
Slovakia	-7 467	45 297	-16%	1.0%
Slovenia	-9 619	19 509	-49%	0.4%
EU-28	**-297 115**	**4 578 469**	**-6%**	**100.0%**

4.11.2. LULUCF under the Kyoto Protocol

The EU submission under the KP-LULUCF refers to EU-15 because the EU-15 has a common target for the first commitment period under the Kyoto Protocol. The KP-LULUCF inventory is compiled by adding together the removals and emissions for elected activities from the supplementary KP-LULUCF reporting of each individual EU-15 Member State. It is important to note that KP units are issued and cancelled at MS level. Therefore, all the emissions/removals and any information on KP-LULUCF activities presented here at EU level are shown for information purpose only.

Ten EU-15 Member States have elected forest management, while only three Member States have elected cropland management, two have elected grazing land management; no EU-15 Member State has elected revegetation (*Table [BR1] 4-9*). Only two MS have chosen annual accounting. CTF Table 4(a)ii in the CTF Appendix shows the net emissions/removals from activities under 3.3 and 3.4 of the Kyoto Protocol and the related accounting quantities for the years 2008-2011.

CTF Table 4 in the CTF Appendix shows the contribution of KP-LULUCF units towards fulfillment of the Kyoto target. For the calculation of accounting quantities of activities under KP Articles 3.3 and 3.4 (crop management, grazing land management and revegetation) in CP1, averages have been calculated by dividing the sums by four (for the years 2008-2011). For the accounting of forest management activities the forest management cap has to be divided by five as the numbers refer to the whole period of 2008-2012, whereas forest management offsets have to be divided by four. This calculation has been conducted in *Table [BR1] 4-8*, explaining the linkage between CTF tables 4 and 4(a)ii.

Table [BR1] 4-8 Calculation of projected net carbon stock change in CP1

	Article 3.3		Article 3.4					Average net carbon stock change during 2008-2011		
	Afforestation and Reforestation	Deforestation	Forest Management 3.3 offset	Forest Management Cap	Cropland Management	Grazing Land Management	Revegetation	Article 3.3	Article 3.4	**Total**
	Mt CO_2 eq							Mt CO_2 eq per year		
EU-15	-185.77	117.20	-41.49	-128.73	-32.78	-9.70	NA	-17.14	-46.74	**-63.88**
EU-28	-226.55	133.24	-45.82	-197.94	-32.78	-9.70	4.05	-23.33	-60.65	**-83.98**

The CTF Appendix includes CTF Table 4 and CTF Table 4(a)ii for both EU-15 and EU-28. The reason for this is that the EU-15 has a joint target under the KP's first commitment period, whereas the target under the KP's second commitment period will be related to EU-28[533]. In the CTF Appendix, the EU does not report in CTF Table 4(a)i as this table is only relevant for Parties which are not Parties to the Kyoto Protocol.

Table [BR1] 4-9 Activities elected under Art. 3.4 and accounting frequency

EU-15 MS	Art 3.4 elected activities	Accounting frequency
Austria	-	end of CP
Belgium	-	end of CP
Denmark	FM, CM, GM	annual
Finland	FM	end of CP
France	FM	annual
Germany	FM	end of CP
Greece	FM	end of CP
Ireland	-	end of CP
Italy	FM	end of CP
Luxemburg	-	end of CP
Netherlands	-	end of CP
Portugal	FM, CM, GM	end of CP
Spain	FM, CM	end of CP
Sweden	FM	end of CP
UK	FM	end of CP

Note: FM: forest management, CM: cropland management, GM: grazing land management, RV: revegetation, CP: commitment period.

4.12. Use of units from the market-based mechanisms and land use, land-use change and forestry activities

The use of units from market-based mechanisms and land use, land-use change and forest activities (LULUCF) from 2008 to 2012 count towards achievement of the Kyoto Protocol targets for the first commitment period (CP1).

Final data on surrendered units is available only for the EU ETS for these years. Final CP1 compliance actions for sectors which are not covered by the EU ETS will take place when reviewed inventory data will be available for the complete period, in the "true-up" period in 2015. As a result, data on the final use of flexible mechanisms and sinks is not available for the 1st BR.

Table [BR1] 4-10 shows the annual quantities of units which have been included in the retirement account in the respective years for the EU Member States.[534] They sometimes equal the amount of ETS units surrendered in the years before, but there is no obligation to retire those units immediately. Hence, the total retired amount for some Member States is lower than the units surrendered in 2008-2011. In others, the amounts are higher because the respective governments decided to retire units before the end of the "true-up" period. Generally the amount of units already retired is not an indicator for fulfilment of the target of the first commitment period.

533 As Cyprus and Malta do not have targets under the KP's 1st Commitment Period, no contributions were calculated for these MS.

534 CTF Table 4b in the CTF Appendix repeats the EU-15 and EU-28 sums shown in Table [BR1] 4-10.

Table [BR1] 4-10 Annual quantities of units which have been included in the retirement account of EU Member States

	AAUS			ERUs			RMUs			CERs			tCERs + lCERs			Units from market-based mechanisms under the Convention + other		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
Austria	26 892	84 450	28 671	3	5	34	NO	NO	NO	389	1 193	1 956	NO	NO	NO	NO		
Belgium	45 538	49 458	39 938	4	75	551	NO	NO	NO	635	566	5 680	NO	NO	NO	NO		
Denmark	25 322	24 447	55 297		2	2 283	NO	NO	288	163	823	1 197	NO	NO	NO	NO		
Finland	32 866	39 383	31 402	131	150	633	NO	NO	NO	1 371	1 767	3 048	NO	NO	NO	NO		
France	106 868	110 182	76 854	304	681	3 339	NO	NO	NO	3 967	4 406	24 181	NO	NO	NO	NO		
Germany	854 570	418 523	907 807	671	4 195	33 232	NO	NO	NO	49 721	33 374	41 123	NO	NO	NO	NO		
Greece	63 506	56 267	44 279	21	8	2 710	NO	NO	NO	134	3 650	7 472	NO	NO	NO	NO		
Ireland	16 992	16 231	13 829		395	844	NO	NO	NO	224	730	1 114	NO	NO	NO	NO		
Italy		567 758	170 503		752	4 809	NO	NO	NO		28 578	14 794	NO	NO	NO	NO		
Luxembourg	4 170	2 065	1 810				NO	NO	NO	110	188	242	NO	NO	NO	NO		
Netherlands	204 470	84 411	187 737			895	NO	NO	NO			7 387	NO	NO	NO	NO		
Portugal	26 780	22 566	21 983		320	93	NO	NO	NO	1 528	1 278	2 898	NO	NO	NO	NO		
Spain	110 996	105 878	105 190	44	3 573	6 836	NO	NO	NO	25 886	12 174	20 601	NO	NO	NO	NO		
Sweden	17 083	21 846	18 594		0	19	NO	NO	NO	430	791	1 595	NO	NO	NO	NO		
United Kingdom	0	456 830	204 600	0	1 846	1 339	NO	NO	NO	0	11 034	14 632	NO	NO	NO	NO		
EU-15	1 536 052	2 060 296	1 908 493	1 178	12 003	57 618	0	0	288	84 557	100 552	147 921	0	0	0	NO		
Bulgaria	69 925	30 528	0		704	0	NO	NO	NO		2 296	0	NO	NO	NO	NO		
Croatia	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		
Cyprus																		
Czech Republic		219 836	67 795		754	3 085	NO	NO	NO		9 383	3 113	NO	NO	NO	NO		
Estonia	10 115	14 345	15 072			141	NO	NO	NO			17	NO	NO	NO	NO		
Hungary	49 639	21 454	20 459		486	687	NO	NO	NO		1 146	1 357	NO	NO	NO	NO		
Latvia	2 001	3 011	2 848	9	18	22	NO	NO	NO	480	212	54	NO	NO	NO	NO		
Lithuania	3 777	5 563	4 076	462	183	1 165	NO	NO	NO	1 551	648	363	NO	NO	NO	NO		
Malta																		
Poland	379 708	184 382	0	245	1 816	0	NO	NO	NO	14 928	13 912	1	NO	NO	NO	NO		
Romania	45 187	39 011	51 239	328	4 151	0	NO	NO	NO	3 403	4 325	0	NO	NO	NO	NO		
Slovakia	43 588	17 818	21 251		12	104	NO	NO	NO	3 344	4 363	1 018	NO	NO	NO	NO		
Slovenia	7 533	7 626	7 204	170	379	631	NO	NO	NO	368	121	166	NO	NO	NO	NO		
EU-28	2 147 524	2 603 870	2 098 438	2 392	20 507	63 453	0	0	288	108 631	136 958	154 009	0	0	0	NO		

Note: Cyprus and Malta do not have a target under the Kyoto Protocol's 1st Commitment Period
AAU: Assigned Amount Unit; ERU: Emission Reduction Unit; RMU: Removal Unit; CER: Certified Emission Reduction; tCER: Temporary Certified Emission Reduction; lCER: Long-term Certified Emission Reduction

In *Table [BR1] 4.11* below, a complete overview of preliminary results about the use of units of Kyoto Mechanisms and sinks to achieve the targets in the first commitment period is shown, based on the results published in the Trends and Projection Report of the EEA[535]. Information on the planned governmental use of flexible mechanisms is displayed by Member States, as it has been reported by questionnaires under the biennial submission from Member States to the European Commission under the EU Monitoring Mechanism Decision[536]. The use of flexible mechanisms surrendered in EU ETS is derived from an extraction from the European Union Transaction Log (EUTL) of July 2013 (see also section 4.2.2.4). The projected use of reductions from sinks under Article 3.3 and 3.4 is the average for the 2008-2011 period, which has been calculated from KP tables submitted to UNFCCC by Member States in 2013[537].

Taking into account approximated emissions for the year 2012[538], ten EU-28 Member States (Austria, Belgium, Denmark, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Slovenia and Spain) will not achieve their KP objective through domestic emissions reductions or limitations alone. If the effect of annual average carbon sinks is taken into account, Ireland and Portugal and Slovenia will reach their KP targets. For the other Member States it will be necessary to make use of the flexible mechanisms.

The combined intended governmental use of flexible mechanisms by EU-15 is expected to represent an increase in the overall EU emission budget by 403 Mt CO_2-equivalent (see*Table [BR1] 4.11*). Nine Member States have allocated financial resources with a total amount of €2 351 million for the whole 5-year commitment period[539]. The total use of flexible mechanisms under the EU ETS totals 808 million units for EU-15 in the years 2008-2012. The expected effect of LULUCF in the EU-15 corresponds to a removal of 319 Mt CO_2 for the complete first commitment period.

Of the other EU Member States which have a Kyoto target, eight Member States (Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Romania and Slovakia) have reported their intention to sell a certain amount of Kyoto units to other parties.

The expected effect of LULUCF in the EU-28 corresponds to the average removal of 420 Mt CO_2 for the complete first commitment period.

In total the estimated effect of the use of flexible mechanisms in CP1 (in the EU ETS and governmental) for EU-28 amounts to 1 056 Mt $CO_{2eq,}$ about 4 % of initial AAU. Carbon sink activities of EU-28 are expected to contribute towards an additional emission reduction of 420 Mt CO_{2eq} in CP1.

535 EEA 2013 Trends and Projections Report, http://www.eea.europa.eu/publications/trends-and-projections-2013.

536 Decision no 280/2004/EC.

537 With regard to the calculation of accounting quantities see section 4.11.2.

538 EEA 2013: Approximated EU GHG inventory: Proxy GHG estimates for 2012. http://www.eea.europa.eu/publications/approximated-eu-ghg-inventory-2012 .

539 The total budget calculated for EU-15 and EU-28 do not include the expected benefits of AAU sales.

Table [BR1] 4.11 Use of flexible mechanisms and sinks in the first commitment period

Member State	Planned use of Kyoto mechanisms at governemnt level	Type of Kyoto mechanisms for government use	Allocated budget at government level	Intended total use of flexible mechanisms at government level	Actual use of flexible mechanisms (CDM and JI) in ETS	Total use of flexible Mechanisms in CP1	Projected use of reductions from sinks under Art. 3.3 and 3.4
	Yes/No	IET, JI, CDM	€ million	Mt CO_2eq	Mt CO_2eq	Mt CO_2eq	Mt CO_2eq
Austria	Yes	IET, JI, CDM	611.0	80.0	14.0	94.0	6.1
Belgium	Yes	IET, JI, CDM	240.6	29.4	19.1	48.5	-1.1
Bulgaria	Yes	IET, JI	-	-7.0	23.4	16.4	2.7
Croatia	No	-	-	0.0	not app.	0.0	4.9
Cyprus		not applicable			2.6	2.6	not app.
Czech Republic	Yes	-	-	-125.0	38.6	-86.4	6.5
Denmark	Yes	IET, JI, CDM	187.7	12.0	12.5	24.5	8.9
Estonia	Yes	JI, IET	-	-73.6	2.7	-70.9	-2.1
Finland	No	JI, CDM	-	0.0	16.3	16.3	2.9
France	No	-	-	0.0	75.6	75.6	16.1
Germany	No	-	-	0.0	302.2	302.2	49.9
Greece	No	-	-	0.0	27.9	27.9	3.2
Hungary	Yes	-	-	-20.0	9.8	-10.2	11.1
Ireland	Yes	IET, JI, CDM	290.0	9.7	6.6	16.3	17.0
Italy	Yes	IET, JI, CDM	-	10.2	95.5	105.7	83.9
Latvia	Yes	JI, IET	-191.1	-40.4	1.6	-38.7	6.2
Lithuania	Yes	JI	-	-70.7	6.8	-63.9	5.6
Luxembourg	Yes	IET, JI, CDM	150.0	14.0	0.8	14.8	-0.3
Malta		not applicable			1.1	1.1	not app.
Netherlands	Yes	IET, JI, CDM	364.5	46.0	28.6	74.6	-1.8
Poland	Yes	IET, JI	-	0.0	95.6	95.6	42.2
Portugal	Yes	IET, JI, CDM	124.8	8.1	14.7	22.8	49.0
Romania	Yes	IET, JI	-	-13.0	32.2	19.2	15.1
Slovakia	Yes	IET, JI	-	-42.0	10.0	-32.0	1.8
Slovenia	Yes	IET, JI, CDM	80.0	5.0	6.2	11.2	6.6
Spain	Yes	IET, JI, CDM	382.2	194.0	107.1	301.1	56.7
Sweden	No	-	-	0.0	10.1	10.1	10.6
United Kingdom	No	-	-	0.0	77.4	77.4	18.2
EU-15	**Yes**	**IET, JI, CDM**	**2 350.7**	**403.4**	**808.3**	**1 211.7**	**319.4**
EU-28	**Yes**	**IET, JI, CDM**	**2 430.7**	**16.7**	**1 038.9**	**1 055.6**	**419.9**

Note: In the aggregation for EU-28 Malta and Cyprus are not included with regard to the use of flexible mechanisms by government and on the projected use of sinks as they have no individual target under the Kyoto Protocol. Croatia is not included in EU ETS in the period 2008-2012.

Source: EEA 2013 Trends and Projections Report

In the electronic reporting facility provided by the UNFCCC secretariat, the numbers from CTF Table 4b are automatically filled into CTF Table 4 in the CTF Appendix for the reporting on progress, in row "Market-based mechanisms under the Convention". As discussed above, the reporting on retired units does not explain the projected progress at this stage in time. Taking into account the projected annual contribution of sinks and governmental use of flexible mechanisms[540], the reporting on progress in

540 The use of flexible mechanisms under the EU ETS is not reported in this table as it does not increase the quantity of emission allowances (Kyoto units) within the registry of Parties.

Table 4 would result in an overview for the reporting on progress as shown in *Table [BR1] 4.12*. The contribution from LULUCF derives from the calculation of the accounting of sinks as shown in *Table [BR1] 4-8*, whereas the use of market-based mechanisms under the convention is calculated as the average of total intended use at governmental level in CP1 from *Table [BR1] 4.11*.

Table [BR1] 4.12 Report on progress (similar to CTF Table 4)

		Base Year	2010	2011	2012	Comment
		Mt CO_2 eq				
EU-15						
	Total (without LULUCF)	4 265.52	3 790.22	3 630.66		
	Contribution from LULUCF		-63.88	-63.88	-63.88	Average projected accounting of activites under Article 3.3 and 3.4, see chapter [BR1] 4.11
	Market-based mechanisms under the Convention		80.68	80.68	80.68	Planned average use of flexible meachnisms
	Other market-based mechanisms		0	0	0	
EU-28						
	Total (without LULUCF)	5 791.12	4 733.82	4 578.47		
	Contribution from LULUCF		-83.98	-83.98	-83.98	Average projected accounting of activites under Article 3.3 and 3.4, see chapter [BR1] 4.11
	Market-based mechanisms under the Convention		3.33	3.33	3.33	Planned average use of flexible meachnisms
	Other market-based mechanisms		0	0	0	

5. PROJECTIONS

5.1. Introduction

This section presents projections of GHG emissions for two scenarios, the "with existing measures scenario" (WEM) and the "with additional measures scenario" (WAM), differentiated by sector and by gas and aggregated to EU-28 level.

Projections are presented for 2015, 2020, 2025 and 2030. All emissions and projections are displayed in CO_2 equivalents and excluding emissions or removals from Land Use, Land Use Change and Forestry (LULUCF).

Projections of emissions related to fuel sold to ships and aircrafts engaged in international transport are not included in the totals reported in this section, unless noted otherwise.

5.1.1. Context

The projections of GHG emissions for EU-28 are based on individual national projections of Member States' submissions to the European Commission under the Decision 208/2004/EC (the Monitoring Mechanism Decision) in 2013.

EEA's European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM) has compiled the national projections and applied QA/QC procedures to ensure consistency of the data reported by MS. This process is described in section 5.6.1.4.

The data used for the EU-28 emission projections conforms with the EEA's and Commission's 2013 reports on progress towards the Kyoto target[541].

- The scenarios which are reported are documented in Section 5.1.2.
- Projections are, unless otherwise noted, reported excluding governmental use of Kyoto mechanisms and without carbon sinks, and excluding emissions from international aviation and marine bunkers.
- Unless otherwise noted, reported emissions refer to the second commitment period (CP2).
- The sector breakdown reported follows the structure of the CTF Tables provided in ***Error! Reference source not found.*** and includes: Energy (without transport), transport, industry/industrial processes, agriculture, waste, other sector[542].
- The gases which are covered are: CH_4 emissions excluding LULUCF, CO_2 emissions excluding LULUCF, N_2O emissions excluding LULUCF and total F-Gases.
- Figures represent historic GHG emissions up to 2011. Projections are represented starting 2010. Thus, there is an overlap of historic and projected values. Note that if 2010 and 2011 GHG emission trajectories do not match this is due to the fact that projected GHG emissions were aggregated from

541 The report is available for download from EEA at : http://www.eea.europa.eu/publications/trends-and-projections-2013. The Commission report is available online at: http://ec.europa.eu/clima/policies/g-gas/docs/com_2013_698_en.pdf

542 The Other Sector is reported as the sum of sectors 3 and 7 (solvent and other product use, and other sector).

individual Member State projections, which may not have taken into account the latest inventory values as the base year in the preparation of their projections.

5.1.2. Scenarios

Member State projections are based on different methodologies, and different activities for QA/QC have been applied. With this, the inclusion of polices and measures and the estimation of impacts cannot be completely harmonised. To improve consistency, the Commission had provided Member States with recommendations of what and how EU measures should be taken into account when preparing national projections. In addition not all national projections include WAM scenarios, and for some an adjustment to most the latest available inventory data was necessary (documented in Section 5.6.1.4).

With existing measures scenario (WEM)

The EU 'with existing measures' (WEM) projection represents a business-as-usual scenario aggregated from 28 national WEM projections where only policies and measures that have been adopted or already implemented in the Member State, and as far as covered by national projections, are considered. With regard to EU policy coverage the WEM projection is thus a conservative scenario. All EU-28 Member States that submitted 2013 projections reported WEM projection scenarios. For Member States that did not submit new projections in 2013, the most recent projections data available was used. For emission trends for missing time periods (e.g. if national projections only covered the period up to 2020), or in case of the new Member State, Croatia, for the entire WEM scenario, the EU-28 2013 climate policy "baseline with adopted measures" scenario (EUCLIMIT BAM, see section [BR] 5.4.1 for more details) for this Member State has been used for gap-filling purposes.

With additional measures scenario (WAM)

The 'with additional measures' (WAM) projection represents a scenario where all planned measures are considered to be fully and timely implemented. The GHG emissions projected by the WAM scenario are therefore lower than the WEM projections. Relative to the WEM scenario for which all Member States reported their projections, less Member States reported a 'with additional measures' scenario.

In this case, in order to compile an aggregated data set for the EU-28, the data was gap filled by using WEM projections.

5.1.3. Key parameters and assumptions

The key parameter assumptions of individual Member States are documented in their national projections and, in addition, were aggregated to obtain information relating to the EU-28. The Commission provided Member States with recommended parameter values for the evolution of the EU ETS CO_2 price and for international fuel import prices and provided default values for GDP and population to improve consistency of Member State projections. In national projections these were used to a varying extent. In the case of different national assumptions, Member States were invited to use the recommended values for sensitivity analysis.

For documentation of the EU-28 projection, key parameters have been derived as weighted averages/sums of the values of key parameters as reported by Member States. These are shown for EU-28 in Table [BR1] 5-3 and in **Error! Reference source not**

found. (CTF Table 5). The key parameters derived in this way are: GDP, population, international fuel import prices (oil, gas, coal) and EU ETS CO_2 price.

5.2. Projections

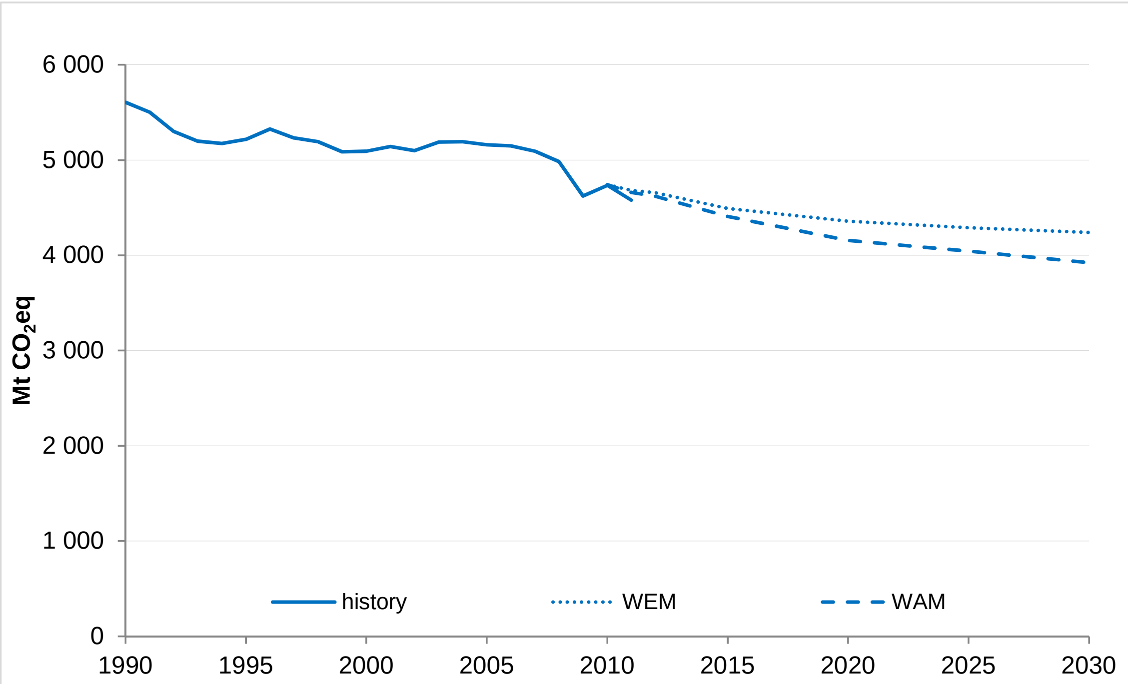
5.2.1. Total aggregate GHG emission projections

Figure [BR1] 5-1 presents total aggregate GHG emissions for EU-28. The figure includes historic values (solid lines) and projected values for both the WEM (dotted line) and WAM scenario (dashed line).

In the **WEM** scenario, total **EU-28** GHG emissions decrease from 5 606 Mt CO_2eq in 1990 to 4 359 Mt CO_2eq in 2020 and 4 239 Mt CO_2eq in 2030.

In the **WAM** scenario they decrease to 4 156 Mt CO_2eq in 2020 and 3 922 Mt CO_2eq in 2030.

Figure [BR1] 5-1 Total, aggregate, absolute historic and projected GHG emissions for EU-28



5.2.1.1. Total aggregate GHG emission projections per sector

Figure [BR1] 5-2 provides a qualitative impression of sector shares on projected total aggregate GHG emissions for EU-28. Detailed numerical data is available in CTF Table 6(a/c) in the CTF Appendix.

Figure [BR1] 5-2 Sector breakdown of projected total aggregate GHG emissions in the EU-28; WEM and WAM scenario

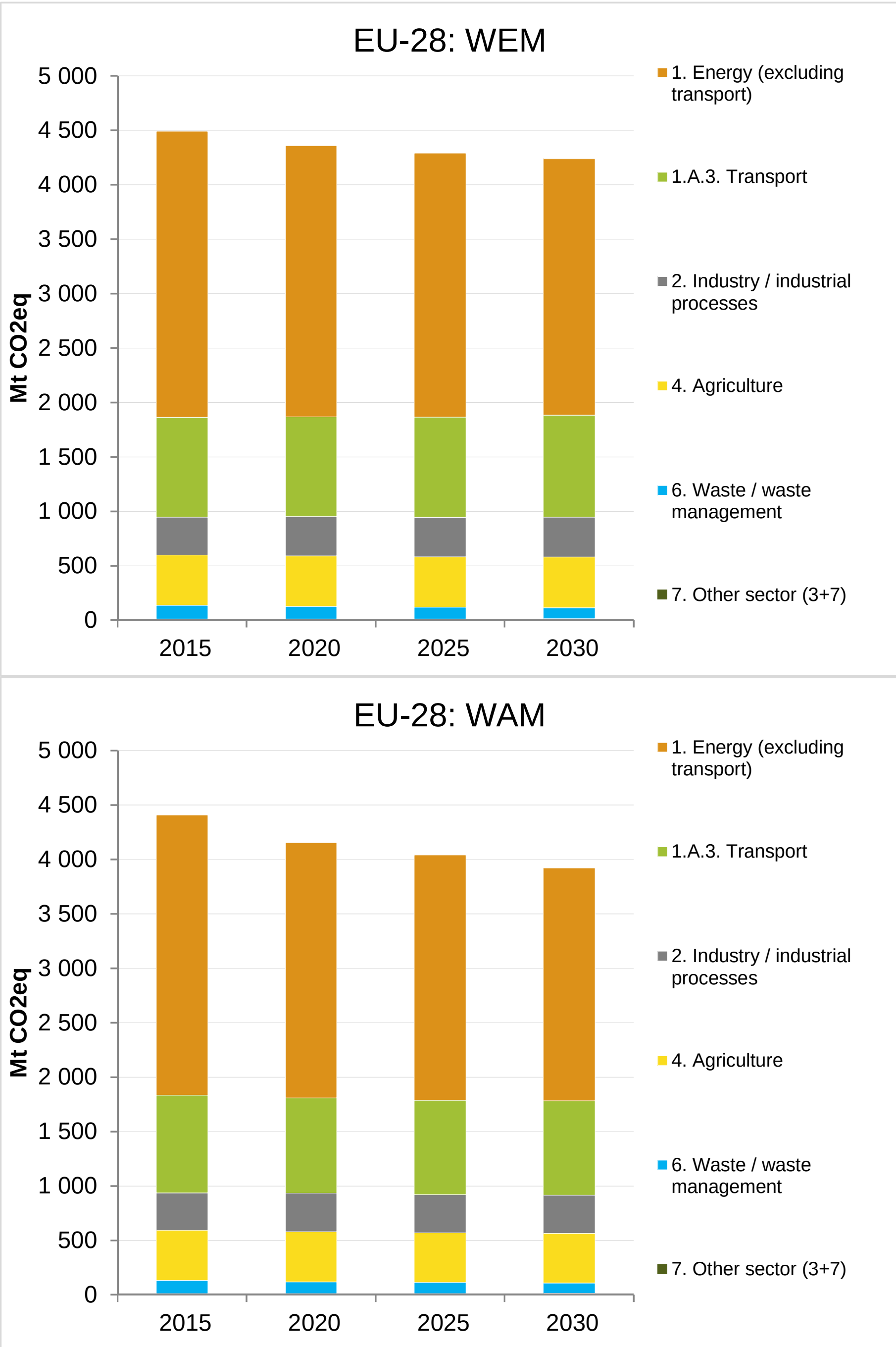


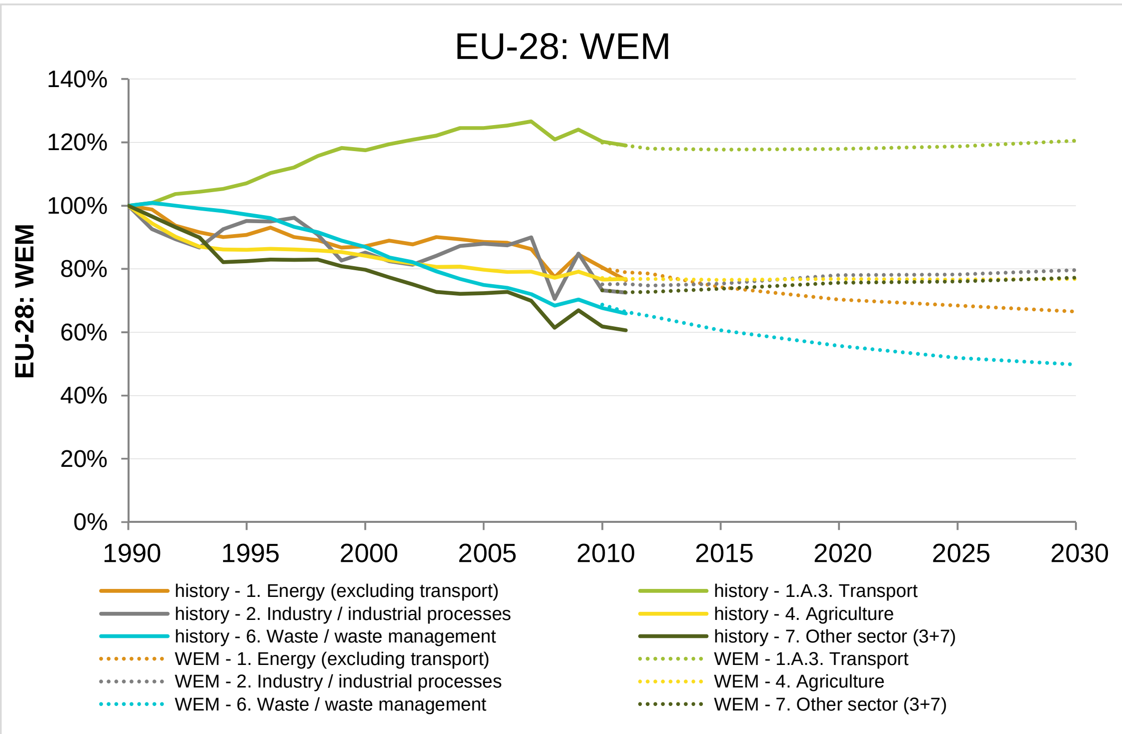
Figure [BR1] 5-3 provides information on total aggregate GHG emissions on sector level relative to 1990. EU-28 projections are shown for 2010, 2011, 2012, 2015, 2020, 2025 and 2030 excluding carbon sinks and governmental use of Kyoto Mechanisms for each sector.

In the **EU-28 WEM** scenario, total aggregate GHG emissions are projected to be 1 247 Mt CO_2eq (22.2 %) below 1990 levels in **2020** and 1 367 Mt Mt CO_2eq below 1990 levels in **2030**. The contribution of sectors to emission changes again varies strongly: The most significant contribution of absolute GHG emission reductions in the EU-28 from **1990 to 2020** is projected to stem from the energy sector (1 051 Mt CO_2eq), followed by the agricultural sector (140 Mt CO_2eq) and the industrial sector (101 Mt CO_2eq). GHG emissions in the transport sector increase by 139 Mt CO_2eq until 2020. The most significant amount of absolute GHG emission reductions in the EU-28 from **1990 to 2030** is projected to stem from the energy sector (1 186 Mt CO_2eq), followed by the agricultural sector (140 Mt CO_2eq) and the waste sector (102 Mt CO_2eq). GHG emissions in the transport sector increase by 159 Mt CO_2eq.

In the **EU-28 WAM** scenario**,** total aggregate GHG emissions are projected to be 1 450 Mt (25.9 %) below 1990 levels in **2020** and 1 684 Mt below 1990 levels in **2030**. The most significant amount of absolute GHG emission reductions in the EU-28 from **1990 to 2020** is projected to stem from the energy sector (1 194 Mt CO_2eq), followed by the agricultural sector (144 Mt CO_2eq) and the industrial sector (108 Mt CO_2eq). GHG emissions in the transport sector increase by 97 Mt CO_2eq. The most significant amount of absolute GHG emission reductions in the EU-28 from **1990 to 2030** is projected to stem from the energy sector (1 401 Mt CO_2eq), followed by the agricultural sector (148 Mt CO_2eq) and the industrial sector (113 Mt CO_2eq). GHG emissions in the transport sector increase by 89 Mt CO_2eq.

Figure [BR1] 5-3 and *Figure [BR1] 5-4* show the total changes in GHG emissions for WEM and WAM scenarios for the EU-28.

Figure [BR1] 5-3 EU-28 GHG emissions per sector in the WEM and WAM scenario; relative to 1990



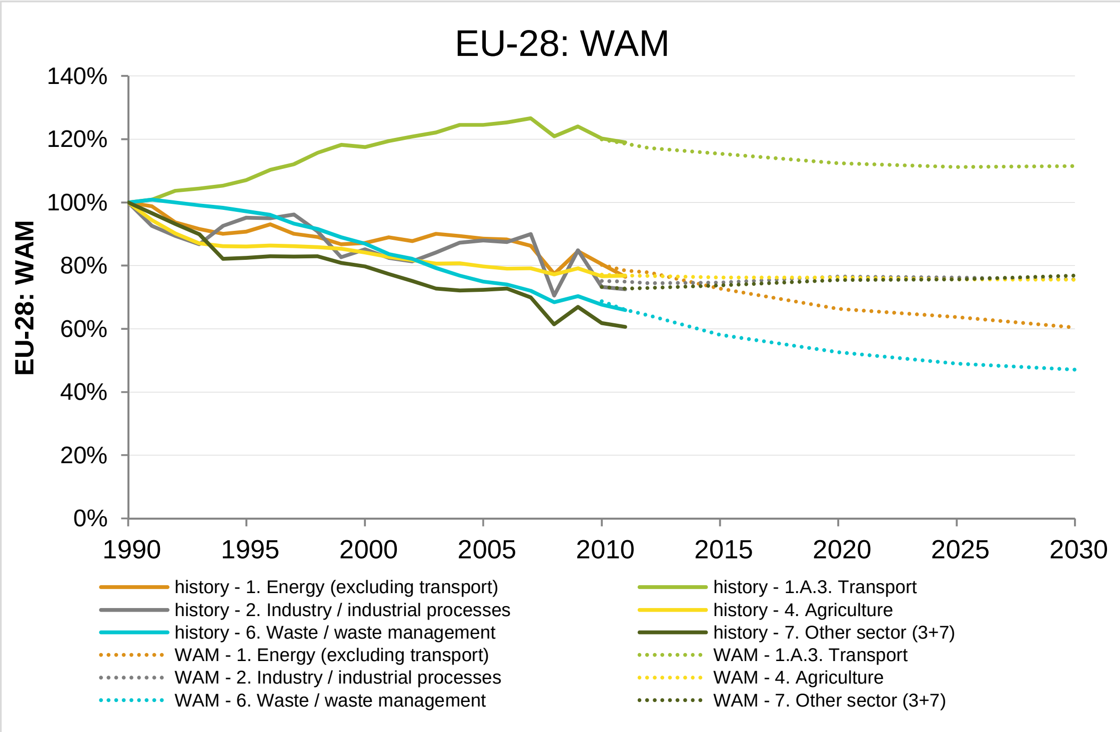
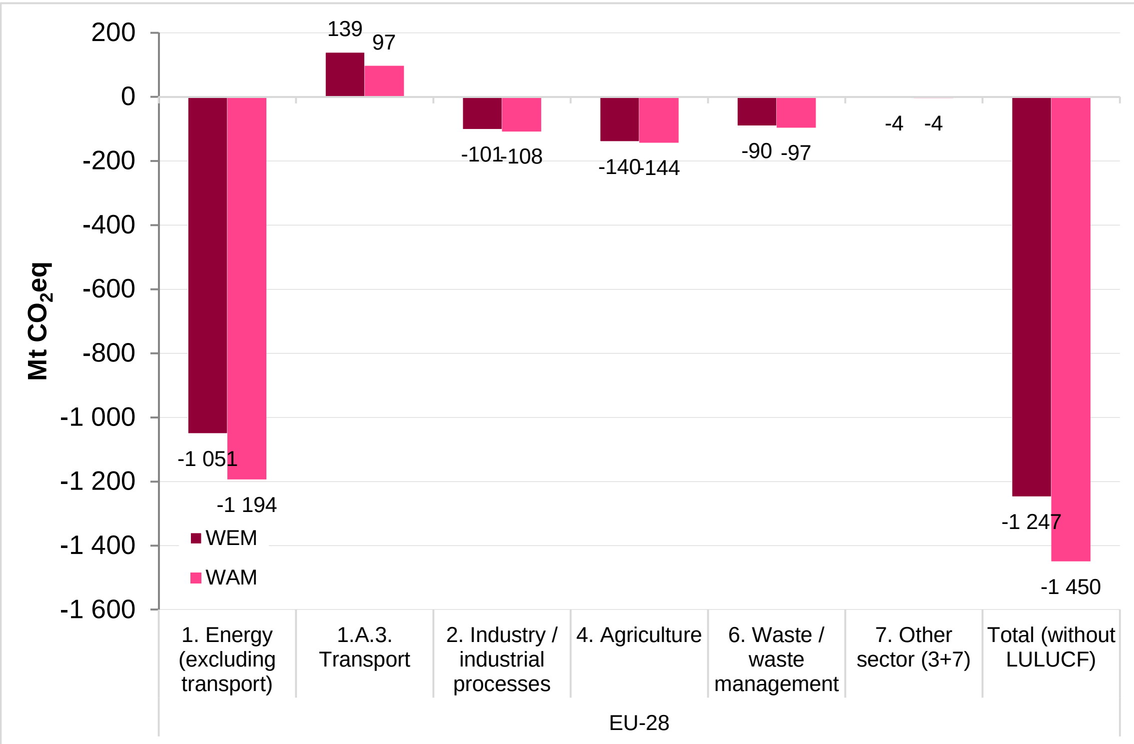


Figure [BR1] 5-4 Absolute projected GHG emission changes from 1990 and 2020 for EU-28; WEM and WAM scenario



The common factors which drive historic trends and projections are discussed in more detail in Section 2 of this report and in the national inventory and projection reports of individual Member States. Policies and measures which influence GHG emissions in each sector are discussed in more detail in Section 4 of this report.

5.2.1.2. Total aggregate GHG emission projections per gas

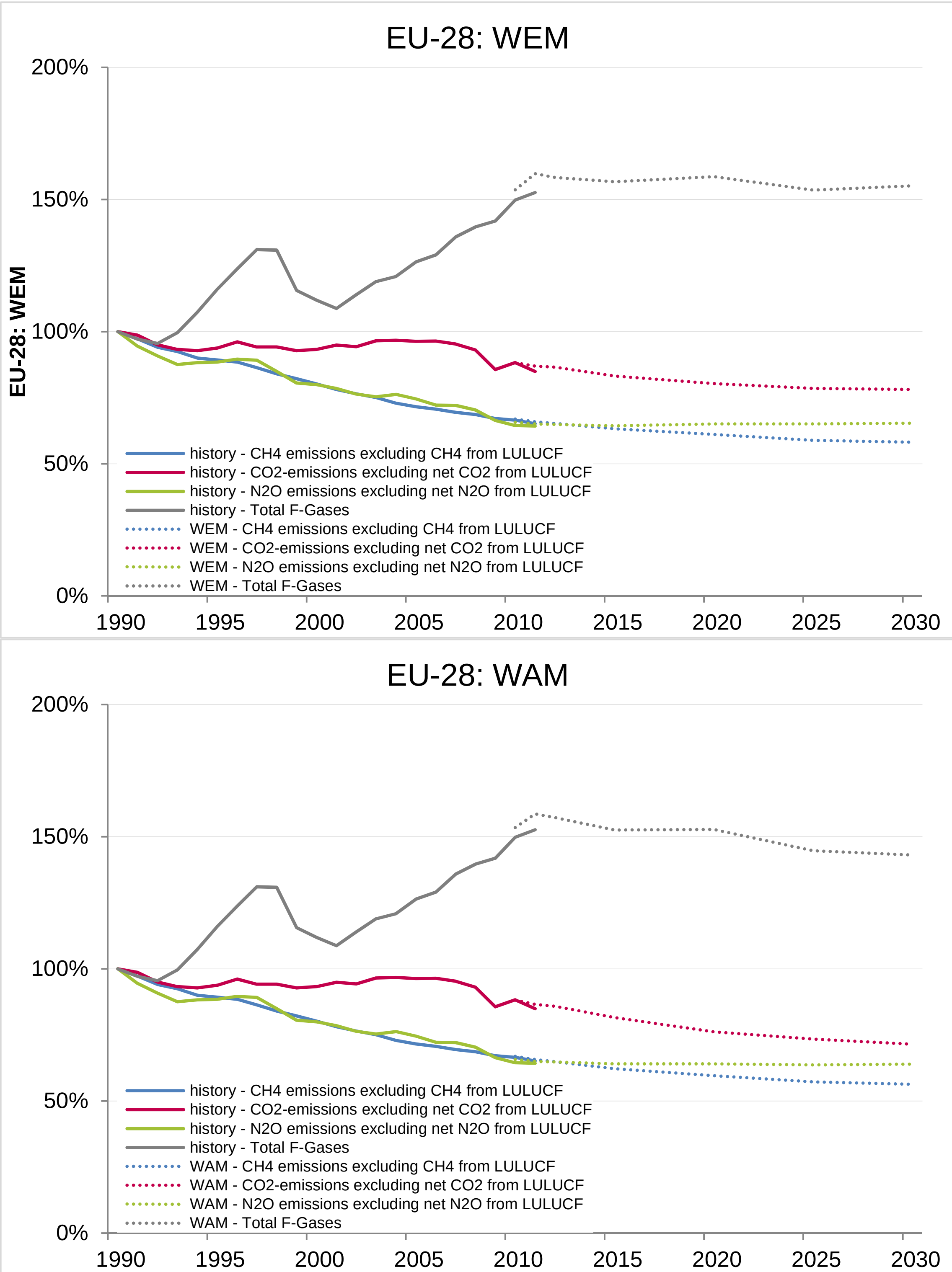
Figure [BR1] 5-5 below illustrates the expected change in emissions from individual greenhouse gases between 1990 and 2030 under the "with existing measures" and "with additional measures" scenarios.

The projected overall reduction GHG emissions (excluding LULUCF) for **1990-2020** under the **WEM** scenario is 1 247 Mt CO_2eq in the EU-28 and 1 367 Mt CO_2eq for **1990-2030**. Reductions in CO_2 emissions are expected to contribute the most to overall emission reductions, the absolute reduction of CO_2 emissions in **1990-2020** under the **WEM** scenario are projected to be 869 Mt CO_2eq in the EU-28. Reductions in CH_4 emissions are projected to amount to 232 Mt CO_2eq. N_2O emissions are projected to be reduced by 182 Mt CO_2eq. F-gases are the only gases projected to increase relative to 1990 levels. However, the absolute contribution of F-gases to overall emissions is less significant: the projected additional F-gas emissions in 2020 compared to 1990 levels are 35 Mt CO_2eq in the EU-28 under the WEM scenario. The absolute reduction of CO_2 emissions in **1990-2030** under the **WEM** scenario is projected to be 972 Mt CO_2eq. Reductions in CH_4 emissions are 249 Mt CO_2eq. N_2O emissions are projected to be reduced by 180 Mt CO_2eq. F-gases are the only gases projected to increase relative to 1990 levels: the projected additional F-gas emissions in 2020 compared to 1990 levels are 33 Mt CO_2eq in the EU-28 under the WEM scenario.

The projected overall reduction in greenhouse gas emissions (excluding LULUCF) in **1990-2020** under the **WAM** scenario is 1 450 Mt CO_2eq in the EU-28 and 1 684 Mt CO_2eq in **1990-2030**. Reductions in CO_2 emissions are expected to contribute the most: the absolute reduction of CO_2 emissions in **1990-2020** is projected to be 1 054 Mt CO_2eq. Reductions in CH_4 emissions are projected to be 240 Mt CO_2eq. N_2O emissions are projected to decrease by 187 Mt CO_2eq. F-gases are the only gases projected to increase relative to 1990 levels: The projected additional F-gas emissions in 2020 compared to 1990 levels are 32 Mt CO_2eq in the EU-28 considering also additional measures of the WAM scenario. The absolute reduction of CO_2 emissions in **1990-2030** is projected to be 1 262 Mt CO_2eq in the EU-28, reductions in CH_4 emissions are projected to be 260 Mt CO_2eq. N_2O emissions are projected to decrease by 188 Mt CO_2eq. The projected additional F-gas emissions in 2030 compared to 1990 levels are 26 Mt CO_2eq in the EU-28 considering also additional measures of the WAM scenario.

CTF Table 6 in the CTF Appendix contain detailed inventory and projections data, including overall EU-28 projections split by gas and sector for the years 1990, 1995, 2000, 2005, 2010, 2011, 2015, 2020, 2025, 2030.

Figure [BR1] 5-5 EU-28 GHG emissions per gas relative to 1990; WEM and WAM scenario



5.2.2. *GHG emission projections per UNFCCC sector (level 1) and separately for bunker fuels*

5.2.2.1. Energy

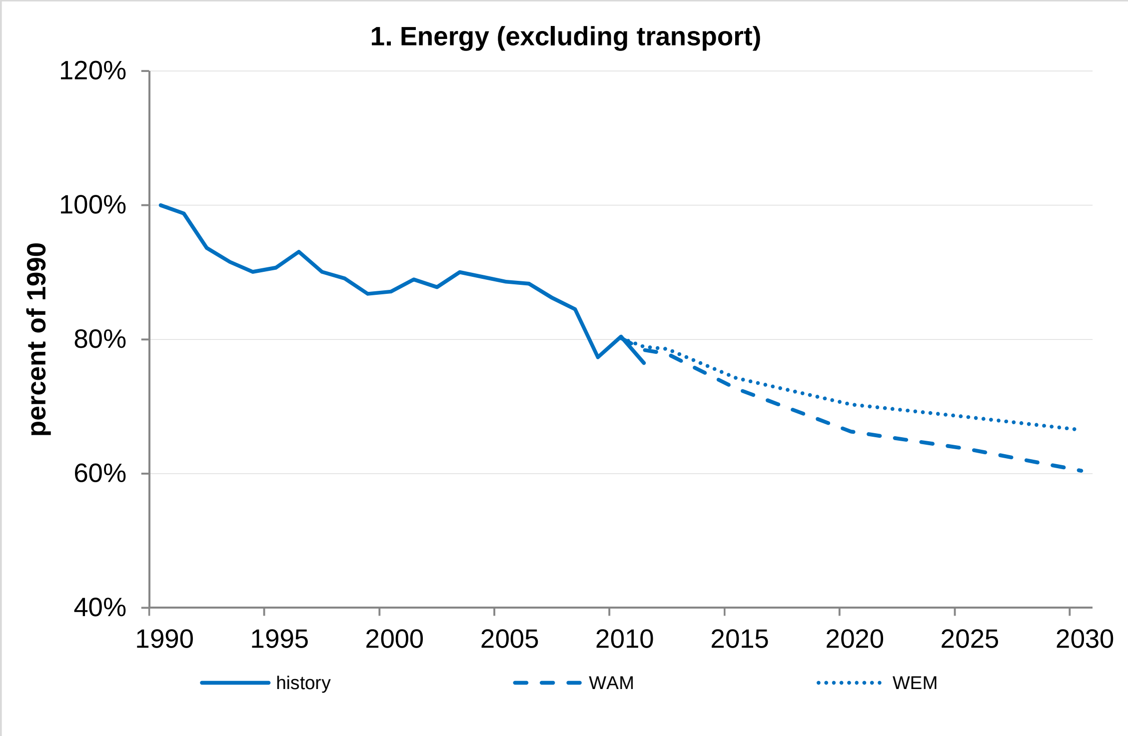
Figure [BR1] 5-6 shows the GHG emissions and projections from the energy sector excluding transport.

For the EU-28, GHG emissions from the energy sector (excluding transport) have fallen since 1990, mainly due to fuel switching to gas (also reducing CH_4 emissions from coal mining), increased energy and technical efficiency, decreases in fuel combustion in manufacturing industries and construction and restructuring of industry in the new Member States. In part, such reductions have been counteracted by increased housing stock and growth in the services sector, resulting in increased demand for energy services in buildings and homes, and in particular strong growth in demand for electricity to provide these. In addition, recent economic growth in the new Member States has begun to increase demand for energy services. In general, EU-28 GHG emissions from the energy sector show a gradual downward trend from 1990 to the present day, with a short and steep decrease during the economic crisis, after which they increased again to pre-crisis levels and continue with the downward trend also in projections.

Projections for the sector demonstrate Member States' expectations that emissions from the sector will decrease as effects of existing policies and measures, both in the EU-28. The actual magnitude of the decreases in GHG emissions from the energy sector that can be reached up to 2020 and 2030 is also dependent on the successful implementation of planned additional measures.

EU-28 GHG emissions from energy under the **WEM** scenario are projected to decrease to 29.7 % below 1990 levels by 2020, and 33.5 % by 2030, while the decreases would reach 33.7 % below 1990 levels by 2020, and 39.6 % by 2030 if additional policies and measures are also considered (see Figure [BR1] 5-6).

*Figure [BR1] 5-6	Projected EU-28 GHG emissions relative to 1990 in the energy sector (excluding transport)*



5.2.2.2. Transport

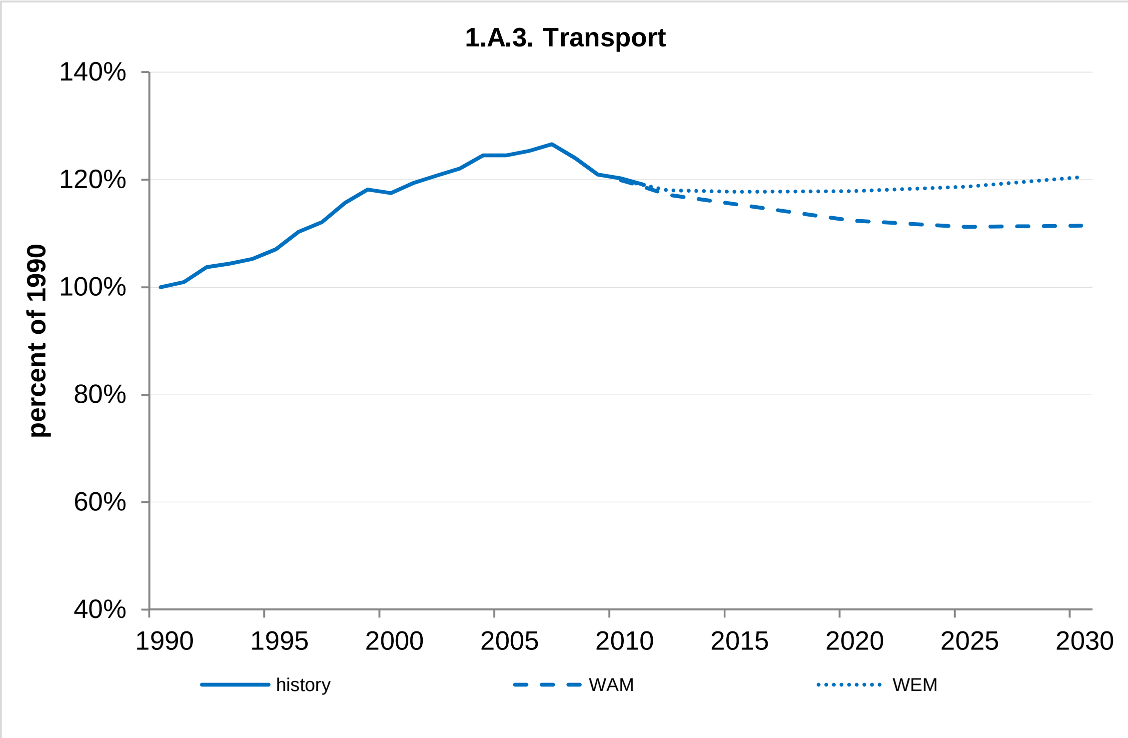
The transport sector caused the largest increase in GHG emissions between 1990 and 2011 (19 % in the EU-28) and is the only sector expected to experience an increase in GHG emissions between 1990 and 2030 under the WEM scenario.

Figure [BR1] 5-7 below shows projected GHG emissions relative to 1990 in the transport sector for EU-28.

Generally it can be observed that while GHG emissions from transport are above 1990 levels until 2030, the emissions continue to decline, while one can observe a slight upward turn after 2020.

Figure [BR1] 5-7 shows that under the **WEM** scenario, although the general pattern shows declining GHG emissions after 2007, emissions are expected to reach 17.9 % above 1990 levels by 2020, and 20.5 % above 1990 levels in by 2030, while in the **WAM** scenario additional measures contribute to further decreases so that they are projected to be only 12.4 % above 1990 levels by 2020, and 11.5 % above 1990 levels by 2030.

*Figure [BR1] 5-7	Projected EU-28 GHG emissions relative to 1990 in the transport sector*

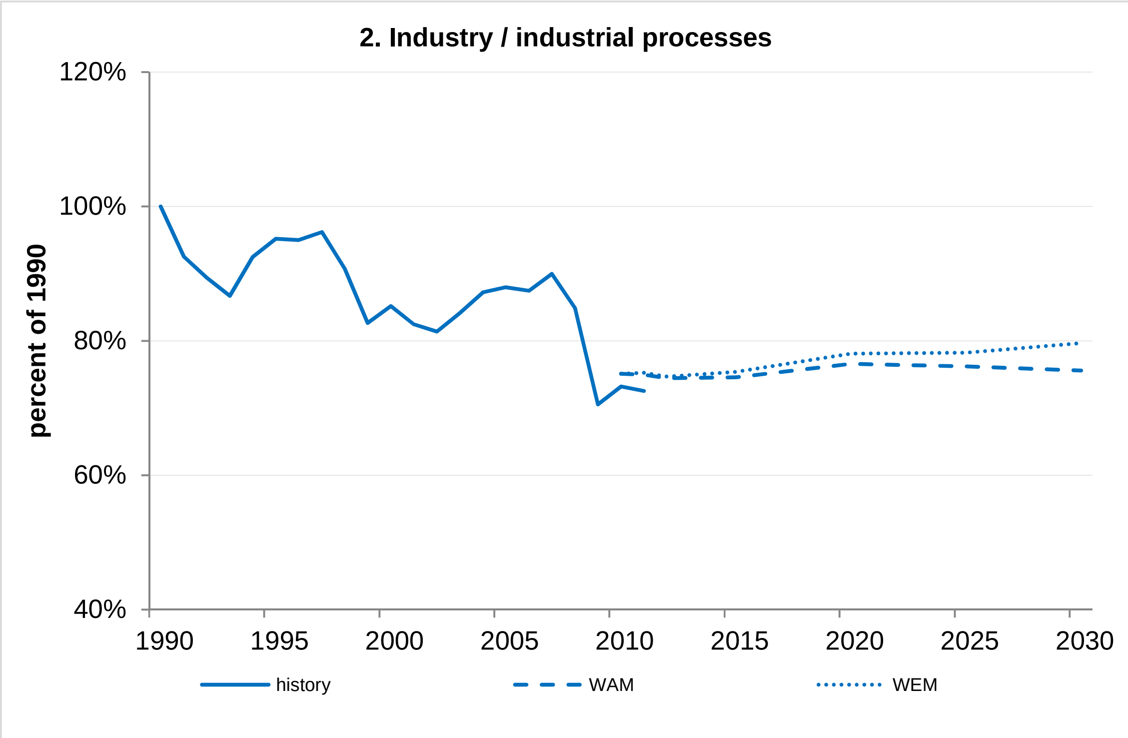


5.2.2.3. Industry/industrial processes

EU-28 GHG emissions from the industry/industrial processes sector have decreased considerably since their peak in 1997. They have sharply declined between 2007 and 2009, then continued slightly upwards and after 2011 a slight upward trend is projected especially in the WEM scenarios. Their fluctuating nature is driven by economic conditions (affecting activity levels) but also by EU and national regulation (affecting efficiency).

Figure [BR1] 5-8 below shows projected **EU-28** GHG emissions from industrial processes under the **WEM** scenario reach 21.9 % below 1990 levels by 2020, and 20.3 % in 2030. Under the assumption of the implementation of **additional measures**, GHG emissions from industrial processes in the EU-28 could be reduced further to 23.4 % below 1990 levels by 2020 and 24.4 % by 2030.

Figure [BR1] 5-8 Projected EU-28 GHG emissions relative to 1990 in the industry/industrial processes sector



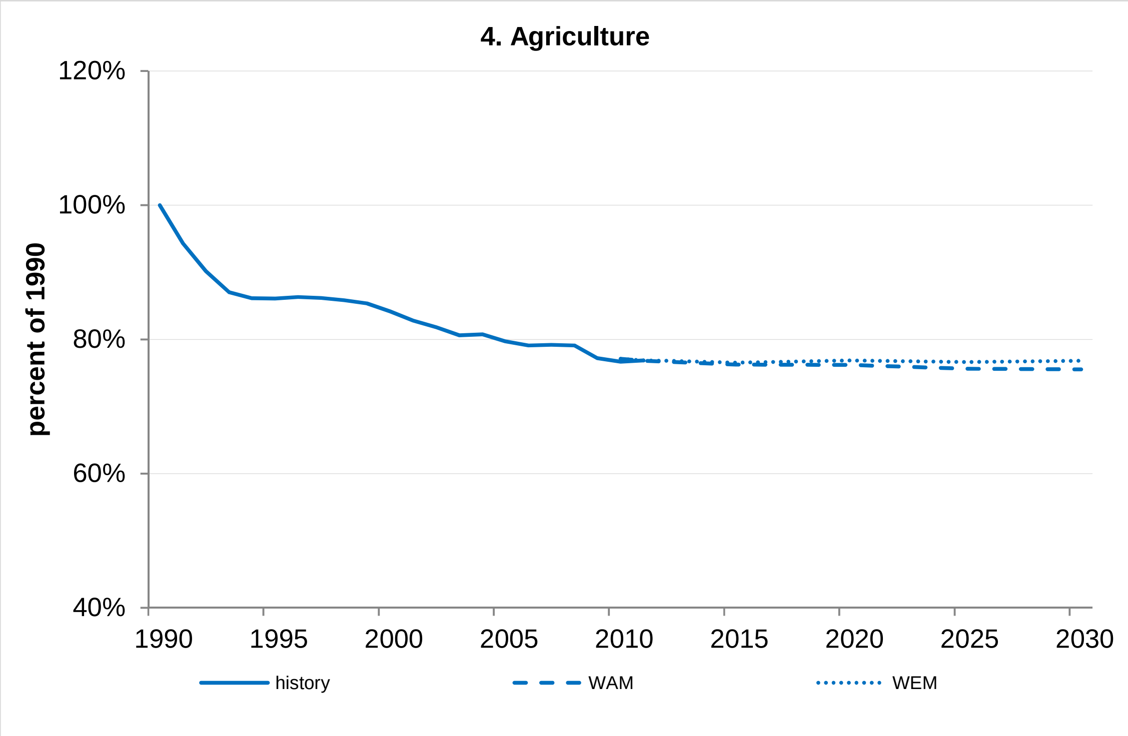
5.2.2.4. Agriculture

EU-28 GHG emissions from the agricultural sector have shown a steady decrease over the past years.

Changes in agricultural policy and farming subsidies as well as increased productivity have driven reduced animal numbers, reduced nitrogen fertiliser production and use and improved manure management resulting in reduced emissions from agricultural soils and livestock.

EU-28 GHG emissions from the agricultural sector are expected to continue decreasing up to 2020 in both WEM and WAM projections but at a slower pace than in previous decades. *Figure [BR1] 5-9* shows that for the **EU-28** under the **WEM** scenario, GHG emissions in the agricultural sector are projected to be 23.1 % below 1990 levels by 2020 and 23.2 % below 1990 levels in 2030. Considering **additional policies and measures** would reduce emissions to 23.8 % below 1990 levels in 2020 and 24.4 % below 1990 levels in 2030.

Figure [BR1] 5-9 Projected EU-28 GHG emissions relative to 1990 in the agriculture sector



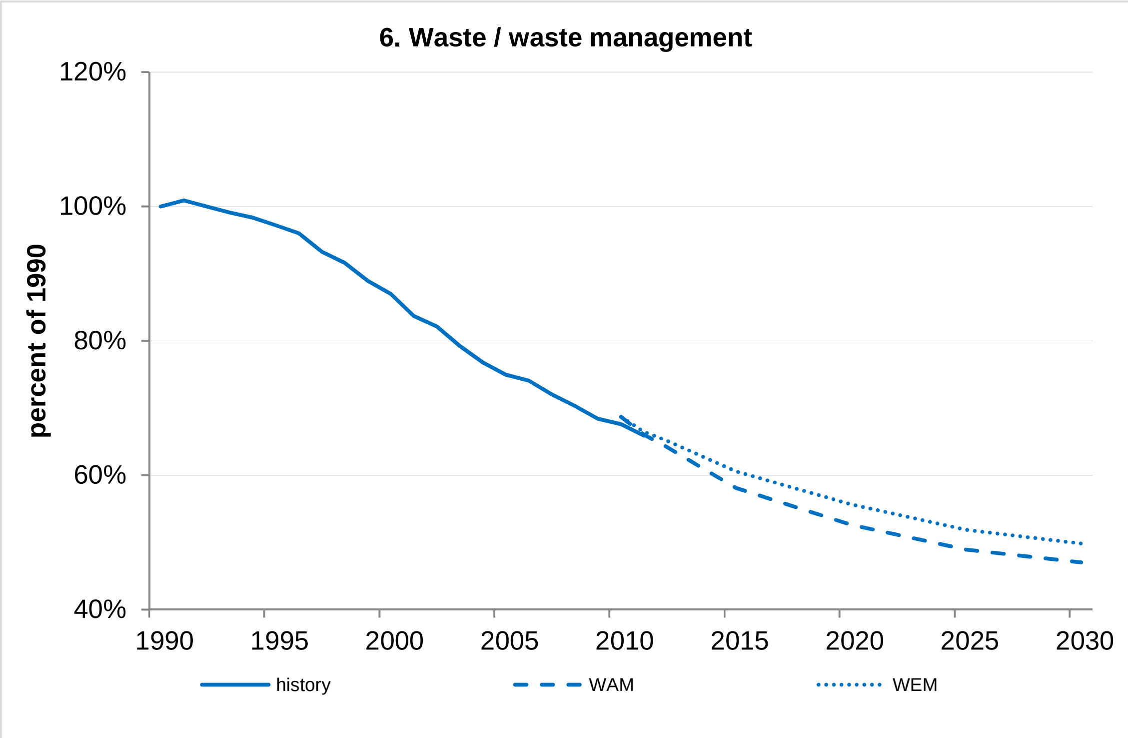
5.2.2.5. Waste

EU-28 GHG emissions from the waste sector have shown a steady and sharp decrease over the past 23 years. EU-28 emissions from the sector are projected to continue to decrease sharply until 2030, while the pace decreases slightly. Planned additional measures of the WAM scenario are projected to have a modest impact on further emission reductions.

Figure [BR1] 5-10 shows that projected GHG emissions in the waste sector on **EU-28** level under **existing measures** are projected to be 44.3 % below 1990 level in 2020 and 50.2 % below 1990 levels in 2030. Additional measures of the **WAM** scenario would contribute to further decreases of GHG emissions in the waste sector: GHG projected emission levels would be 47.4 % below 1990 levels in 2020 and 52.9 % below 1990 levels in 2030.

Past and future emission decreases can largely be attributed to successful waste legislation, e.g. increased recycling, bans on landfilling, landfill taxes and methane recovery from treated wastewater and landfill. In particular, the Landfill Directive (see Section 4.8.3) has established objectives for the progressive reduction of biodegradable waste to landfill by 25 % within five years of Member State implementation of the Directive, 50 % within eight years, and by 65 % within fifteen years, compared to 1995 levels.

Figure [BR1] 5-10 Projected EU-28 GHG emissions relative to 1990 in the waste sector



5.2.2.6. Other Sector (3+7)

The 'Other sector' is reported as the sum of emissions from Common Reporting Format (CRF) sectors 3 (Solvent and Other Product Use) and 7 (Other).

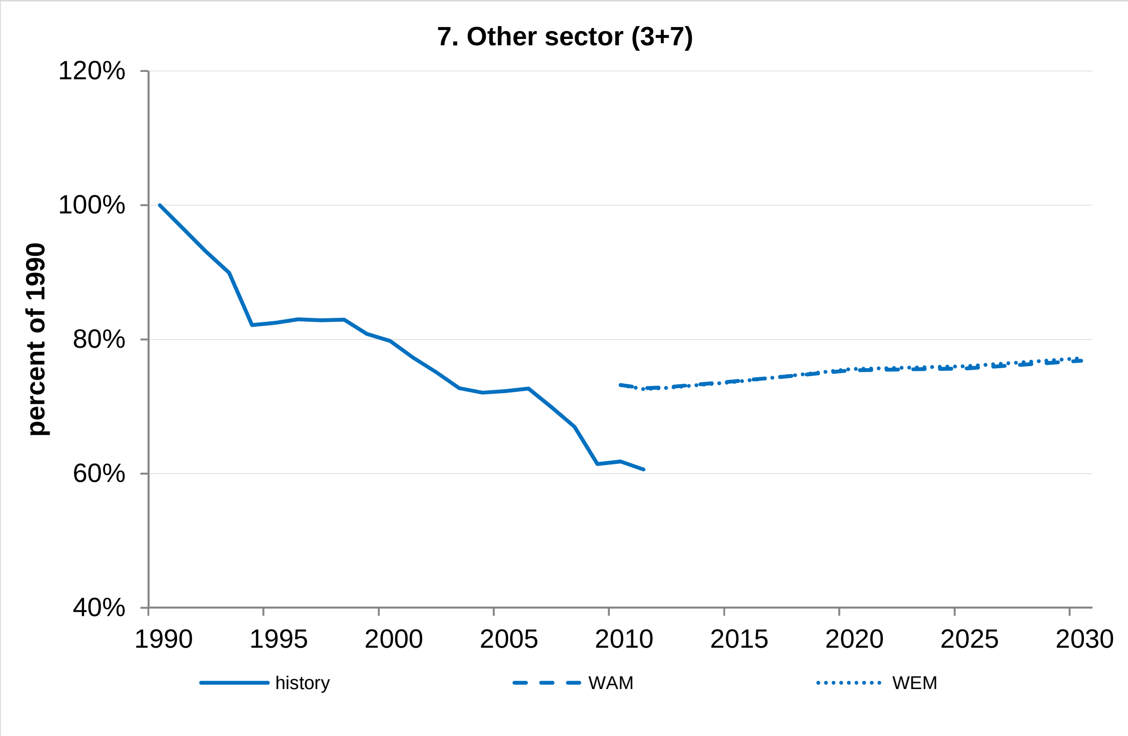
The contribution to the overall emissions from this sector has historically[543] been very small (0.2 % in 2011 for EU-28). EU-28 GHG emissions from 'other' sources have shown a steady and sharp decrease in the past.

Member State projections however indicate a rather stable (slightly increasing) trend after 2015 in both WEM and WAM scenarios.

In **EU-28**, there is very little difference between the **WEM and WAM** projections. The figure shows that emissions are projected to slowly increase, reaching 24.4 % (WEM scenario) and 24.6 (WAM scenario) below 1990 levels by 2020, and 22.8 % (WEM scenario) and 23.2 % (WAM scenario) below 1990 levels in 2030.

543 The inventories list a zero value for the „Other Sector", so historically seen, this only includes „Solvents and Other Product Use".

Figure [BR1] 5-11   Projected EU-28 GHG emissions relative to 1990 in the other sector (solvent and other product use, other sector)



5.2.2.7. Aviation and maritime bunker fuels

WEM projections of emissions from international bunker fuels sold to aircrafts have been reported by 26 Member States. WAM projections of emissions from international bunker fuels sold to aircrafts have been reported by 22 Member States. Missing values were gap-filled by WEM values. With this broad coverage nearly all emissions from international aviation are covered in the projections. The same holds for emissions from international bunker fuels sold to ships.

Figure [BR1] 5-12 shows the projected emissions for the aviation sector for the EU-28 and the WEM (dotted line) and WAM (dashed line) scenario.

The figure shows that the rapid increase which was dampened by the economic crisis is projected to continue up to 2030.

In the **EU-28** under the **WEM** scenario, emissions from international aviation are projected to continue to increase, reaching 98.9 % above 1990 levels by 2020, and 132.4 % above 1990 levels by 2030. Considering also additional measures from the **WAM** scenario, this increase is slightly slowed down and is projected to reach 94.3 % above 1990 levels by 2020 and 121.4 % above 1990 levels by 2030.

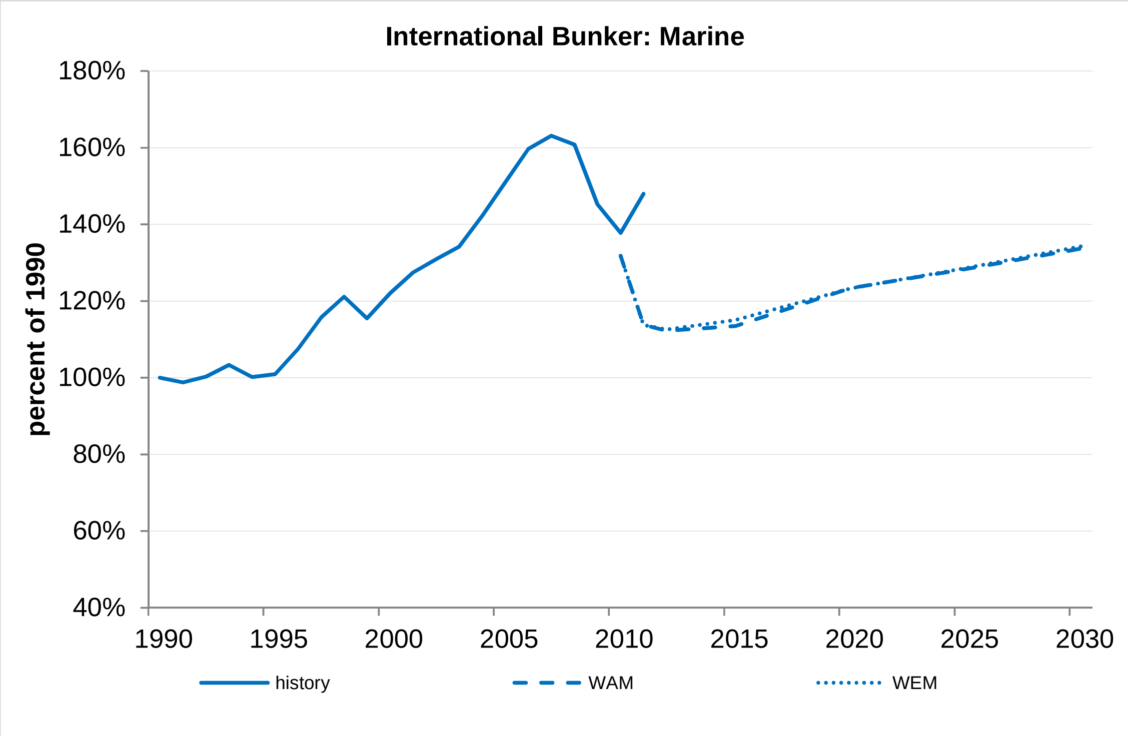
Figure [BR1] 5-12 Projected EU-28 GHG emissions relative to 1990 in the international bunkers – aviation sector

Figure [BR1] 5-13 below shows the projected emissions for the marine sector for the EU-28 and both reported scenarios.

The figure shows that the increase in emissions from the marine sector was broken by the economic crisis but is projected to continue up to 2030, but at a lower level and pace.

In the **EU-28** under the **WEM** scenario, emissions from international marine are projected to continue to increase, reaching 23.3 % above 1990 levels by 2020, and 34.3 % above 1990 levels by 2030. Taking into account additional measures from the **WAM** scenario does not change the projection to a visible magnitude (23.4 % above 1990 levels in 2020 and 33.7 % above 1990 levels in 2030).

Figure [BR1] 5-13 Projected EU-28 GHG emissions relative to 1990 in the international bunkers – marine sector



5.2.3. Projections of indirect GHG

A presentation of indirect GHG emission projections is not possible.

5.3. Assessment of aggregate effects of policies and measures

Please refer to Section 5.6.2 for details on the methodology.

The effects of policies and measures in *Figure [BR1] 5-14* are shown in total, distinguishing between WEM and WAM scenario. The disaggregation of the total effects of policies and measures into sectors and gases is provided by Table [BR1] 5-1 and Table [BR1] 5-2.

For the aggregate effects of policies and measures in the WEM scenario a bottom-up approach had to be used whereas a top-down approach was used to assess the aggregate effects of policies and measures in the WAM scenario. The effects were disaggregated into sectors in both scenarios, WEM and WAM. However, the sector split differs between the approaches and the sectoral policy effects in WEM and WAM are therefore not fully comparable.

Figure [BR1] 5-14 Total effects of policies and measures for EU-28 in Mt CO_2-eq avoided emissions

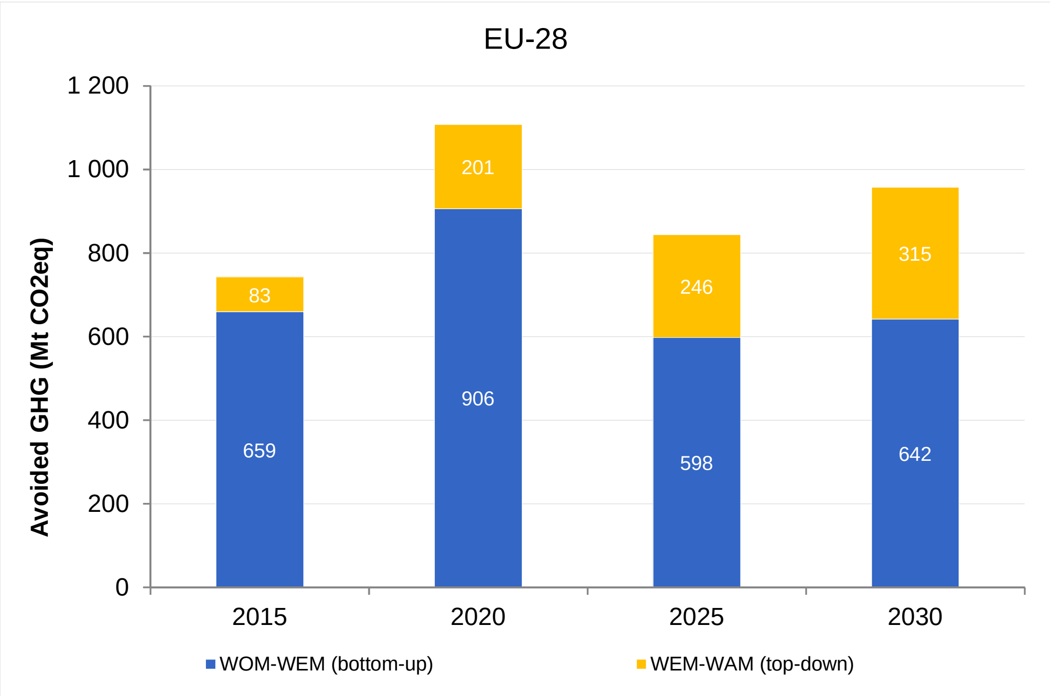


Table [BR1] 5-1 Total effects of policies and measures EU-28, by sectors Mt CO_2eq avoided GHG emissions

EU-28	2015	2020	2025	2030
	Mt CO_2 eq.			
WOM-WEM (bottom-up)	**659**	**906**	**598**	**642**
Energy consumption+supply	367	544	379	390
Transport	77	126	85	111
Industrial Processes	15	22	17	18
Agriculture	39	49	30	31
Waste	61	54	7	7
Cross-cutting	100	111	81	85
WEM-WAM (top-down)	**83**	**201**	**246**	**315**
1. Energy (excluding transport)	56	143	168	214
1.A.3. Transport	18	42	58	70
2. Industry / industrial processes	2	6	8	17
4. Agriculture	2	4	6	8
6. Waste / waste management	5	6	6	6
7. Other Sector (3+7)	0	0	0	0
Total effects of policies and measures	**742**	**1107**	**844**	**957**

Table [BR1] 5-2 Effects of polices and measures as avoided GHG emission by gas for EU-28 Mt CO_2eq avoided GHG emissions[544]

	2015	2020	2025	2030
EU 28	*Mt CO_2 eq.*			
WOM-WEM (bottom-up)	**761**	**1030**	**655**	**702**
CO_2	579	817	561	597
CH_4	103	106	37	41
N_2O	51	62	26	29
HFC, PFC, SF_6	28	44	31	35
WEM-WAM (top-down)	**84**	**203**	**247**	**317**
CO_2	74	185	225	291
CH_4	6	9	10	11
N_2O	1	6	7	7
HFC, PFC, SF_6	2	4	5	7

5.4. Sensitivity Analysis

5.4.1. Introduction

As the EU-28 projection comprises of an aggregation of individual MS projections, a sensitivity analysis for the EU-28 cannot be calculated from these individual projections. An aggregation of sensitivity analyses from individual Member States would not lead to meaningful results as these are based on different assumptions and methodologies, take into account different national circumstances and structures, and vary key parameters and assumptions in a heterogeneous manner.

To provide sensitivity insights for the EU-28, the results of the EU-28 2013 climate policy “baseline with adopted measures” (BAM) projection prepared and consulted with Member State experts in the framework of the EUCLIMIT project[545] on behalf of the European Commission, DG Climate Action are considered instead. The EU-28 EUCLIMIT BAM scenario is based on EU-wide sectoral modelling and focuses on the impacts of existing concrete measures. It includes adopted EU and key national measures in climate, energy and transport related areas up to spring 2012, including the EU level, e.g. the EU Emission Trading Scheme, Eco-design and labelling legislation, the Energy Performance in Buildings directive, the CO_2 and cars and CO_2 and vans regulations, the F-Gas regulation, the Mobile Air Conditioning directive, the Landfill directive and the Nitrate directive. Progress in non-ETS sectors towards the national GHG emission targets set out in the Effort Sharing Decision and the deployment of renewables towards the legally binding national 2020 targets depends on already adopted national policies and measures and concrete EU measures. The EU Energy Efficiency Directive adopted in autumn 2012 is not included insofar as effects on GHG, ETS and non-ETS emissions depend on the way in which transposition into national measures will take place. The EUCLIMIT BAM scenario is hence comparable with a "with existing measures" projection[546].

544 The sum of effects by gas does not result in total effects, because effects have not been allocated unambiguous by MS.

545 Full project title: Development and application of EU economy-wide climate mitigation modelling capacity. Website: http://www.euclimit.eu.

546 For a detailed description see: European Commission, EU Baseline Scenario 2013. An EU "with existing measures" projection of greenhouse gas, ETS and non-ETS emissions trends to 2020 and beyond.

A comparison of results between the two different approaches is shown in Section 5.4.4. Also some key parameters are differing between aggregated Member State projections and EUCLIMIT results, because EUCLIMIT key parameters are based on data and assumptions available in a consistent way for all Member States, while for the EU-28 projection they are based on a weighted averages of MS projections key parameter values. A comparison of several key parameters is conducted in Section 5.4.3.

In this section the WEM scenario is referred to as "main projection" and the EUCLIMIT BAM scenario as "sensitivity projection".

5.4.2. Member State sensitivities

For information of sensitivity analyses accomplished at Member State level, please refer to the individual Member States' Biennial Reports.

5.4.3. Key parameters main and sensitivity projection

The key parameters and assumptions of the main projection can be found in Table [BR1] 5-3 and in CTF Table 5 in the CTF Appendix.

Table [BR1] 5-3 Key parameters and assumptions of the main projection

Parameter	2015	2020	2025	2030
CO2-price (Euro (2010)/tCO2_eq)	12	17	21	27
GDP (Bio. Euro (2005))	13	14	16	17
International coal price (Euro (2010)/boe)	19	20	23	23
International gas price (Euro (2010)/boe)	50	54	58	61
International oil price (Euro (2010)/boe)	86	94	95	101
Population (Mio.)	506	514	518	510

Table [BR1] 5-4 lists key parameters and assumptions underlying the sensitivity projection. It needs to be noted that EU ETS CO_2 price and primary energy demand are endogenous variables in the EUCLIMIT modelling framework and thus model outputs, while in other modelling frameworks these are often provided as external parameters.

Table [BR1] 5-4 Key parameters and assumptions of EU-28 sensitivity projection (EUCLIMIT BAM scenario)

Parameter	2015	2020	2025	2030
CO2-price (Euro (2010)/tCO2_eq)	7	20	35	59
GDP (Bio. Euro (2005))	12	13	15	16
International coal price (Euro (2010)/boe)	22	23	24	24
International gas price (Euro (2010)/boe)	54	62	59	65
International oil price (Euro (2010)/boe)	86	89	89	93
Population (Mio.)	511	517	522	525

Source: EUCLIMIT (GDP deflation to 2005 based on Eurostat price index (nama_gdp_p)

The variation of several key parameters between main and sensitivity are documented below:

- The annual average growth rate between 2015-2030 of GDP in the main projection is 1.87 % p.a. while the sensitivity projection assumes 1.55 % p.a.;

- EU ETS CO_2 prices between 2015 and 2030 develop from €12 (2010)/t CO_2eq to €27 (2010)/t CO_2eq in the main projection and from €7 (2010)/t CO_2eq to €59 (2010)/t CO_2eq in the sensitivity projection;
- The international oil price in the main projection rises from €86 (2010)/boe in 2015 to €101 (2010)/boe in 2030 while in the sensitivity projection it develops from €86 (2010)/boe to € 93 (2010)/boe over the same period.

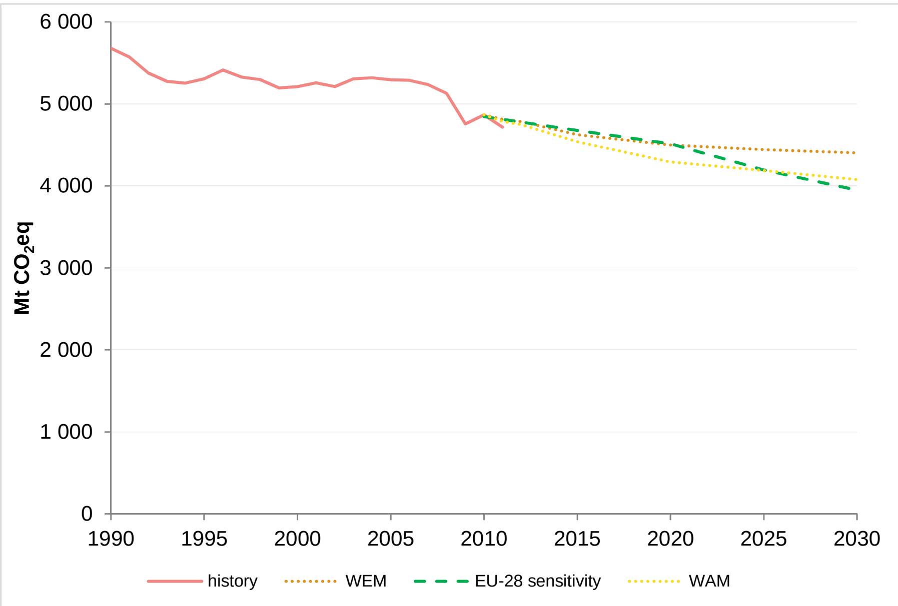
5.4.4. Sensitivity results

Figure [BR1] 5-15 below includes a comparison of total aggregate GHG emissions on EU-28 level for the main projection (labelled WEM) and the sensitivity projection (labelled EU-28 sensitivity). For illustrative purposes the EU-28 WAM projection is also included in the representation.

The presented trajectories include GHG emissions from international aviation.

A comparison of the EU-28 main projection with the sensitivity projection yields the following main insight: At a variation of the key parameters of the main projection as documented in Section 5.4.3, total projected GHG emissions in the EU-28 sensitivity projection in 2020 are at very similar levels as in the main projection.

Figure [BR1] 5-15 Total aggregate EU-28 GHG emissions, historic (red solid) and projected WEM (orange dotted), WAM (yellow dotted) and sensitivity projection (green dashed)



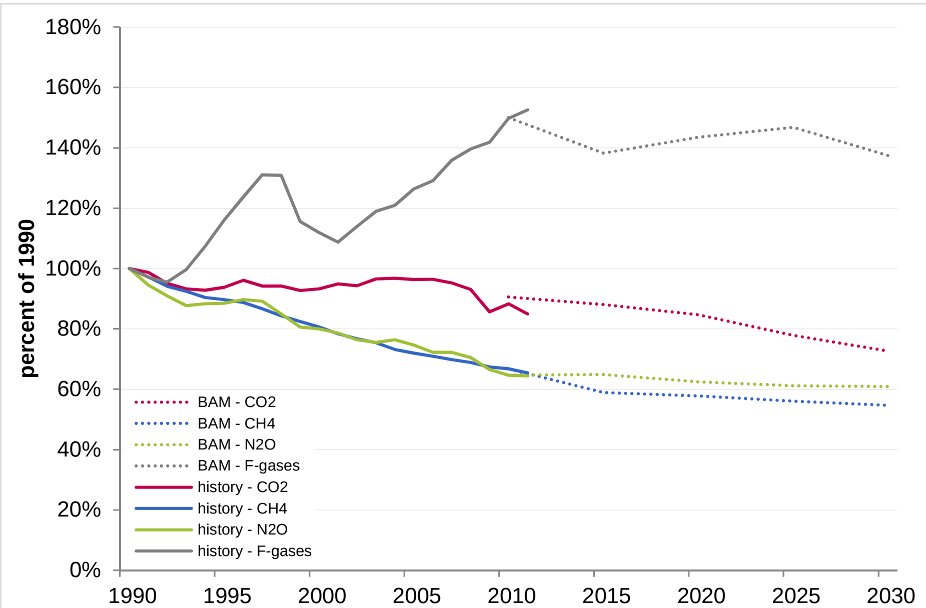
Note: The projections presented by this figure include international aviation. The projected emissions do not include emissions from marine bunkers and LULUCF.

Results after 2020 are of course more uncertain and more dependent on the assumptions made. The sensitivity projection sees a decline in EU GHG emissions at a faster pace as the main WEM projection, yielding results for 2025 and 2030 of a similar order of magnitude as the main WAM projection. This pattern is consistent with the multi-level character of the EU. The EU sensitivity includes EU measures which have been adopted recently, and which might not be fully covered by all national projections, or be covered in a more conservative way. One example is the revised Energy Performance in Buildings Directive which mainly has emission reduction effects from 2020 onwards and on which implementation in national legislation was still ongoing in some countries, so that it might not be included in national WEM but in WAM projections. And the CO_2 and cars regulation includes a decrease of the fleet average to be achieved by all new cars to 95 g/km by 2020, of which the effect on transport emissions will mainly occur after 2020 with the turnover of the car fleet. For those national projections underpinning the main projection that focus on the 2020 time frame and project post 2020 emissions in a simplified way, these post 2020 effects might not be covered. Another reason for the faster decline of the sensitivity projection post-2020 is that it takes fully into account the continuing decrease of the EU ETS cap by a linear factor of 1.74%, reflected in higher CO_2 prices towards the end of the projection period, while Member States chose more conservative assumptions on average, with some of them varying ETS price assumptions between WEM and WAM scenarios. Higher CO_2 prices have also a dampening effect on the projected increase of aviation emissions. Finally, it is recalled that neither main projection nor sensitivity projection includes the recently adopted EU Energy Efficiency Directive which is expected to induce further GHG emission reductions.

5.4.4.1. Total aggregate GHG emission projections per gas according to sensitivity projection

Figure [BR1] 5-16 below summarises the sensitivity projection per gas relative to 1990 values. The results are generally in line with the EU-28 projection per gas as presented in *Figure [BR1] 5-5*. The analogue presentation of GHG emission projections per gas for the WEM (and WAM) scenario is found in section 5.2.1.2. It must be noted that CO_2 emissions presented in Figure [BR1] 5-16 include emissions from international aviation, while the trajectory presented in section 5.2.1.2 does not.

Figure [BR1] 5-16 EU-28 GHG emissions by gas, relative to 1990; sensitivity projection , including international aviation



Source: Calculated from absolute values provided by EUCLIMIT BAM[547]

5.5. Supplementarity

To achieve international greenhouse gas targets, Annex I Parties can use Kyoto Protocol mechanisms. Information on the actual and intended use in the first commitment period is given in section 4.12

As the chapter on projections only focuses on the development of GHG emissions until 2030, the question of supplementarity cannot be raised for this time horizon as no targets are finally defined and no final decisions are taken with regard to the (supplementary) use of Kyoto mechanisms.

For the EU-28 in the framework of the two most important cross-sector measures (Emission Trading Scheme (ETS) and Effort Sharing Decisions (ESD)) the maximum use of flexible mechanisms is defined as follows:

In the EU - ETS the exact amount per operator for phase 3 (2013 – 2020) is determined in line with the methodology set out in the revised EU ETS Directive (Article 11a(8)) and is further specified in a Regulation on determining international credit entitlements[548].Unused entitlements can be carried over from the second to the third trading period. These, amount to approx. 330 million units[549].

In the ESD, an annual level of Clean Development Mechanism (CDM) and Joint Implementation (JI) mechanism credits is defined per Member State: In general the use of these flexible mechanisms in the 2013-2020 period is limited to 3 % of its 2005 emissions. The Effort Sharing Decision also allows certain Member States that have emission reduction targets, or which are allowed to increase emissions by up to 5 % of 2005 levels, to use an additional 1 % of credits. These credits can come only from CDM projects in least developed countries and small island developing states, and are not bankable or transferable. The Member States concerned are Austria, Finland, Denmark, Italy, Spain, Belgium, Luxembourg, Portugal, Ireland, Slovenia, Cyprus and Sweden.

5.6. Methodology

Information presented in Section 5.2 for the EU-28 is derived through an aggregation of individual Member State information. Detailed descriptions of the methodologies used to generate individual Member State projections, further information on their sensitivity and uncertainty analyses and their key parameters and assumptions are presented in individual Member State National Communications and are not replicated in the EU's National Communication.

The methodology for generating EU-28 projections is described in Section 5.6.1. Changes to the methodology are documented in Section 5.6.1.5

547 It should be noted that the EUCLIMIT BAM is calibrated to inventory data as reported by the EU to the UNFCCC in 2012 and energy-related CO2 emissions for 2010 are calculated based on energy balances as reported by Eurostat.

548 Commission regulation on determining international credit entitlements pursuant to Directive 2003/87/EC of the European Parliament and of the Council. (OJ L 299, 9.11.2013, p.32-33) http://ec.europa.eu/clima/policies/ets/linking/docs/rice_regulation_20131107_en.pdf

549 see EEA 2013 Trends and Projections Report (http://www.eea.europa.eu/publications/trends-and-projections-2013).

Further, the methodology on determining the total effects of policies and measures and regarding the sensitivity analysis are also outlined in the remainder of this section.

5.6.1. Methodology for projections

5.6.1.1. General methodology

The EU-28 projections have been aggregated using Member State's submissions to the European Commission under the MMD in 2013. EEA's European Topic Centre for Air Pollution and Climate Change Mitigation (ETC/ACM) has compiled the national projections and applied quality assessment and quality control (QA/QC) procedures that consist of a number of checks against quality criteria such as completeness, consistency, comparability, accuracy and transparency of reported data. If the quality checks showed that the submission did not follow the quality criteria, the ETC/ACM reviewer was seeking explanation in the accompanying documents submitted by MS. If no explanations could be found, the reviewers contacted MS projection experts to request the clarification needed. If issues remained unresolved or the inaccuracy risk associated with MS projections was deemed too high, the ETC/ACM performed corrective actions on the reported data. A specific corrective action corresponds to each identified quality issue. Such corrective actions are essential to ensure the quality of projections data used in the annual reports of the Commission and the EEA. The EU-15 and EU-28 emission projections conform with the EEA's and European Commission's 2013 reports on progress towards the Kyoto target[550].

5.6.1.2. Models used for sensitivity analysis

A sensitivity analysis in the traditional sense – i.e. ordering by importance the strength and relevance of the input key parameters and assumptions in determining the variation of the model output – is not applicable for a global aggregation of 28 individual Member States projections. Each Member State, however, conducts individual sensitivity analyses. Please refer to the 6th National Communication/1st Biennial Report of the Member States to gain insights into individual sensitivity analyses.

In order to provide a sensitivity analysis on EU-28 level, an alternative method was utilised. The EUCLIMIT service contract provides EU-wide modelling of climate policies for the European Commission based on a consistent set of key parameters and assumptions for individual Member States. Further, as described in Section 5.4 it has produced a scenario (BAM) which, in its definition, comes very close to the WEM scenario as it only includes adopted measures.

The models which have been utilised in EUCLIMIT (Prometheus, GEM-E3, PRIMES, PRIMES TREMOVE, PRIMES Biomass Supply, GAINS, CAPRI, GLOBIOM-G4M) are documented in Section 5.6.3.

Thus, the EU-28 BAM scenario as provided by EUCLIMIT serves as a sensitivity projection to the EU-28 WEM projection presented throughout the report. Please refer to Section 5.6.3 for more details on the sensitivity approach taken.

550 The report is available for download from EEA under : http://www.eea.europa.eu/publications/trends-and-projections-2013. The Commission report is available under: http://ec.europa.eu/clima/policies/g-gas/docs/com_2013_698_en.pdf

5.6.1.3. Key parameters and assumptions

For key parameters and assumptions please refer to Section 5.1.3 and to CTF Table 5 in the CTF Appendix. For key parameters and assumptions of the sensitivity projection, please refer to Section 5.4.3.

5.6.1.4. QA/QC procedure

To acquire best possible consistency of the aggregated projection on EU-28 level, data adjustments and gap-filling were performed by the EEA. These alignments of data resulting from the QA/QC procedures are documented in this section below.

As a further QA/QC procedure the sensitivity projection presented in Section 5.4 is used. In contrast to the EU-28 “with existing measures” projection totalised through individual Member State projections, the EU-28 “baseline scenario” projection (BAM) of EUCLIMIT is derived by a modelling exercise based on one set of key parameters and assumptions.

Reference year calibration

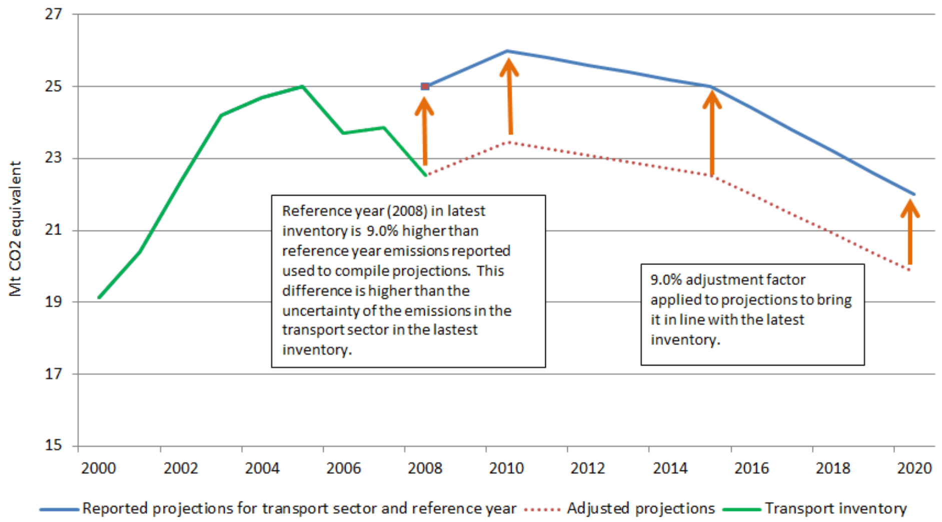
To assure a coherent EU-28 compilation it is of particular importance that the starting year of each projection activity is time-series consistent with the latest available greenhouse gas emissions inventory. In order to correct any inconsistencies between projected emissions reported by Member States and the latest available inventory data, Member States’ reference year emissions have been aligned to the respective inventory year of the inventory submission 2013 per MS at a sector level. For projections submitted in 2013, two MS used 2011 (Ireland and Italy), one MS used 2009 (Cyprus), two MS used 2007 (Poland, Sweden) and the remaining 22 MS used 2010 as a reference year.

An adjustment was performed where the deviation between the sector emissions for the reference year and the latest available inventory data for that year was more than the specified sector inventory uncertainty in per cent. The adjustment has been applied for 17 of 27 national projections[551] because a difference higher than specified sector inventory uncertainty was found for at least one of the sectors reported.

An illustrative example of the reference year calibration is given in Figure [BR1] 5-17 below.

551 This applies to Austria, Czech Republic, Denmark, Estonia, Finland, France, Germany, the Netherlands, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia, Spain and the United Kingdom.

Figure [BR1] 5-17 Example of reference year calibration



Source: EEA

Policies included in the projections scenarios

EU-15 and EU-28 projections presented are aggregated from individual Member States submissions. Projections for the 'with existing measures' and 'with additional measures' scenarios therefore include a variety of measures depending on the status of implementation of EU initiated policies in different Member States and programmes of measures developed independently in individual Member States. Measures included in the EU 'with existing measures' and 'with additional measures' scenarios are therefore not indicated in this chapter.

Gap-filling procedure

Partly or fully gap-filling of MS' projections has been carried out where gaps exist in the projections reported by Member States. The following methods were used to gap-fill:

- Where a 'with additional measures' projection was not provided, the 'with additional measures' projection has been gap-filled with the 'with existing measures' projection to enable an EU level 'with additional measures' projection to be produced. Four of 28 MS[552] did not provide a WAM scenario.
- Where a sector or gas breakdown was available for one scenario and not available for another, the available data from the former have been applied to the national total of the latter.
- Where total projections were provided but no gas or sector breakdown was provided, the relevant breakdowns in 2013 inventory data have been applied to the projections' national total to generate gas and sector breakdowns. Some sectors were gap-filled for 12 countries of 27.

552 Denmark, Poland, Portugal and the United Kingdom.

- Where the years between the mandatory reporting years 2010, 2015 and 2020 was not reported, interpolation was performed. In the submission year 2013, this gap-filling of intermediate years was carried out for 21 of 27 MS.
- Where the years 2025 and/or 2030 were not reported, the years where gap-filled with EUCLIMIT BAM data. Seven countries did not report 2025 and/or 2030 projections.
- Where no scenario was reported or the reported scenario was outdated the entire projection scenario was replaced by EUCLIMIT BAM data. The entire time-series of EUCLIMIT BAM data was used for HR.
- Where an ETS/non-ETS split was not available or only available for some years, the split was gap-filled with EUCLIMIT BAM data. Ten countries did not report an ETS/non-ETS split for all years.

An aggregation of "without measures" projections from national projections was not possible due to the lack of data as the WOM scenario was only reported by 4 of 28 MS.

5.6.1.5. Changes in projection methodologies

Since the projections reported within the 1st Biennial Report need to cover the period up to 2030, but not all Member States provided data up to this point in time, missing data for 2030 has been gap-filled as documented in Section 5.6.1.4

Since Croatia did not submit projections to the EEA, the entire time-series of EUCLIMIT BAM data was used instead.

5.6.2. Methodology for assessing aggregate effects of policies and measures

5.6.2.1. General methodology

The aggregate effects of policies and measures documented in this section have been calculated using two methodological approaches due to the EU projections being an aggregation of individual projections.

The estimated effects of policies and measures from the WEM scenario would ideally be calculated subtracting the emissions from the 'without measures scenario' (WOM) from the WEM scenario. Following this approach, however, was not possible since only four Member States reported a WOM scenario. Thus to estimate the effects of the existing policies and measures, a bottom-up approach was followed (documented in Box 1 below).

For the estimation of the total effect of the measures included in the WAM scenario, a top-down methodology has been applied, subtracting WEM GHG emissions from WAM GHG emissions. This approach is documented in Box 2 below.

Box 1 Bottom-up methodology to determine effects of existing policies and measures.

The bottom-up approach estimates total savings from policies and measures by aggregating the expected savings from individual policies and measures as reported by Member States and aggregated by the EEA in a PaM database. Member States report the savings from their 'existing measures' and 'additional measures' separately, not all impacts of policies and measures are reported and quantified.

On the other hand the bottom-up determination of the effects of policies and measures is likely to be an overestimation, because Member States do include the effects of policies and measures which are not purely national and effects of cross-sectoral policies and measures are taken into account separately. In addition there are generally overlapping effects of policies and measures, which lead to overestimations.

The allocation of effects to sectors and gases could not be conducted in an unambiguous manner, resulting in different sums, depending on the chosen sector and gas.

The effects in the EEA database are categorised into sectors which are not completely compatible with UNFCCC categories: Specifically there is a sector for "Cross sectoral" policies and measures, which leads to an underestimation of effects in other sectors if they are compared to effects with the top-down analysis, based on UNFCCC categories. In addition the allocation of effects to sectors and gases by MS could not always be conducted in a definite manner, which may lead to inconsistencies if effects are summed up.

The effects summed up here draw from the reports of Member States under the MMD while the estimated effects of EU policies and measures documented in section 3, and CTF Table 3 in the CTF Appendix focus only on EU-wide policies. Thus the results are different in nature and cannot be compared.

Box 2 Top-down methodology to determine total effects of additional policies and measures

The estimated effect of additional policies and measures as included in the WAM scenario are calculated by taking the difference between WEM and WAM total GHG emissions:

Effects from additional policies and measures = total WEM GHG emissions – total WAM GHG emissions.

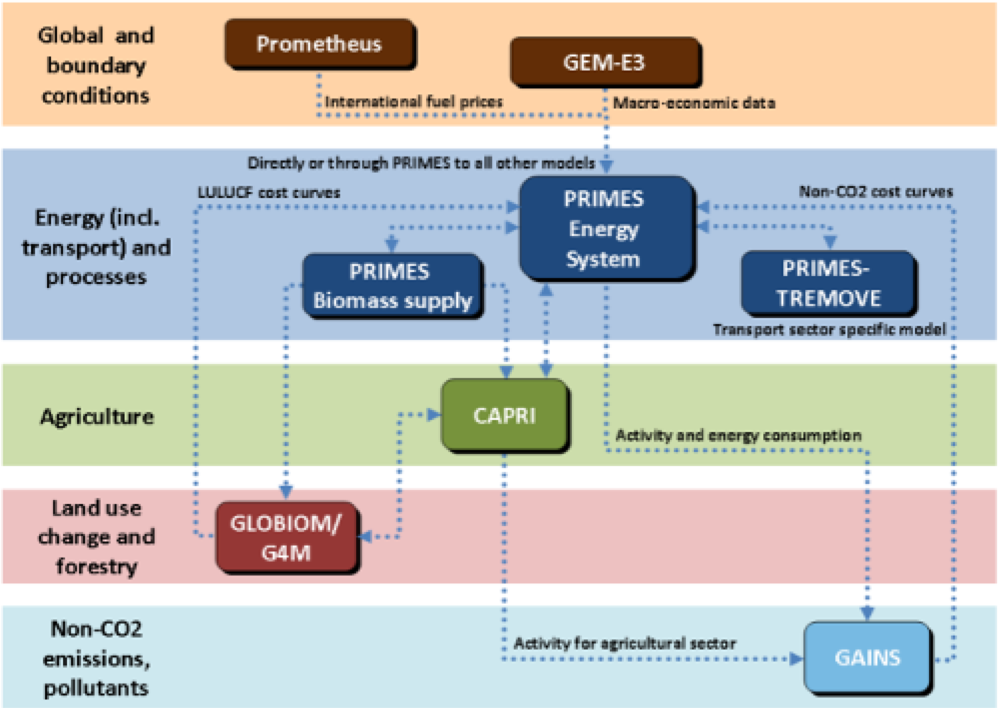
5.6.3. Methodology for sensitivity analysis

Due to the aggregate nature of the EU projection, a sensitivity analysis needs to be achieved by alternative means and the EUCLIMIT BAM scenario, including adopted policies and measures, provided in the EU-28 aggregation, serves as a sensitivity to the main projection presented throughout this 6th National Communication and 1st Biennial Report.

5.6.3.1. General methodology

EUCLIMIT performs model-based scenario quantification supporting the European Commission in undertaking impact assessments and analysing policy options for implementing and further developing the EU climate and energy package and other climate-relevant policies in the EU. For this purpose a suite of mathematical models is linked together in a formally defined way (see *Figure [BR1] 5-18* below) to project all greenhouse gas emissions up to the year 2050 in 5-year time steps. Modelling takes place individually for each EU Member State and at the EU-28 aggregate level, the latter is made available for enabling the sensitivity analysis in this 6th National Communication and Biennial Report.

Figure [BR1] 5-18 EUCLIMIT model interlinkages



Source: http://www.euclimit.eu/Default.aspx?Id=2

The emissions covered by this modelling approach are: CO_2 emissions from energy and processes via the PRIMES model, CH_4, N_2O and the fluorinated greenhouse gases via the GAINS model, GHG from LULUCF via the GLOBIOM-G4M model. Box 3 briefly introduces the models.

Box 3 EUCLIMIT model suite. Source: http://www.euclimit.eu

The models:

Prometheus:

A fully stochastic World energy model used for assessing uncertainties and risks associated with the main energy aggregates including uncertainties associated with economic growth and resource endowment as well as the impact of policy actions (R&D on specific technologies, taxes, standards, subsidies and other supports). The model projects endogenously to the future the world energy prices, supply, demand and emissions for 10 World regions. For the EU BAM modelling world fossil fuel price trajectories generated for the EU Reference scenario 2013[553] serve as import price assumptions for PRIMES.

GEM-E3:

The GEM-E3 (World and Europe) model is an applied general equilibrium model, simultaneously representing World regions and European countries, linked through endogenous bilateral trade flows and environmental flows. The European model is

553 The 2013 EU Reference scenario has been jointly developed during 2012-2013 by the European Commission DG's Energy, DG Climate Action and DG Mobility and Transport to project EU energy, transport and GHG emission trends to 2050 as starting point for assessing further EU policy options. For doing so, it includes also the EU Energy Efficiency Directive and assumes the achievement of the legally binding targets for GHG and RES by 2020.

including the EU countries, the Accession Countries and Switzerland. The world model version includes 18 regions among which a grouping of European Union states. GEM-E3 aims at covering the interactions between the economy, the energy system and the environment. It is a comprehensive model of the economy, the productive sectors, consumption, price formation of commodities, labour and capital, investment and dynamic growth. The model is dynamic, recursive over time, driven by accumulation of capital and equipment. The current GEM-E3 version has been updated to the GTAP7 database (base year 2004) and has been updated with the latest Eurostat statistics for the EU Member States. For the EU BAM modelling sectoral value added projections generated for the EU Reference scenario 2013 consistent with exogenous EU GDP and population projections serve as activity assumptions for PRIMES. GDP projections mirror DG ECFIN projections for the short- and medium term and the EPC/DG ECFIN Ageing Report 2012 for the long-run. The population projections are based on EUROSTAT population projection for the period 2010 to 2050.

PRIMES

The PRIMES model simulates the response of energy consumers and the energy supply systems to different pathways of economic development and exogenous constraints and drivers. It is a modelling system that simulates a market equilibrium solution in the European Union and its member states. The model determines the equilibrium by finding the prices of each energy form such that the quantity producers find best to supply match the quantity consumers wish to use. The equilibrium is forwarding looking and includes dynamic relationships for capital accumulation and technology vintages. The model is behavioural formulating agents' decisions according to micro economic theory, but it also represents in an explicit and detailed way the available energy demand and supply technologies and pollution abatement technologies. The system reflects considerations about market competition economics, industry structure, energy /environmental policies and regulation. These are conceived so as to influence market behaviour of energy system agents. The modular structure of PRIMES reflects a distribution of decision making among agents that decide individually about their supply, demand, combined supply and demand, and prices. Then the market integrating part of PRIMES simulates market clearing. PRIMES is a partial equilibrium model simulating the entire energy system both in demand and in supply; it contains a mixed representations of bottom-up and top-down elements. The PRIMES model covers the 27 EU Member States as well as candidate and neighbour states (Norway, Switzerland, Turkey, South East Europe). The timeframe of the model is 2000 to 2050 by five-year periods; the years up to 2005 are calibrated to Eurostat data.

PRIMES TREMOVE

The PRIMES-TREMOVE Transport Model projects the evolution of demand for passengers and freight transport by transport mode and transport mean, based on economic, utility and technology choices of transportation consumers, and projects the derived fuel consumption and emissions of pollutants. Operation costs, investment costs, emission costs, taxes and other public policies, utility and congestion influence the choice of transportation modes and means. The new transportation model is much more detailed than the previous version and its mathematical structure is considerably more enhanced. It is essentially a dynamic system of multi-agent choices under several constraints, which are not necessarily binding simultaneously. Part of the model (e.g.

the utility nested tree) was built following the TREMOVE model. Other parts, as for example the component on fuel consumption, follow the COPERT model. The results are consistent with and feed into the general PRIMES model.

PRIMES Biomass Supply

The biomass system model is linked with the PRIMES large scale energy model for Europe and can be either solved as a satellite model through a closed-loop process or as a stand-alone model. The biomass model follows the standards of the PRIMES model: it covers all the EU countries and other associated European countries; it performs dynamic projections to the future from 2000 until 2030 in 5-year time period step; it is calibrated to base years 2000 and 2005 so as to reproduce Eurostat statistics; it computes endogenously the energy and resource balances, the investments, the costs and prices, and the emission of pollutants. The model represents policy instruments, such as taxes, subsidies, technology progress, emission and other policy constraints, and certificate or allowances markets. For the BAM modelling, it projects biomass supply consistent with the EU bioenergy demand resulting from PRIMES, and generates related inputs for the CAPRI and GLOBIOM-G4M modelling.

GAINS

The GAINS model is an integrated assessment model that brings together information on the sources and impacts of air pollutant and greenhouse gas emissions and their interactions. GAINS is an extension of the earlier RAINS (Regional Air Pollution Information and Simulation) model, which addressed air pollution aspects only. GAINS brings together data on economic development, the structure, control potential and costs of emission sources, the formation and dispersion of pollutants in the atmosphere and an assessment of environmental impacts of pollution. GAINS addresses air pollution impacts on human health from fine particulate matter and ground-level ozone, vegetation damage caused by ground-level ozone, the acidification of terrestrial and aquatic ecosystems and excess nitrogen deposition) of soils, in addition to the mitigation of greenhouse gas emissions. GAINS describes the interrelations between these multiple effects and the range of pollutants (SO_2, NOx, PM, NMVOC, NH_3, CO_2, CH_4, N_2O, F-gases) that contribute to these effects at the European scale. It uses energy related activity data and fuel prices generated by PRIMES and agricultural activity data provided by CAPRI, while generating own activity projections for other sectors, using among others the GDP and population assumptions as described above.

CAPRI

CAPRI is a partial equilibrium economic model which supports decision making related to the Common Agricultural Policy and Environmental policy related to agriculture based on sound scientific quantitative analysis. CAPRI is only viable due to its Pan-European network of researchers which based on an open source approach tender together for projects, develop and maintain the model, apply it for policy impact assessment, write scientific publications and consult clients based on its results. For the BAM modelling, it provides the agricultural activity data per Member State, drawing among others on the EU agricultural market outlooks for the short term and relevant GLOBIOM results for the longer term.

GLOBIOM-G4M

The Global Biosphere Management Model (GLOBIOM) has been developed and is used at the International Institute for Applied Systems Analysis (IIASA). GLOBIOM is a global recursive dynamic partial equilibrium model integrating the agricultural, bioenergy and forestry sectors with the aim to provide policy analysis on global issues concerning land use competition between the major land-based production sectors. It is global in the sense that it encompasses all world regions aggregated in a way that can be altered. GLOBIOM covers 28 (or 50) world regions. Partial denotes that the model does not include the whole range of economic sectors in a country or region but specialises on agricultural and forestry production as well as bioenergy production. These sectors are, however, modelled in a detailed way accounting for about 20 globally most important crops, a range of livestock production activities, forestry commodities as well as different energy transformation pathways.

For further documentation of EUCLIMIT please refer to http://www.euclimit.eu.

5.6.3.2. Key parameters & assumptions

For key parameters and assumptions of the sensitivity projections please refer to Section [BR] 5.4.3.

6. PROVISION OF FINANCIAL, TECHNOLOGICAL AND CAPACITY BUILDING SUPPORT TO DEVELOPING COUNTRIES

6.1. Introduction

This chapter should be read in conjunction with the chapter on provision of financial support of the 6th National Communication. Together, they present a comprehensive description of the EU's climate support.

This chapter covers the quantitative information for 2011 and 2012, using the required table formats. Data for 2011 and 2012 is therefore not included in the NC chapter.

This chapter also covers all the information related to technology transfer and capacity building. Such information is, therefore, not included in the NC.

The CTF tables with detailed data on the support provided in 2011 and 2012 are included in the CTF Appendix to this report[554].

6.2. General information: the EU's approach to provision of climate finance

The EU collectively continues to be the largest contributor of Official Development Assistance (ODA) and of climate finance flows to developing countries. The European Commission alone has provided ODA for climate change related interventions of more than € 4 billion since 2002.

Finance for development and climate action, both for adaptation and mitigation are intrinsically linked. Unchecked climate change has the potential to undermine all past, current and future efforts to eradicate poverty and achieve the MDGs. Similarly, development is an opportunity for investing in a green, low carbon and climate resilient growth path from the outset.

Therefore, mainstreaming of climate concerns into our aid programmes makes good sense both from a development and from a climate angle. We seek to ensure that the funding we provide is policy-coherent, results-oriented and efficiently targeting multiple global policies when relevant and possible. In practice, the EU's support to climate action combines a focus on integration of climate change considerations into the regular EU development aid with targeted initiatives and instruments, such as the Global Climate Change Alliance (GCCA) and specific climate-change "windows" in regional investment facilities that the EU has established since 2007.

It is the responsibility of governments to take the lead in designing and implementing climate policies as a basis for enhanced action and enhanced support. The EU strives to work closely with its partners to strengthen national planning capacities, institutions, planning processes, public financial management and procedures and monitoring systems to create a solid basis for countries to take charge of climate mainstreaming and to enable them to benefit from climate change finance and support from all sources.

There is a limit to what can be achieved with ODA alone. ODA plays an important role in supporting the most vulnerable countries, and it can help leverage climate relevant investment in developing countries. In order to stay within the 2°C target, however, much more needs to be done and additional resources are needed from different funding

554 These tables will be submitted to the UNFCCC using the official upload software.

sources, including domestic sources, the private sector and International Finance Institutions.

Addressing climate change and support sustainable development are key priorities for the EU's external aid. The implementation of climate actions at national and regional level is supported by geographical instruments. These instruments include the European Development Fund (in the ACP countries – Africa, Caribbean and Pacific), the Development Cooperation Instrument (in Asia, Latin America and South Africa), and the European Neighborhood & Partnership Instrument (in the EU's neighbourhood regions). These are complemented by a specific thematic programme (under the development Cooperation Instrument) focusing on environment and sustainable management of natural resources, including energy that addresses global environmental challenges as well as issues of common interest to groups of countries that do not belong to a single region. Further, the EU has established a number of innovative initiatives and facilities such as the Global Climate Change Alliance (GCCA), the Forest Law Enforcement, Governance and Trade (FLEGT), the Global Energy Efficiency and Renewable Energy Fund (GEEREF), the EU water and energy facilities and the Regional Investment Facilities (the so called blending mechanisms).

The EU, together with all the members of the OECD DAC, is increasing its efforts to enhance the capacity to track all its official financial flows, with particular emphasis on climate finance flows. The EU believes that such efforts will result in an enhanced measurement, reporting and verification (MRV) system for climate finance.

6.2.1. Addressing the needs of non-Annex I Parties

The magnitude, complexity and level of threats posed by climate change are understood, by a wide range of countries, as requiring a joint global response. Climate challenges will impact on the life of all humanity, but the biggest challenges will be faced by the poorest that are particularly vulnerable.

Hence, the EU has placed climate change high on the agenda of our external relations; and in particular in our relations with developing countries. Climate change is now regularly discussed in the framework of our Policy Dialogue with Partner countries. National ownership is a key principle for all EU support. Programming of bilateral support normally starts with the national government / actors taking ownership of an inclusive development process. To the extent possible, the EU bases its programming on the partner countries'/regions' own development plans or equivalent, including regional and sector plans, such as National Adaptation Programmes of Action (NAPAs/NAPs) or Nationally Appropriate Mitigation Actions (NAMAs) or – as appropriate – a combination of such documents, depending on the national context.

African countries are key partners in our work. Africa is a complex and diverse grouping, with many Least Developed Countries (LDCs) and it is in this continent that the adaptation challenge is perhaps greatest. EU and African countries share many common views and objectives as regards tackling climate change, and they have the opportunity to form strong alliances to reach global agreement. This EU engagement with Africa is put in practice through, for example, the Africa-EU Strategic Partnership on Climate Change and Environment, which includes a number of key strategic initiatives to jointly address climate change. In addition the EU is occasionally participating to the African Environment Ministries (AMCEN) process.

In 2011 the EU commenced cooperation on Climate Change with the Caribbean Community as a group, providing significant support to the Caribbean Community Climate Change Centre (CCCCC). In the Pacific Region, major high level meetings and several workshops took place, in parallel with increasing support to field actions, in the context of renewed EU-Pacific relations. These efforts are also supported through the Global Climate Change Alliance (GCCA), the EU initiative to step up dialogue and cooperation with developing countries most vulnerable to climate change in particular Least Developed Countries and Small Island Developing States.

GCCA programmes are designed to align with national priorities and support on-going national activities. Many GCCA interventions, including project-based ones directly contribute to the implementation of existing national programmes and strategies. A similar approach is pursued at the regional level. For instance, the GCCA supports the Mekong River Commission's Climate Change and Adaptation Initiative and the implementation of some priorities of the Pacific Islands Framework for Action on Climate Change.

The table below shows how GCCA-supported interventions promote or build on national adaptation strategies.

Table [BR1] 6-1 GCCA programme contributions to existing national programmes or strategies)

GCCA intervention in:	Contributes to:
Belize	Implementation of the National Adaptation Strategy to Address Climate Change in the Water Sector
Burkina Faso	Implementation of the National Rural Sector Plan
Central African Republic	Implementation of the national REDD+ strategy in the south-western region
Ethiopia	Implementation of the Climate Resilient Green Economy strategy, the national Climate Change Adaptation programme, and the Sustainable Land Management programme
Nepal	Mainstreaming of NAPA-prioritised activities through the national framework of Local Adaptation Plans for Action
Papua New Guinea	Implementation of national REDD readiness plan
Uganda	Implementation of the NAPA, operationalisation of two climate-related objectives of the 2010 National Development Plan
Vanuatu	Implementation of measures identified in the NAPA
Bangladesh	Implementation of the Bangladesh Climate Change Strategy and Action Plan
Bhutan	Implementation of the Renewable Natural Resources sector programme/five-year plan
Guyana	Implementation of the National Mangrove Action plan
Rwanda	Implementation of the Strategic Roadmap for Land Tenure Reform and the Strategic Plan for Environment and Natural Resources
Samoa	Implementation of the Water for Life sector plan
Lesotho	Implementation of the environment and climate change priorities of the National Strategic Development Plan
Mauritius	Implementation of the 'Maurice Île Durable' sustainable development strategy
Seychelles	Implementation of the Seychelles National Climate Change Strategy and the Seychelles Sustainable Development Strategy
Solomon Islands	Implementation of some NAPA priorities and the National Disaster Risk Management Plan

Source: Paving the Way for Climate Compatible Development: Experiences from the GCCA

Climate change is also regularly discussed with our partners from Latin America and Asia. The European Commission and the European External Action Service (EEAS) hosted an EU-Asia-Pacific roundtable on 4 June 2012 to discuss the position of the region in the global climate debate and the relevance of EU policies for the region. The roundtable brought together senior officials from EU Member States and from countries in the Asia-Pacific region, experts from selected policy institutes and other invited specialists. Participants discussed global issues and climate politics in view of improving mutual understanding and exploring the scope for advancing cooperation in areas such as industrial policy, research, trade, and development co-operation. Among the specific topics discussed were low emission development strategies, technology transfer, innovative carbon market mechanisms and improved delivery methods for climate change assistance. The roundtable followed a similar event for Africa held in October 2011.

Climate change is putting at risk years of efforts towards sustainable development. Developing countries are particularly vulnerable because their economies often depend more on climate-sensitive natural resources, and because they possess less resources to adapt to the impacts of climate change. Similarly, the development path chosen has important implications for the capacity of countries and communities to adapt to climate change and for their contribution to greenhouse gas emissions. Thus, climate change, be it related to adaptation or mitigation, is vital to all social and economic development activities.

The EU is therefore putting climate change mainstreaming at the core of its work. It addresses this on two fronts: i) with regard to policies, strategies and practices of EU institutions and Member States and ii) with regard to development processes of our partner countries.

Together with our partner countries, we seek to ensure that EU assistance is systematically integrating climate change considerations, from programming investments in social and physical infrastructure to national sector programmes. We are working to help strengthen countries' institutions and systems to integrate climate change in their development planning processes, from policy-making to budgeting, implementation and monitoring.

6.2.2. Innovating in delivering aid: engaging the private sector in adaptation and mitigation in developing countries

There is an increasing range of ways to collect and pool revenues, use traditional development finance and deliver aid. Engaging the private sector in development financing is another innovative way of mobilizing new funds.

In many developing countries, the expansion of the private sector is a powerful engine of economic growth and the main source of job creation. One of the main challenges for governments in developing countries is to ensure an environment that supports private sector development. This often requires far-reaching economic reforms aimed at improving the investment climate and facilitating access to finance. Accordingly, and as outlined in the EU Agenda for Change, the EU continue to assist partner countries' efforts to improve their business environment with a view to fostering inclusive growth.

EU grants need to be used strategically and effectively to leverage public and private sector financing.

The EU and Member States, together with European and international public financing institutions are actively collaborating though **regional blending mechanisms**, which are expected to be further scaled up in future, in order to use grant funding to leverage financing from other sources. This includes the possibility of making greater use of guarantee mechanisms, equity investments and other types of innovative financing. In this context, the EU has established with Member States an "EU Platform for External Cooperation and Development" to maximize the impact of resources through enhanced cooperation, coherence, monitoring and development of new innovative financing mechanisms.

A blending mechanism combines grants with additional flows (such as loans and risk capital) to gain financial and qualitative leverage, thereby increasing EU development policy impact.

The following regional blending mechanisms have been established:

- EU-Africa Infrastructure Trust Fund (ITF) - 2007
- Neighbourhood Investment Facility (NIF) - 2008
- Latin America Investment Facility (LAIF) - 2010
- Investment Facility for Central Asia (IFCA) – 2010
- Asia Investment Facility (AIF) – 2012
- Caribbean Investment Facility–2012
- Investment Facility for the Pacific –2012
- Western Balkans Investment Facility 2009

From 2007 to mid 2013, the relevant figures for climate change projects ITF,NIF, LAIF, AIF & IFCA are:

- 96 projects
- €750 million in grants
- Over €10 billion in loans and
- About €20 billion in total project financing.

The types of grant contributions that are made available through the blending mechanisms include: direct grant, technical assistance, interest rate subsidy, risk capital and guarantees.

The EU regional blending facilities have until now mainly supported public investments. The intention is to make growing use of the grants to facilitate private sector participation in investment projects.

The **Global Energy Efficiency and Renewable Energy Fund (GEEREF)** is another innovative financing mechanism**.** It aims to accelerate the transfer, development, use and enforcement of environmentally sound technologies for the world's poorer regions, helping to bring secure, clean and affordable energy to local people.

Structured as a Fund-of-Funds, GEEREF invests in private equity funds that specialise in providing equity finance to small and medium-sized project developers and enterprises (SMEs). GEEREF's beneficiaries are small and medium size (i.e. € 5-10 million) renewable energy and energy efficiency projects and enterprises in developing countries and economies in transition. These projects and enterprises often suffer from lack of capital financing – despite potentially attractive returns.

6.2.3. Methodology for tracking the provision of finance, technology and capacity building support

The approach used by the EU to track its provision of climate finance, technology and capacity building support is based on the OECD DAC system of Rio markers that has been integrated into the EU's own project monitoring and reporting system.

The OECD has developed a comprehensive system for measuring aid in support of climate-related objectives. It is based on detailed project level reporting against carefully defined policy markers. A Rio marker for mitigation was introduced 1998 and in 2010 an additional marker for adaptation was introduced. There are specific guidelines from OECD DAC agreed by DAC members for scoring projects and programmes against these markers. For each Rio marker, projects and programmes are placed in three categories: a) Principal objective, b) significant objective or c) not targeting.

According to the Rio marker methodology an activity is classified as climate change mitigation-related (either marked as 'Principal' or 'Significant') if it "contributes to the objective of stabilisation of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system by promoting efforts to reduce or limit GHG emissions or to enhance GHG sequestration."

As regards adaptation, an aid activity is marked as relevant if it "intends to reduce the vulnerability of human or natural systems to the impacts of climate change and climate-related risks, by maintaining or increasing adaptive capacity and resilience. This encompasses a range of activities from information and knowledge generation, to capacity development, planning and the implementation of climate change adaptation actions."

The Rio markers are policy makers, and were originally not intended for accurate quantification of flows to support policy goals. Therefore, an activity can have more than one principal or significant policy objective (i.e. it can be marked for several Rio markers; mitigation, adaptation and other Rio conventions such as Biodiversity and Desertification).

The EU has adopted the following approach to "translate" the Rio marked data into estimated climate finance flows:

- If an activity is marked as principal for mitigation or adaptation, 100% of the support is considered and reported as climate finance;
- If an aid activity is marked as significant for mitigation or adaptation, then only 40% of the support is considered and reported as climate finance.

- To avoid double counting, any activity can only count as 100%, 40% or 0%. If an activity is marked for both mitigation and adaptation, only the highest marking will count when calculating the total climate relevant financial contributing of the activity.

This biennial report covers support that has been committed in 2011 and 2012. A commitment entails that a final decision has been taken on allocation of the funds to a specific project and programme. In general, disbursement follows commitment unless exceptional circumstances arise.

In this biennial report the EU reports only flows that are provided 100% in the form of grants.

The EU is striving to improve the methodology for the tracking of support to climate action, and recognises that there is a need to further refine marking certain types of support to increase accuracy. Further, the EU recognizes that it is still not possible to provide an accurate account of the full technology and capacity building support provided as no comprehensive tracking system for this support is in place.

6.3. Financial Resources

The EU has increased the amount of finance dedicated to mitigation and adaptation and is climate proofing its aid that is not directly climate-related. During the reporting period 2011-2012, the EU delivered USD 1817 / €1 362 million in climate finance. In 2011 and 2012, support provided to mitigation was higher than support provided to adaptation. However, the gap narrowed substantially in 2012. The summary figures are provided in the table below. Detailed country information is provided in the Common Tabular Formats (CTF).

Table [BR1] 6-2 Provision of climate relevant support in 2011 and 2012 (USD 1000)

	2011	2012	Total
Total Support	873 953$	943 114$	1 817 067$
Total Mitigation	677 676$	712 725$	1 390 401$
Total Adaptation	596 205$	710 682$	1 306 888$

Table [BR1] 6-3 - *Provision of climate relevant support in 2011 and 2012 (EUR 1000)*

	2011	2012	Total
Total Support	€ 628 372	€ 733 743	€ 1 362 115
Total Mitigation	€ 487 249	€ 554 500	€ 1 041 749
Total Adaptation	€ 428 672	€ 552 911	€ 981 583

In Table [BR1] 6-2 and *Table [BR1]* 6-3, as per the methodology described above, the figures for mitigation and for adaptation cannot be added.

6.3.1. *Provision of financial support through multilateral channels*

The EU has not provided core contributions to multilateral organizations, including to the operating entities of the financial mechanism of UNFCCC (the Global Environmental Facility and the Green Climate Fund)[555]. In this regards, table 7a in the CTF Appendix is not filled in.

The EU, however, recognizes that such organizations are particularly suited to facilitate an effective and efficient deployment of support to developing countries, given in particular, their network and experience on the ground.

The EU has supported a number of global programme and Trust Funds managed by multilateral organisations, such as UNDP, UNEP, FAO and the World Bank. The two initiatives described below are examples of such collaboration with multilateral initiatives to pool resources for a more effective, efficient and country driven support. In the EU's statistical system such support is categorised as bilateral support with multiple recipients Thus, in the context of this Biennial Report it will be reported as bilateral support and included in CTF table 7(b).

6.3.1.1. The EU-UNDP Low Emission Capacity Building Programme

The Low Emission Capacity Building Programme (LECBP) was launched in January 2011 as part of a joint collaboration between the European Union (European Commission and Member States) and the United Nations Development Programme. Since its inception the LECB Programme has grown both in scope and breadth, proudly including 25 participating countries and enhanced technical support through contributions from the European Commission, the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, the Australian Department of Climate Change and Energy Efficiency and AusAID.

The LECBP was based on a 2010 European Commission „scoping study", which focused on 5 pilot countries: Kenya, Indonesia, Mexico, Peru, Thailand, with a view to exploring developing countries' capacity building needs on MRV, NAMAs and LEDS.

This scoping study delivered recommendations for tailor-made capacity building activities in the 5 pilot countries and a toolbox of general recommendations applicable to all developing countries.

This collaborative, country driven programme aims to strengthen technical and institutional capacities at the country level, while at the same time facilitating inclusion and coordination of the public and private sector in national initiatives addressing climate change. It is a six-year programme to strengthen capacities in participating countries in the following ways:

- Develop greenhouse gas (GHG) inventory management systems
- Identify opportunities for Nationally Appropriate Mitigation Actions (NAMA)
- Design systems for measuring, reporting, and verification of proposed actions and means to reduce GHG emissions
- Facilitate the design and adoption of mitigation actions by selected industries in some countries

555 The EU's contributions to the UNFCCC and the Kyoto Protocol's budgets are included in the National Communication.

6.3.1.2. The UN-REDD Programme

The UN-REDD Programme is the United Nations collaborative initiative on Reducing Emissions from Deforestation and forest Degradation (REDD) in developing countries. The Programme was launched in 2008 and builds on the convening role and technical expertise of the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP). The UN-REDD Programme supports nationally-led REDD+ processes and promotes the informed and meaningful involvement of all stakeholders, including Indigenous Peoples and other forest-dependent communities, in national and international REDD+ implementation.

The Programme supports national REDD+ readiness efforts in 47 partner countries, spanning Africa, Asia-Pacific and Latin America, in two ways: (i) direct support to the design and implementation of UN-REDD National Programmes; and (ii) complementary support to national REDD+ action through common approaches, analyses, methodologies, tools, data and best practices developed through the UN-REDD Global Programme. By June 2013, total funding for these two streams of support to countries totalled US$172.4 million, of which over USD13 million have been committed by the European Union.

6.3.2. Provision of financial support through bilateral channels

The principal channel of EU support to climate action in developing countries is provided through the bilateral partnerships and cooperation programmes.

The adaptation challenge is very unevenly distributed among countries and regions depending on their specific exposure, vulnerability and capacity to adapt. Developing countries, and in particular the least developed countries, will face the biggest challenge because poverty and low levels of development are major factors determining vulnerability and capacity to adapt. The EU has taken steps to strengthen its support to adaptation in the field through integration of adaptation considerations into existing and new development assistance programmes and through new areas of work linking adaptation and disaster risk reduction.

The EU also supports countries in their efforts to move towards, more climate resilient and low emission development pathways. It is important that the growth and development challenges faced by developing countries be addressed in an integrated way that avoids locking in inefficient and costly, environmentally damaging, carbon-emitting technologies and infrastructure that will contribute significant emission for many years to come. Moving to a green low-carbon economy constitutes an opportunity for all countries. For example, the 2011 EU Development Policy: an Agenda for Change highlights the provision of sustainable energy as an activity that has a strong multiplying impact on developing countries' economies and, at the same time, contributes to climate change mitigation.

The EU seeks to support combined efforts that builds synergy between mitigation and adaptation. The EU provides substantial support to cross-cutting sectors such as forestry, agriculture, eco-systems based approaches,

In total, the European Union committed USD874 / €628 million in 2011 and USD943 / €734 million in 2012 in bilateral support to climate action in developing countries.

Support provided to mitigation and adaptation is shown in *Table [BR1] 6-2* and *Table [BR1] 6-3* above. Out of the Total support provided in the two years (USD 1 817 / €1 362 million), USD 1 235 / €924 million were committed in cross-cutting activities (related both to mitigation and to adaptation).

As can be seen in *Table [BR1]* 6-4, the EU has provided most support to cross-cutting projects, i.e. projects impacting two or more relevant sectors, followed by support to the energy and agriculture sectors.

During the reporting period, the EU has placed a particular focus on Africa, where USD 768 / €578 million have been committed. Support to Africa, as a region, was followed to the provision of support to LDCs (as a group of countries)[556]. Such figures can be seen in *Table [BR1]* 6-5.

For detailed information on the bilateral provision of support by the EU, please see CTF Table 7(b) in the CTF Appendix.

556 Note that these two figures do not overlap."

Table [BR1] 6-4 – Provision of climate relevant support by sector (2011-2012) (EUR and USD 1000)

	Mitigation															
	Energy		Transport		Industry		Agriculture		Forestry		Water and sanitation		Cross-cutting		Other	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
2011	€ 40 709	56 620$							€ 9 280	12 907$			€ 35 861	49 876$		
2012	€ 148 138	190 409$	€ 13 600	17 481$			€ 2 702	3 472$			€ 12 200	15 681$			€ 8 000	10 283$
	Adaptation															
	Energy		Transport		Industry		Agriculture		Forestry		Water and sanitation		Cross-cutting		Other	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
2011			€ 8 990	12 503$			€ 64 079	89 123$			€ 7 800	10 848$	€ 4 600	6 398$	€ 3 200	4 451$
2012							€ 44 940	57 763$			€ 17 962	23 088$	€ 8 000	10 283$	€ 8 132	10 452$
	Cross-cutting															
	Energy		Transport		Industry		Agriculture		Forestry		Water and sanitation		Cross-cutting		Other	
	EUR 1000	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*	*EUR 1000*	*USD 1000*
2011							€ 16 520	22 976$	€ 34 000	47 288$	€ 12 800	17 803$	€ 390 532	543 160$		
2012	€ 3 595	4 621$					€ 56 036	72 026$	€ 79 800	102 571$	€ 69 684	89 568$	€ 242 473	311 662$	€ 18 480	23 753$
TOTAL	€ 192 443	251 650$	€ 22 590	29 984$	€ 0	0$	€ 184 277	245 361$	€ 123 080	162 765$	€ 120 446	156 988$	€ 681 466	921 379$	€ 37 812	48 939$

Table [BR1] 6-5 - Provision of support by region (2011-2012) (EUR and USD 1000)

	ACP		Africa		Asia		Caribbean		Eastern Europe and Central Asia		Latin America		Oceania		Unspecified LDCs		Global	
	EUR 1000	USD 1000	EUR 1000	USD 1000	EUR 1000	USD 1000	EUR 1000	USD 1000	EUR 1000	USD 1000	EUR 1000	USD 1000	EUR 1000	USD 1000	EUR 1000	USD 1000	EUR 1000	USD 1000
2011			€ 231 639	322 168$	€ 100 880	140 306$	€ 28 034	38 990$	€ 80 600	112 100$	€ 27 755	38 602$	€ 5 090	7 079$	€ 154 374	214 707$		
2012	€ 27 706	35 611$	€ 346 730	445 668$	€ 88 900	114 267$	€ 42 112	54 129$	€ 42 680	54 859$	€ 82 840	106 478$	€ 26 908	34 586$	€ 14 825	19 055$	€ 61 043	78 461$
TOTAL	€ 27 706	35 611$	€ 578 369	767 836$	€ 189 780	254 573$	€ 70 146	93 119$	€ 123 280	166 959$	€ 110 595	145 080$	€ 31 998	41 665$	€ 169 199	233 762$	€ 61 043	78 461$

Below are some of our most prominent initiatives during the reporting period.

6.3.2.1. Global Climate Change Alliance

The Global Climate Change Alliance (GCCA) is a European Union initiative to strengthen dialogue and cooperation on climate change with developing countries most vulnerable to climate change, in particular LDCs and SIDS. The GCCA comprises 45 programmes in 35 countries and across 8 regions within an envelope of € 290 million.

The first cycle of GCCA regional conferences between the EU, LDCs and SIDS was finalised with the conferences held in Vanuatu and Belize in March 2011. That year, the GCCA pursued a series of workshops on mainstreaming climate change into national planning and budgeting which has trained over 190 government officials from ministries of finance, planning and environment and regional organisations, across the world.

As an example of country level work, the GCCA supports the Cambodia Climate Change Alliance. The programme has already reaped results in the mainstreaming of climate change into overall development strategies. It has supported the creation of an inter-ministerial body for technical advice on climate change and a platform for dialogue on the same topic. GCCA is also enabling Cambodian officials to participate in international negotiations in climate change (through the preparation of position papers, sharing the outcomes of negotiations) and is assisting in-depth analysis to inform policy making. The first call for proposals under GCCA Cambodia produced eight climate change adaptation interventions covering ten provinces and multiple sectors such as agriculture, fisheries, forestry, bio-diversity, urban/coastal infrastructure, disaster risk reduction and community development.

6.3.2.2. The EU Energy Initiative

The EU addresses the current and future energy and development challenges in collaboration with its development partners. The EU Energy Initiative (EUEI) has been a key vehicle for the Commission and Member States to jointly deliver on these commitments. The EUEI celebrated its 10th anniversary in 2012 and is currently preparing a new phase. The new phase will focus on improving its impact and visibility and optimising financial resources as well as suggesting innovative approaches for financing.

An example of a specific EUEI initiative is the Africa- EU Energy Partnership (AEEP). It is a long-term framework for structured political dialogue and co-operation between Africa and the EU on energy issues. The AEEP has several sub-programmes, including the Africa-EU renewable energy cooperation programme. It aims to promote development of the renewable energy market, capacity building, application of feed-in tariffs, technology transfer, mobilisation of financing, and the setting up of renewable energy centres. It serves as an umbrella for renewable energy investments within EU bilateral programmes in support of the 2020 targets for renewable energy agreed between the EU and Africa. Another sub-programme is the ECOWAS renewable energy and energy efficiency centre (ECREEE) based in Praia, Cape Verde.

6.4. Technology development and transfer

Technology Transfer (TT) in the context of climate change is defined as: "A broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change among different stakeholders." More specifically, the transfer and development of technology activities can be hard or soft in nature. These categorisations are defined in the Technology Transfer Framework[557] as:

- "soft" technologies: capacity-building, information networks, training and research.
- "hard" technologies: equipment to control, reduce or prevent anthropogenic emissions of greenhouse gases in the energy, transport, forestry, agriculture, and industry sectors, to enhance removals by sinks, and to facilitate adaptation.

The framework also lists five themes for technology transfer, enabling more precise identification of projects that are of relevance:

1. technology needs and needs assessments
2. technology information
3. enabling environments
4. capacity-building
5. mechanisms for technology transfer.

Since 1999, developing countries have been supported to assess their technology needs through the development of Technology Needs Assessments (TNAs). TNAs are a set of country-driven activities that identify and determine the mitigation and adaptation technology priorities of Parties, particularly developing country Parties. They involve different stakeholders in a consultative process to identify the barriers to technology transfer and measures to address these barriers through sectorial analyses. The purpose of TNAs is to assist in identifying and analysing priority technology needs, which can form the basis for a portfolio of projects and programmes that aim to facilitate the transfer and access of technology. The sectors considered in the TNAs vary according to national circumstances. However, the most commonly selected sectors and subsectors for which technology needs have been identified for mitigation were energy generation and use, industry and transport, and for adaptation, agriculture and fisheries, coastal zones and water resources. TNAs are the first step in understanding the needs in one specific country for new techniques, equipment, knowledge and skills for mitigating greenhouse gas emissions and reducing vulnerability to climate change. Based on a TNA, a national Technology Action Plan can address practical actions necessary to reduce or remove policy, finance, and technology related barriers.

At the UN climate conference in Cancun in December 2010, the Convention Parties agreed to implement a new Technology Mechanism. The core task of the new Technology Mechanism is facilitating international technology cooperation to accelerate action at different stages of the technology cycle, including research and development, demonstration, deployment, diffusion and transfer. The Convention's Technology Mechanism consists of the Technology Executive Committee (TEC) and the Climate

557 Technology Transfer Framework: http://unfccc.int/ttclear/jsp/Framework.jsp

Technology Centre and Network (CTC-N), both fully operational since early 2013. The TEC will provide an overview of technological needs and analysis of policy and technical issues related to the development and transfer of technology for mitigation and adaptation. Driven by the needs and acting on requests from developing countries the CTC-N will provide capacity building and technical assistance for research, development, demonstration, deployment and diffusion of new and existing technologies on climate mitigation and adaptation. The CTC-N will have a coordinating role, engaging existing institutions from public, private, academic, research and business communities. Requests by developing countries for assistance will be channelled through national focal points (Designated National Entities) and in full coordination with national technology needs and strategies. The CTC-N addresses the fragmentation of information related to climate technology by establishing a support structure of organisations with outstanding technical and regional competencies.

The Technology Mechanism is fully operational since early 2013 and stimulates the transfer of technologies to developing countries through North-South, South–South and triangular technology cooperation. The CTC-N addresses the need of low-income countries to access information on mitigation and adaptation technologies through its demand driven system and training offers.

The European Commission and several EU Member States support the implementation of the CTC-N. The centre is located in Copenhagen, Denmark.

6.4.1. EU Funded Technology Transfer Initiatives and Programmes

All development aid cooperation projects in the field of climate change, and described in the previous section, involve technology transfer activities as defined by the technology transfer framework. It is in most case impossible, within a given programme, to get a breakdown of the technology transfer activities and related financial resources.

In addition to these, there are a number of other climate change activities involving technology transfer funded by the EU, most notably in the area of research. The following section provides an overview of such programmes. For detailed information on some of the projects, please consult section 8.4.6 in the EU's sixth National Communication for concrete examples addressing research and development of mitigation and adaptation technologies.

6.4.1.1. EU Framework Programmes

The 7th Framework Programme for research and technological development (FP7) remained during 2007-2013 the most important EU financial mechanism to support research on climate change and the development of energy technologies, including cooperation with non-EU countries, with resources for research in support to TT and capacity building with third countries. Many specific FP instruments are developed to promote and support international cooperation including on climate change technologies.

The main component of FP7, which ran between 2007 and 2013, was the €32.4 billion “Cooperation” programme, which was divided into research themes, one of which is called “Environment (including climate change)”: with a total budget of €1.89 billion, which was the cornerstone of environmental research in Europe and also expanded to developing countries, as a number of projects under FP7 awere specifically targeted at these countries. Furthermore, the mitigation of greenhouse gas emissions was a priority of projects across FP7, i.e. on energy, transport or food production.

6.4.1.2. Strategic Energy Technology Plan

The Strategic Energy Technology (SET) Plan provides a blueprint for Europe to develop a world-class portfolio of affordable, clean, efficient and low emission energy technologies. It puts forward a vision of Europe investing and working collectively to develop and facilitate a global market take-up of such technologies, with European industry leading the way. SET Plan also includes a substantial international cooperation dimension with industrialised, emerging and developing countries that should create new opportunities for cooperation between the EU and international partners.

6.4.1.3. Near-zero Emissions Power Generation Technology through Carbon Dioxide Capture and Storage

The EU and China committed to cooperate on Carbon Dioxide Capture and Storage (CCS) in the framework of the "Near-zero Emissions Power Generation Technology through Carbon Dioxide Capture and Storage" programme (NZEC). This cooperation aims at demonstrating the CCS technology in China to enable deployment from 2020.

The first phase of NZEC was completed between 2006 and 2009. Four research and development projects financed by the European Commission and UK involving Chinese and European academic organizations, companies and government bodies made significant progress in identifying options and constraints for CCS in China. At the 2009 Summit, China and EU jointly agreed to finalise the feasibility (phase II) of a demonstration plant, and a Memorandum of Understanding was signed between the European Commission and the Ministry of Science and Technology (MOST). Implementation is on-going. In 2010 Norway joined the initiative. A call for proposals has been launched in 2013 to select the project and conduct pre-feasibility studies to be finalised in 2014.

6.5. Capacity building

Capacity development is at the heart of the EU development assistance, in line with the provisions of the Paris Declaration on Aid Effectiveness and the Accra Agenda for Action. EU's development activities in the field of climate change are based on, and emphasize the importance of, the principles of national ownership, stakeholder participation, country-driven demand, cooperation between donors and across programmes, and impact assessment and monitoring (when appropriate). Due to the fact that almost all development activities undertaken by the EU and its member-states include a capacity-building component(s) or activities and given the high number and volume of development programmes supported, it is impossible to estimate and single out the full extent of financial support provided by the EU explicitly for the purposes of capacity-building. Since EU support is partner country-driven, only information from partner countries, for example through National Communications, is the best way to get a picture of capacity building support and activities and their effectiveness.

The EU supports a wide range of climate-related capacity development actions at the national level. This includes strengthening local institutional capacity for:

- Adaptation to the negative effects of climate change through: enhancing national institutions’ and stakeholders' capabilities to analyse and predict the impact of climate change; support for the development and implementation of national plans, policies and measures; creating an environment for active dissemination of information, raising of public awareness and exchange of best practices.
- Mitigation of greenhouse gases via: assistance in the preparation of baseline scenarios, cost-benefit analysis, GHG-inventories on national and sectoral level; enhancing capabilities to monitor, report and verify GHG-data; supporting local institutions and the private sector with the development and implementation of low-carbon strategies and nationally appropriate mitigation actions.
- Climate financing by: creating capacities, which enable access to existing bilateral, multilateral and private capital financing options for diverse projects in the area of climate change adaptation and mitigation.
- Integration (mainstreaming) of climate change into national policies, strategies and plans in all relevant sectors as well as into country systems (planning, budgeting, reporting, procurement, etc.)
- Support to the participation in the international climate change negotiation process through assisting the preparation of national communications, consulting national focal points, creating an environment for exchange, coordination and debate on climate political goals and strategies.

The common tabular formats adopted at COP-18 included a table on capacity building activities (CTF Table 9), which should be filled in to the extent possible. While, as mentioned above, it is not yet possible for the EU to report on such activities in the format provided, the EU still wishes to provide the following examples of capacity building activities. Most of these activities have been supported by the EU and one or more of its Member States.

6.5.1. Capacity building for mitigation

6.5.1.1. Low Emission Capacity-Building Programme

Name of the initiative: Low Emission Capacity-Building Programme: A global initiative to support NAMA, LEDS and MRV

Recipient country: 25 developing countries

Support provided by: the EU, Germany and Australia

Description of the activity

This global initiative aims at supporting developing and emerging countries in their national climate change mitigation efforts, low emission development strategies and enhanced measuring, reporting and verification systems. The methodology follows a country-driven and multi-stakeholder approach, with includes the participation of both the public and the private sectors. It is based on focused capacity-building activities addressing collection of relevant data, identification of key actions in selected sectors, design of measuring, reporting and verification (MRV) systems, linkages with outcomes and processes of National Communications.

One of the countries in which the Low Emission Capacity-Building Programme (LECB) programme works is Argentina. In this country, the LECB efforts are contributing to strengthen the capacity of the Secretariat of the Environment and Sustainable Development to lead the process of policy dialogue and formulation to support mitigation strategies in the petrochemical and fertiliser industry. Such a process is indeed a complex task requiring coordination at several levels of government with the participation of a wide spectrum of stakeholders.

The following three specific objectives were agreed upon:

- support knowledge generation and transfer allowing a positioning of Climate Change in the design of development policies and strategies;
- develop capacities by promoting sector-based dialogue and synergies in existing plans, programs and policies; and
- design and implement an advocacy and communications plan on Climate Change to better position the subject into the political agenda.

The project thus supports the public and private sector to formalize a joint strategy towards the reduction of greenhouse gases. This joint work conducted with all stakeholders in a given sector allows building capacities on both sides on the same basis, thereby facilitating a common understanding of the challenges and of the solutions that can be implemented. The idea is to start working in the petrochemical and fertilizer industry and then replicate the experience in other industrial sectors in Argentina. These sectors were selected because 1) there was an agreement to move forward on these issues by private companies, 2) the significant incidence on the total emissions of the country (especially ammonia and urea) and 3) the demonstration effect it will have on a wide range of private actors.

6.5.2. Capacity building for adaptation

6.5.2.1. Chololo Eco-village

Name of the initiative: Chololo Eco-village: an integrated approach to adaptation and resilience

Recipient country: Tanzania

Support provided by: European Union (Global Climate Change Alliance)

Description of the activity

Chololo village, located in one of the drought prone regions of Tanzania, is made up of vulnerable and deprived farming families, using rain fed agriculture, subsistence farming, communal grazing, and thus dependent on natural resources for livelihood.

Seeking to strengthen capacity of vulnerable rural communities to adapt to climate change, the pilot project aimed at transforming Chololo into a thriving eco-village – a model of good practice in climate change adaptation and mitigation. It worked closely with all villagers to identify, test, evaluate and share innovative adaptation technologies and approaches; to support the village community to adopt and implement land use plans and natural resource management practices; to empower women to act at the forefront of the transformation, with increased authority and reduced workload and to increase household food security and income, and improve livelihoods.

What has been achieved so far? 400 farmers and their families now have improved food security thanks to the introduction of drought resistant, high-yielding, early-maturing seeds and supply of improved cattle and cocks. The village water supply system was restored, roof catchment for rainwater installed at the village school and a sub-surface dam and a sand dam, to capture water in the nearby river, were constructed. In addition, 133 villagers were trained on afforestation and nursery management, and planted 14 500 tree seedlings and 3 000 trees. As regards energy efficiency, 10 domestic biogas plants were constructed and are now functioning, 60 energy saving cooking stoves are used by families.

Several high-ranking officials from the Government, as well as the media, visited the village which raised the awareness of many communities in the country, leading to wide-ranging efforts to scale-up and replicate the initiative.

6.5.2.2. QESPIKUNA

Name of the initiative: QESPIKUNA: Capacity building of local authorities and civil society actors for the integration of DRM in the sustainable development planning

Recipient country: Peru

Support provided by: European Union

Description of the activity

Peru is one of the most bio-diverse countries, with the most productive sea, one of the largest portions of the Amazon forest, and the Andean glaciers representing 70 % of the ice surface in the tropics. Many rural communities live in difficult conditions in sometimes harsh environmental conditions: they are highly vulnerable to and badly affected by the effects of climate change.

In order to reduce this vulnerability, "QESPIKUNA", an action supported by the NGO Practical Action together with local communities, has prioritized work in three regions of the Peruvian Andes to strengthen the capacities of local authorities and civil society for the integration of the Disaster Risk Management (DRM) in local sustainable development planning. The project seeks to disseminate and apply political and economic tools to allow appropriate social development planning and greater coordination and transparency among the institutions involved, prioritizing the use of Information and Communication Technologies (ICT).

6.5.2.3. Improving livelihoods and food security in rural Uganda

Name of the initiative: Improving livelihoods and food security in rural Uganda

Recipient country: Uganda

Support provided by: European Union and Ireland

Description of the activity

Climate change poses a significant threat to Uganda because of its predicted effect on agriculture, food security and soil and water resources. The project is tackling this threat by focusing on the sustainable improvement of livelihoods and food security for the rural population. The aim is to strengthen the resilience of the rural population and the agricultural production systems in the central part of the cattle corridor, and to build the capacities of communities, commercial farmers and the Government of Uganda to cope with climate change. Ireland has provided € 11 million for the project through the EU’s Global Climate Change Alliance.

The project has three key components: strengthening knowledge and capacities for climate change adaptation; creating better access for livestock to water; and improving the resilience of agricultural production systems in the cattle corridor. The project will run from 2012 to 2016.

Good progress has been made in consultation and engagement with partners including local governments, ministries and other development partners. This has provided the opportunity to assess the potential for using existing structures and implementation modalities for the project, as well as assessing complementarities and alignment with existing projects and programmes.

Following the conclusion of the Memorandum of Understanding between the FAO and the Government of Uganda in August 2012, the project has moved from inception to launch. The definition of all the key actions has been finalized, a monitoring and evaluation system has been established and major procurement of technical assistance and other core services has been undertaken. Experience shows the need to work closely with farmer groups and the private sector, which are the key drivers of agriculture and forestry in Uganda. In the water sector, there is a need to address the lack of community involvement which can be a cause of failure due to lack of ownership of infrastructure and poor operation and maintenance.

6.5.2.4. Peri-urban water and sanitation programme

Name of the initiative: Peri-urban water and sanitation programme (PASAP)

Recipient country: Peru

Support provided by: European Union, Sweden

Description of the activity

Together with Sweden, the EU supports strengthened institutional capacity building for climate change adaptation in Bolivia through support to the Bolivian government, Ministry of Water and Environment, to implement the sector programme PASAP which is based on the national plan for basic sanitation. The overall objective of PASAP is to improve the livelihoods of people living in poverty in peri-urban areas focusing on sustainable management of water resources and promoting water and sanitation systems that are resilient to climate change. Indicators for climate change adaptation have been developed in order to ensure that climate-resilient water and sanitation systems are implemented, e.g. in terms of more efficient water use, installing low-consumption appliances, and treating waste water. The support from EU and Sweden for the overall intervention is 28 million Euro, of which the capacity building component amounts to 2 million Euro.

6.5.3. Capacity building for climate finance

6.5.3.1. Cambodia Climate Change Alliance

Name of the initiative: Cambodia Climate Change Alliance

Recipient country: Cambodia

Support provided by: European Union, Sweden and Denmark

Description of the activity

The EU is, together with Sweden, Danida and UNDP, supporting national capacity development and institutional strengthening in Cambodia through the Cambodia Climate Change Alliance (CCCA). The CCCA’s overall objective is to strengthen the capacity of the National Climate Change Committee (NCCC) to fulfil its mandate to address climate change. The support is strategically important to build climate change adaptation capacity and in order to make the government better prepared to receive and manage climate change funds. The capacity building and institutional strengthening activities include, inter alia: i) the establishment of a climate fund and a fund secretariat which are integrated in the Climate Change Department within the Ministry of Environment; ii) establishment of an inter-ministerial technical team specialised on climate issues has been established to provide support to the National Committee on Climate Change; iii) the establishment of a knowledge and information platform; and iv) strengthening capacity of government officials to actively manage climate change issues and participate in national and international climate change dialogue. The total budget is 10 million USD.

6.5.4. Capacity building for mainstreaming and integration

6.5.4.1. Mainstreaming of climate change into national systems and policies

Name of the initiative: Mainstreaming of climate change into national systems and policies

Recipient country: Mozambique

Support provided by: European Union, Denmark and Ireland

Description of the activity

Aiming at supporting the government of Mozambique's efforts in tackling the adverse effects of climate change, with a special focus on the most vulnerable communities in the rural areas of the country, this program seeks to increase the capacity of the Government to adequately mainstream climate change and climate-proofing initiatives into its poverty alleviation and development strategies. It benefits from support of the Global Climate Change Alliance (GCCA), Ireland and Denmark.

The main expected results and activities are structured around 3 pillars, two of which have a strong capacity-building component.

The first pillar aims at strengthening institutional capacity and technical expertise of key government institutions. It does so by supporting local staff to review relevant sector development strategies to integrate environmental and climate change themes. These reviews are set against the most recent legal and policy frameworks. Other courses of action include strengthening the environmental monitoring system to adequately measure sector performance; promoting good governance practices; improving compliance with relevant legal and regulatory framework; and providing a clear reference for enhanced coordination and linkages between all government and non-state actors, at central, provincial and district level.

Information sharing and awareness campaigns form the backbone of the second pillar. Specific tailor-made capacity-building actions take the form of on-the-job training courses aimed at improving responsiveness to climate change amongst key development agents at all levels from central to local level.

Finally, the third pillar focuses on implementation of the national response to climate change (Environment Strategy for Sustainable Development, National Adaptation Programme of Action), which is supported by putting into practice a number of pilot projects, mainly in the agrarian and agroforestry sectors and sharing the lessons learnt, including through farm-to-farm exchanges.

6.5.4.2. Nepal Climate Change Support Programme

Name of the initiative: Nepal Climate Change Support Programme- Building Climate Resilience in Nepal: Integrating climate change into poverty reduction and other development strategies

Recipient country: Nepal

Support provided by: European Union, United Kingdom and Cyprus

Description of the activity

The European Union (Global Climate Change Alliance), in partnership with the UK and Cyprus, is supporting the Nepal Climate Change Support Programme (NCCSP), which focuses on building community resilience to climate change. Local communities will use a simple national adaptation framework to plan and prioritize adaptation activities. The UK support will help fund these activities to ensure the needs of the poorest and most climate vulnerable people in Nepal are addressed first.

The project also aims to enable the Government of Nepal (GoN) to adopt climate change policies and implement actions that increase benefits and sustainability of public as well as public private development efforts in a longer term. It does so by building capacity of GoN to develop, cost, budget and implement evidence-based policy and measures aimed at mainstreaming climate change in key development sectors (agriculture, forestry, water and energy), including through public-private partnerships.

An interesting feature of the program is that it also seeks to strengthen technical and institutional capacity of Village Development Committees (VDCs) and District Development Committees (DDCs) in mid- and far-west regions (14 districts), to increase their capacity in integrating climate change into key local and district policies, government institutions and budget processes.

The initiative will support GoN to implement NAPA prioritized activities through the national framework of Local Adaptation Plans for Action (LAPA), which provides effective delivery of adaptation services to the most climate vulnerable communities. The programme will also establish and/or strengthen mechanisms of sharing in adaptation interventions among different stakeholders at the district and national levels. The project is expected to have important cross-cutting impacts and aspects, such as women's empowerment, inclusion of the poor and disadvantaged groups, enhancement of good governance, mainstreaming of climate change in local planning, as well as look into ecosystem and livelihood perspective working at VDC level.

By 2015, the NCCSP programme will assist 3 million people from the poorest and most vulnerable groups (over half of them women and girls). The UK has provided 3 million pounds in Fast Start Finance to the NCCSP, the EU € 8 million and Cyprus € 0.6 million.

7. LIST OF ABBREVIATIONS

AAU	Assigned Amount Unit
AEA	Annual Emission Allowances
AMESD	African Monitoring of Environment for Sustainable Development
Art	Article
BAM	baseline scenario of EUCLIMIT
boe	Barrel of oil equivalent
BR	Biennial report
BR1	1st Biennial report
BRICS	Brazil, Russia, India, China and South Africa
CAP	Common Agricultural Policy
CB	Capacity building
CCC	Climate Change Committee (under the Monitoring Mechanism Decision)
CCCA	Cambodia Climate Change Alliance
CCPMs	Common and Coordinated Policies and Measures
CCS	Carbon Capture and storage
CDM	Clean Development Mechanism
CEOS	Committee on Earth Observation Satellites
CER	Certified Emission Reduction
CIF	Climate Investment Funds
CION	European Commission
CITL	Community Independent Transaction Log
CM	Cropland Management
CM SAF	Satellite Application Facility on Climate Monitoring
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2eq	Carbon dioxide equivalents
COP	Conference of Parties
COSME	Programme for the Competitiveness of enterprises and SMEs
COSPAR	Committee on Space Research
CP	Commitment Period
CPA	Classification of products by activity in the European Union
CRF	Common Reporting Format
CTF	Common Tabular Format
DCs	Developing countries
DDC	District Development Committee
DG	Directorate-General
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EAP	Environment Action Programme
ECMWF	European Centre for Medium range Weather Forecasting

ECV	Essential Climate Variable
EDCTP	European and Developing Countries Clinical Trials Partnership
EEA	European Environment Agency
EEAS	European External Action Service
Eionet	European Environment Information and Observation Network
EIT	Economy in transition
EMU	Economic and Monetary Union
EO	Earth Observation
EP	European Parliament
ERA	European Research Area
ERA-NET	European Research Area Net
ERC	European Research Council
ERDF	European Regional Development Fund
ERT	Expert Review Team
ERU	Emission Reduction Unit
ESA	European Space Agency
ESD	Effort Sharing Decision
ESF	European Social Fund
ESSP	Earth System Science Partnership
ETAP	EU Environmental Technologies Action Plan
ETC/ACM	European Topic Centre on Air Pollution and Climate Change Mitigation
ETS	Emission trading scheme
EU ETS	The European Union's emission trading scheme
EU	European Union
EUCLIMIT	Development and application of EU economy-wide climate mitigation modelling capacity (project)
EU-15	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom
EU-27	EU-15 plus Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia,
EU-28	EU-27 plus Croatia
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUR	Euro
EURATOM	European Atomic Energy Community
FACCE-JPI	Joint Programming Initiative Agriculture, Food Security and Climate Change
FCDR	Fundamental Climate Data Records
FlexMechs	Flexible Mechanisms under the Kyoto Protocol
FM	Forest Management
FP	Framework Programme
FP6	6th Framework Programme
FP7	7th Framework Programme
FSF	Fast Start Financing

GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GFCS	Global Framework for Climate Services
GHG	Greenhouse Gases
GIS	Geographical Information Systems
GM	Grazing Land Management
GVA	Gross Value Added
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
IA	Impact Assessment
IAB	Impact Assessment Board
ICPC	International Cooperation Partner Countries
ICSU	International Council for Science
IDR	In Depth Review
IET	International Emissions Trading
IOCCG	International Ocean Colour Coordinating Group
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental panel on climate change
JI	Joint Implementation
JPI	Joint Programming Initiative
JRC	Joint Research Centre
koe	Kilograms of Oil Equivalents
KP	Kyoto Protocol
LBA	Legally-Binding Agreement
lCER	Long-term Certified Emission Reduction
LDCF	Least Developed Countries Fund
LDCs	Least developed countries
LECB	Low Emission Capacity-Building Programme
LEDS	Low-Emission Development Strategies
LULUCF	Land use, land use Change and Forestry
MESA	Monitoring of Environment and Security in Africa
MISR	Multi-angle Imaging SpectroRadiometer
MMD	Monitoring Mechanism Decision
MMR	Monitoring Mechanism Regulation
MRV	Monitoring, Reporting and Verification
MS	EU Member State
MSG	Meteosat Second Generation
Mt	Megatonnes
Mtoe	Megatonnes of oil equivalent

N_2O	Nitrous Oxide
NACE	Statistical classification of economic activities in the European Union
NAMA	Nationally Appropriate Mitigation Action
NAP	National Adaptation Plan
NAS	National Adaptation Strategy
NASA	National Aeronautics and Space Administration
NC	National Communication
NC4	4th National Communication
NC5	5th National Communication
NC6	6th National Communication
NCCC	National Climate Change Committee
NCCSP	Nepal Climate Change Support Programme
NEC	National Emissions Ceiling
NER	New Entrant Reserve
NF3	Nitrogen Trifluoride
NIR	National Inventory Report
NMVOC	Non-methane volatile organic compounds
NREAP	National Renewable Energy Action Plan
NOx	Nitrogen oxides
ODA	Official Development Assistance
PaMs	Policies and measures
PASAP	Peri-urban water and sanitation programme
PFCs	Perfluorocarbons
QELRC	quantified emission limitation and reduction commitment
RMU	Removal Unit
RSO	Research and Systematic Observation
RV	Revegetation
SAF	Satellite Application Facility
SANSA	South African National Space Agency
SBI	Subsidiary Body for Implementation
SBSTA	Subsidiary Body for Scientific and Technological Advice
SCCF	Special Climate Change Fund
SDS	Sustainable Development Strategy
SEF	Standard Electronic Format for reporting Kyoto Protocol units
SF_6	Sulphur Hexafluoride
SICA	Specific International Cooperation Actions
SME	Small and Medium-sized Enterprises
SO_2	Sulphur Dioxide
SPP	Strategic Planning and Programming
tCER	Temporary Certified Emission Reduction
TFEU	Treaty on the Functioning of the European Union
toe	Tonnes of Oil Equivalents

TT	Technology transfer
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations framework convention on climate change
USD	United States of America Dollars
VDC	Village Development Committee
VE	Verified emissions
WAM	With additional measures scenario
WCRP	World Climate Research Programme
WEM	With existing measures scenario
WG I	Working Group I under the CCC
WG II	Working Group II under the CCC
WOM	Without measures scenario

8. APPENDIX: CTF FOR EU 1ST BIENNIAL REPORT

Overview on CTF tables provided with the first EU Biennial Report:

CTF Table 1 (EU-28):	Emission trends
CTF Table 1 (EU-15):	Emission trends
CTF Table 2 (EU-28):	Description of quantified economy-wide emission reduction target
CTF Table 3 (EU-28):	Progress in achievement of the quantified economy-wide emission reduction target: information on mitigation actions and their effects
CTF Table 4 (EU-28):	Reporting on progress
CTF Table 4(a)II (EU-28):	Progress in achievement of the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the counting of emissions and removals from the land use, land-use change and forestry sector in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
CTF Table 4(b) (EU-28):	Reporting on progress
CTF Table 4 (EU-15):	Reporting on progress
CTF Table 4(a)II (EU-15):	Progress in achievement of the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the counting of emissions and removals from the land use, land-use change and forestry sector in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
CTF Table 4(b) (EU-15):	Reporting on progress
CTF Table 5 (EU-28):	Summary of key variables and assumptions used in the projections analysis
CTF Table 6(a)/(c) (EU-28):	Information on updated greenhouse gas projections under a ‘with measures’ scenario and under a ‘with additional measures’ scenario
CTF Table 7 (EU-28):	Provision of public financial support: summary information
CTF Table 7(b) (EU-28):	Provision of public financial support: contribution through bilateral, regional and other channels

8.1. CTF Table 1 (EU-28): Emission trends

8.1.1. CTF Table 1 (EU-28): Emission trends: summary

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	CO_2 equivalent (Gg)																					
CO_2 emissions including net CO_2 from LULUCF	4 159 772	4 059 355	3 907 259	3 834 990	3 812 968	3 859 488	3 955 960	3 873 724	3 870 231	3 790 888	3 834 014	3 875 017	3 903 625	4 025 666	4 010 262	3 978 538	3 959 546	3 944 256	3 805 984	3 462 426	3 607 925	3 458 944
CO_2 emissions excluding net CO_2 from LULUCF	4 430 302	4 373 120	4 210 575	4 131 621	4 111 840	4 155 793	4 256 619	4 174 494	4 172 165	4 107 753	4 131 745	4 203 658	4 177 413	4 277 389	4 287 706	4 269 224	4 273 988	4 220 994	4 124 952	3 792 439	3 912 211	3 764 300
CH_4	599 346	582 985	563 848	554 091	541 545	537 452	532 101	519 344	505 443	494 124	483 077	469 649	459 965	452 032	438 737	431 122	425 431	418 678	412 705	403 753	400 313	392 169
N_2O	525 561	496 900	477 772	460 769	464 288	464 977	471 302	468 799	446 447	423 715	420 445	413 134	401 623	396 767	401 199	392 375	379 729	379 530	370 393	349 717	339 842	338 577
HFCs	27 882	27 537	29 447	31 880	36 039	40 426	45 761	52 796	54 214	47 681	47 142	46 846	49 574	54 878	57 111	61 686	64 537	69 319	72 745	75 989	80 181	81 761
PFCs	21 304	19 470	15 763	14 890	14 303	14 028	13 496	12 527	11 871	11 560	9 876	8 904	10 389	8 635	7 327	6 129	5 497	5 083	4 376	2 844	3 329	3 602
SF_6	10 958	11 396	12 216	13 147	14 231	15 332	15 136	13 509	12 622	10 284	10 282	9 629	8 553	8 001	8 274	8 192	7 575	7 318	6 868	6 471	6 559	6 429
Total (including net CO_2 from LULUCF)	**5 344 823**	**5 197 644**	**5 006 304**	**4 909 767**	**4 883 374**	**4 931 703**	**5 033 755**	**4 940 699**	**4 900 827**	**4 778 252**	**4 804 835**	**4 823 179**	**4 833 730**	**4 945 979**	**4 922 910**	**4 878 042**	**4 842 315**	**4 824 184**	**4 673 071**	**4 301 200**	**4 438 149**	**4 281 481**
Total (excluding net CO_2 from LULUCF)	**5 615 353**	**5 511 409**	**5 309 621**	**5 206 398**	**5 182 246**	**5 228 007**	**5 334 414**	**5 241 469**	**5 202 762**	**5 095 118**	**5 102 566**	**5 151 820**	**5 107 518**	**5 197 702**	**5 200 354**	**5 168 727**	**5 156 757**	**5 100 923**	**4 992 039**	**4 631 213**	**4 742 434**	**4 586 837**
Total (without LULUCF)	**5 606 118**	**5 502 415**	**5 300 837**	**5 197 649**	**5 171 502**	**5 217 746**	**5 324 172**	**5 231 717**	**5 192 796**	**5 086 012**	**5 092 807**	**5 142 950**	**5 098 801**	**5 187 898**	**5 191 779**	**5 159 660**	**5 147 924**	**5 091 633**	**4 983 739**	**4 622 743**	**4 733 944**	**4 578 597**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	CO_2 equivalent (Gg)																					
1. Energy	4 319 605	4 283 306	4 123 808	4 054 034	4 009 684	4 045 929	4 154 190	4 062 632	4 054 521	3 993 696	4 000 242	4 078 342	4 048 881	4 138 318	4 132 251	4 106 849	4 102 932	4 039 130	3 959 346	3 680 648	3 784 411	3 634 727
2. Industrial Processes	461 477	427 085	412 545	400 235	426 956	439 424	438 508	444 021	418 825	381 456	393 099	380 585	375 469	388 397	402 633	406 017	403 715	415 233	391 719	325 652	337 860	334 685
3. Solvent and Other Product Use	16 855	16 274	15 696	15 161	13 846	13 904	13 989	13 969	13 980	13 622	13 442	13 033	12 660	12 264	12 152	12 188	12 254	11 788	11 287	10 356	10 415	10 215
4. Agriculture	604 008	569 741	544 575	525 841	520 252	520 030	521 420	520 665	518 477	515 661	508 448	500 085	494 081	487 087	487 939	481 543	477 833	478 424	477 855	466 382	463 189	464 418
5. Land-Use, Land-Use Change and Forestry	-261 295	-304 770	-294 533	-287 881	-288 128	-286 042	-290 416	-291 018	-291 969	-307 760	-287 972	-319 772	-265 071	-241 919	-268 869	-281 618	-305 609	-267 449	-310 668	-321 543	-295 796	-297 115
6. Waste	204 173	206 009	204 212	202 378	200 764	198 459	196 065	190 431	186 993	181 577	177 575	170 905	167 711	161 832	156 804	153 063	151 189	147 059	143 533	139 704	138 069	134 553
7. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Abbreviation: LULUCF = land use, land-use change and forestry.

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[b] Includes net CO_2, CH_4 and N_2O from LULUCF.

8.1.2. CTF Table 1 (EU-28): *Emission trends: CO_2*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	(Gg)																					
1. Energy	**4 129 772**	**4 100 979**	**3 949 194**	**3 880 523**	**3 845 056**	**3 881 713**	**3 990 875**	**3 903 826**	**3 904 266**	**3 847 999**	**3 860 265**	**3 942 566**	**3 916 728**	**4 007 442**	**4 006 515**	**3 984 776**	**3 984 049**	**3 924 483**	**3 845 365**	**3 572 082**	**3 673 771**	**3 526 430**
A. Fuel Combustion (Sectoral Approach)	4 104 312	4 076 671	3 924 309	3 855 426	3 820 399	3 854 666	3 963 450	3 876 626	3 879 598	3 823 865	3 835 383	3 918 350	3 891 987	3 982 061	3 982 118	3 959 408	3 958 175	3 899 277	3 821 524	3 549 395	3 650 626	3 503 092
1. Energy Industries	1 663 267	1 639 784	1 561 449	1 501 054	1 505 870	1 508 534	1 539 451	1 491 033	1 508 968	1 469 307	1 497 585	1 535 312	1 554 581	1 606 267	1 592 145	1 579 665	1 589 978	1 598 771	1 523 270	1 398 668	1 421 659	1 399 748
2. Manufacturing Industries and Construction	850 702	805 500	761 071	741 731	741 365	753 194	742 817	741 998	713 677	692 255	701 744	680 525	661 063	672 666	671 428	665 233	665 681	659 500	631 175	532 943	571 227	559 521
3. Transport	765 675	772 928	794 386	798 963	804 950	817 681	842 098	855 374	882 395	902 712	899 893	915 024	926 680	936 896	956 301	956 831	963 794	973 460	954 061	930 526	925 040	915 617
4. Other Sectors	796 900	835 425	788 556	796 851	752 236	759 614	824 869	774 751	760 843	746 968	724 151	776 619	739 040	755 164	750 445	745 563	727 498	655 922	702 177	677 377	723 217	618 718
5. Other	27 768	23 034	18 847	16 828	15 979	15 643	14 214	13 470	13 714	12 622	12 010	10 869	10 621	11 068	11 798	12 116	11 225	11 623	10 842	9 882	9 483	9 487
B. Fugitive Emissions from Fuels	25 460	24 308	24 885	25 097	24 657	27 047	27 426	27 200	24 668	24 134	24 882	24 215	24 742	25 381	24 397	25 367	25 874	25 206	23 840	22 687	23 145	23 339
1. Solid Fuels	4 474	3 213	3 207	2 884	1 668	2 642	2 664	3 748	1 973	2 915	3 643	2 969	3 190	3 762	3 590	3 041	3 362	3 120	2 888	2 055	3 200	3 383
2. Oil and Natural Gas	20 986	21 095	21 678	22 213	22 988	24 405	24 762	23 453	22 695	21 219	21 239	21 247	21 552	21 619	20 807	22 326	22 511	22 086	20 953	20 632	19 945	19 956
2. Industrial Processes	**283 869**	**255 982**	**245 834**	**236 207**	**253 364**	**261 017**	**252 736**	**258 125**	**255 335**	**247 609**	**259 406**	**249 325**	**248 783**	**258 183**	**269 480**	**272 506**	**277 760**	**285 163**	**268 613**	**210 310**	**227 954**	**227 779**
A. Mineral Products	150 233	136 947	132 385	126 546	134 946	140 010	135 586	138 741	140 915	141 042	143 570	141 132	141 072	142 465	148 777	148 770	152 834	158 038	147 619	117 850	120 030	120 276
B. Chemical Industry	44 010	41 213	38 982	37 558	40 306	43 698	43 816	41 854	40 836	40 638	44 042	41 838	40 704	42 752	43 491	45 016	42 745	45 340	43 812	38 305	41 549	43 425
C. Metal Production	88 274	76 519	73 018	70 783	76 729	75 831	71 984	76 053	71 890	64 497	70 051	64 685	65 412	71 516	75 619	76 681	80 387	80 009	75 479	52 518	64 596	62 414
D. Other Production	87	63	68	64	43	36	63	62	56	66	62	56	46	60	55	48	33	43	52	49	48	38
E. Production of Halocarbons and SF_6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F. Consumption of Halocarbons and SF_6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. Other	1 265	1 238	1 381	1 256	1 340	1 442	1 286	1 414	1 639	1 367	1 681	1 614	1 550	1 391	1 537	1 990	1 761	1 734	1 651	1 588	1 732	1 625
3. Solvent and Other Product Use	**11 786**	**11 291**	**10 658**	**10 159**	**8 911**	**8 940**	**8 931**	**9 002**	**9 072**	**8 891**	**8 823**	**8 521**	**8 441**	**8 278**	**8 290**	**8 314**	**8 314**	**7 975**	**7 600**	**6 817**	**7 129**	**6 989**
4. Agriculture	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
A. Enteric Fermentation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. Manure Management	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C. Rice Cultivation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. Agricultural Soils	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. Prescribed Burning of Savannas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F. Field Burning of Agricultural Residues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5. Land-Use, Land-Use Change and Forestry	**-270 530**	**-313 765**	**-303 317**	**-296 631**	**-298 873**	**-296 304**	**-300 659**	**-300 770**	**-301 935**	**-316 866**	**-297 731**	**-328 641**	**-273 788**	**-251 723**	**-277 444**	**-290 685**	**-314 442**	**-276 738**	**-318 968**	**-330 013**	**-304 286**	**-305 356**
A. Forest Land	-390 799	-432 439	-421 849	-417 675	-420 692	-416 684	-417 862	-414 941	-418 267	-429 336	-404 553	-435 001	-382 192	-366 397	-383 572	-393 277	-415 190	-384 364	-424 303	-430 977	-401 415	-405 798
B. Cropland	86 456	83 232	85 467	83 696	85 077	88 179	84 197	82 778	80 748	81 501	78 144	77 360	82 128	88 072	79 257	76 055	73 614	75 471	73 898	72 755	74 477	77 349
C. Grassland	2 879	2 447	-677	1 643	-114	-4 104	-3 400	-2 842	-724	-4 235	-6 743	-8 023	-10 519	-11 023	-12 200	-12 830	-12 829	-7 277	-10 912	-11 643	-13 313	-12 884
D. Wetlands	5 466	5 595	5 568	5 462	5 647	5 681	5 684	5 585	5 506	5 990	6 275	6 691	5 815	6 209	6 269	6 336	6 195	6 184	5 476	5 958	5 603	5 681
E. Settlements	28 088	28 995	29 390	29 742	31 171	30 719	30 735	31 248	31 882	33 524	32 894	33 266	33 707	34 230	35 838	37 168	38 549	38 678	39 989	38 982	38 619	38 469
F. Other Land	2 447	1 875	1 765	2 657	2 392	2 865	3 746	3 070	4 423	2 281	2 220	1 446	1 533	1 947	1 075	-115	-300	-676	326	-1 013	-2 174	-2 329
G. Other	-5 067	-3 469	-2 980	-2 156	-2 352	-2 960	-3 758	-5 669	-5 503	-6 591	-5 968	-4 380	-4 261	-4 760	-4 111	-4 022	-4 480	-4 754	-3 444	-4 075	-6 081	-5 843
6. Waste	**4 875**	**4 868**	**4 889**	**4 732**	**4 509**	**4 122**	**4 077**	**3 541**	**3 492**	**3 254**	**3 250**	**3 246**	**3 460**	**3 486**	**3 421**	**3 628**	**3 865**	**3 374**	**3 375**	**3 229**	**3 356**	**3 101**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	(Gg)																					
A. Solid Waste Disposal on Land	227	268	308	299	244	104	83	60	58	54	38	36	27	27	26	25	14	12	10	5	2	2
B. Waste-water Handling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C. Waste Incineration	4 630	4 581	4 562	4 415	4 247	3 997	3 974	3 462	3 415	3 180	3 193	3 192	3 415	3 440	3 377	3 585	3 832	3 342	3 344	3 203	3 336	3 081
D. Other	18	19	20	18	18	20	20	19	18	19	19	19	18	20	18	18	19	19	21	21	18	18
7. Other	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total CO_2 Emissions including net CO_2 from LULUCF	**4 159 772**	**4 059 355**	**3 907 259**	**3 834 990**	**3 812 968**	**3 859 488**	**3 955 960**	**3 873 724**	**3 870 231**	**3 790 888**	**3 834 014**	**3 875 017**	**3 903 625**	**4 025 666**	**4 010 262**	**3 978 538**	**3 959 546**	**3 944 256**	**3 805 984**	**3 462 426**	**3 607 925**	**3 458 944**
Total CO_2 Emissions excluding net CO_2 from LULUCF	**4 430 302**	**4 373 120**	**4 210 575**	**4 131 621**	**4 111 840**	**4 155 793**	**4 256 619**	**4 174 494**	**4 172 165**	**4 107 753**	**4 131 745**	**4 203 658**	**4 177 413**	**4 277 389**	**4 287 706**	**4 269 224**	**4 273 988**	**4 220 994**	**4 124 952**	**3 792 439**	**3 912 211**	**3 764 300**
Memo Items:																						
International Bunkers	**178 662**	**175 925**	**183 156**	**190 728**	**190 417**	**196 005**	**207 225**	**220 577**	**233 541**	**235 483**	**248 740**	**253 157**	**254 378**	**262 427**	**280 065**	**296 537**	**311 630**	**319 118**	**318 097**	**290 468**	**282 208**	**297 038**
Aviation	69 556	68 260	73 910	78 184	81 397	86 194	90 091	94 231	101 719	109 381	115 493	113 926	111 271	115 770	124 614	131 432	137 179	141 610	142 603	131 845	131 846	135 343
Marine	109 106	107 665	109 246	112 545	109 020	109 811	117 134	126 346	131 822	126 101	133 247	139 231	143 107	146 657	155 451	165 105	174 451	177 508	175 494	158 623	150 362	161 696
Multilateral Operations	**1**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**4**	**2**	**2**	**3**	**4**	**4**	**4**	**4**	**4**	**4**
CO_2 Emissions from Biomass	**177 810**	**187 975**	**188 910**	**206 023**	**206 952**	**215 470**	**228 581**	**241 299**	**243 067**	**249 110**	**249 990**	**259 691**	**264 591**	**288 906**	**306 343**	**323 189**	**343 494**	**362 615**	**394 890**	**411 240**	**460 109**	**460 041**

8.1.3. CTF Table 1 (EU-28): Emission trends: CH_4

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	(Gg)																					
Total CH_4 Emissions	**28 540**	**27 761**	**26 850**	**26 385**	**25 788**	**25 593**	**25 338**	**24 731**	**24 069**	**23 530**	**23 004**	**22 364**	**21 903**	**21 525**	**20 892**	**20 530**	**20 259**	**19 937**	**19 653**	**19 226**	19 063	18 675
1. Energy	**7 409**	**7 046**	**6 704**	**6 640**	**6 175**	**6 145**	**6 028**	**5 803**	**5 368**	**5 197**	**5 013**	**4 810**	**4 661**	**4 569**	**4 321**	**4 176**	**4 024**	**3 824**	**3 816**	**3 642**	3 699	3 612
A. Fuel Combustion (Sectoral Approach)	1 211	1 211	1 142	1 149	1 056	1 048	1 095	1 040	981	953	884	875	829	855	865	864	873	868	902	888	963	902
1. Energy Industries	55	56	55	57	58	65	71	71	73	73	71	72	74	93	100	106	113	124	133	134	148	148
2. Manufacturing Industries and Construction	78	74	72	71	72	75	76	78	78	78	81	81	81	87	91	92	92	89	86	72	80	82
3. Transport	245	235	233	224	217	208	201	190	181	171	153	144	133	124	115	108	100	92	83	77	71	66
4. Other Sectors	820	834	776	792	705	697	745	700	647	629	577	574	537	548	556	554	565	561	598	603	661	603
5. Other	13	10	6	5	3	3	3	2	2	2	2	3	3	3	3	3	3	3	3	2	2	3
B. Fugitive Emissions from Fuels	6 198	5 836	5 562	5 490	5 119	5 097	4 933	4 763	4 387	4 244	4 129	3 935	3 832	3 714	3 456	3 312	3 151	2 956	2 914	2 754	2 737	2 710
1. Solid Fuels	3 506	3 342	3 161	3 068	2 719	2 788	2 668	2 591	2 281	2 232	2 117	1 920	1 818	1 701	1 504	1 359	1 270	1 122	1 078	957	932	936
2. Oil and Natural Gas	2 693	2 494	2 401	2 422	2 399	2 309	2 265	2 172	2 106	2 012	2 013	2 015	2 013	2 013	1 952	1 953	1 881	1 834	1 836	1 797	1 805	1 774
2. Industrial Processes	**64**	**60**	**59**	**59**	**64**	**66**	**64**	**64**	**59**	**55**	**58**	**57**	**55**	**61**	**62**	**64**	**63**	**63**	**58**	**48**	52	52
A. Mineral Products	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1
B. Chemical Industry	44	43	43	43	47	47	46	46	43	40	42	42	40	45	46	45	43	43	41	36	40	39
C. Metal Production	16	13	12	12	14	14	14	14	13	12	12	12	11	12	13	15	16	16	14	8	9	10
D. Other Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. Production of Halocarbons and SF_6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F. Consumption of Halocarbons and SF_6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. Other	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
3. Solvent and Other Product Use	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
4. Agriculture	**11 991**	**11 499**	**11 025**	**10 703**	**10 535**	**10 477**	**10 467**	**10 338**	**10 282**	**10 203**	**10 033**	**9 945**	**9 810**	**9 756**	**9 647**	**9 599**	**9 593**	**9 632**	**9 567**	**9 489**	**9 347**	**9 216**
A. Enteric Fermentation	9 277	8 870	8 492	8 257	8 134	8 086	8 074	7 959	7 902	7 841	7 705	7 602	7 453	7 392	7 292	7 260	7 227	7 264	7 245	7 178	7 077	7 000
B. Manure Management	2 554	2 475	2 389	2 312	2 259	2 252	2 247	2 228	2 240	2 228	2 200	2 212	2 227	2 224	2 206	2 202	2 226	2 229	2 189	2 160	2 116	2 057
C. Rice Cultivation	114	108	104	101	108	106	114	114	108	104	99	99	105	108	117	112	111	113	105	120	124	127
D. Agricultural Soils	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. Prescribed Burning of Savannas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F. Field Burning of Agricultural Residues	46	46	39	33	33	33	32	37	32	30	29	32	26	32	32	25	28	25	28	30	30	31
G. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5. Land-Use, Land-Use Change and Forestry	**222**	**216**	**209**	**208**	**304**	**290**	**280**	**269**	**275**	**243**	**269**	**237**	**233**	**275**	**230**	**251**	**242**	**256**	**217**	**223**	**227**	**214**
A. Forest Land	78	76	71	65	77	65	57	60	68	55	78	56	58	93	54	80	71	63	44	49	57	46
B. Cropland	7	8	7	7	7	7	7	6	7	7	7	7	6	9	8	7	7	7	7	7	8	7
C. Grassland	29	25	24	29	28	15	17	19	27	15	21	16	12	19	16	14	14	36	16	18	14	13
D. Wetlands	105	105	105	105	105	106	106	106	106	106	106	106	106	107	107	107	107	108	108	108	109	110
E. Settlements	2	2	2	2	2	2	2	2	2	3	2	3	3	3	3	3	3	3	3	3	3	3
F. Other Land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. Other	0	0	0	0	85	95	90	75	65	58	55	50	48	45	42	40	39	38	38	37	37	36
6. Waste	**8 854**	**8 939**	**8 854**	**8 776**	**8 709**	**8 616**	**8 499**	**8 257**	**8 085**	**7 831**	**7 631**	**7 316**	**7 145**	**6 864**	**6 632**	**6 440**	**6 336**	**6 162**	**5 995**	**5 824**	**5 736**	**5 581**
A. Solid Waste Disposal on Land	7 694	7 819	7 768	7 707	7 644	7 549	7 449	7 220	7 052	6 816	6 699	6 417	6 241	5 938	5 704	5 545	5 442	5 283	5 141	5 005	4 901	4 732

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	(Gg)																					
B. Waste-water Handling	1 132	1 088	1 052	1 034	1 027	1 025	1 003	992	988	968	881	848	846	869	873	839	835	819	795	762	777	789
C. Waste Incineration	9	10	9	9	7	7	7	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4
D. Other	19	22	25	27	31	35	40	41	41	44	47	47	54	54	52	53	55	56	55	53	54	56
7. Other	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Memo Items:																						
International Bunkers	**5**	**5**	**5**	**5**	**5**	**5**	**6**	**6**	**13**	**6**	**6**	**7**	**7**	**7**	**7**	**8**	**10**	**22**	**14**	**9**	**9**	**9**
Aviation	1	1	1	1	1	1	1	1	1	2	1	1	1	1	2	2	2	2	2	1	1	1
Marine	4	4	4	4	4	4	4	4	11	5	5	5	5	6	6	6	9	21	12	8	8	8
Multilateral Operations	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

8.1.4. *CTF Table 1 (EU-28): Emission trends: N_2O*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	(Gg)																					
Total N_2O Emissions	**1 695**	**1 603**	**1 541**	**1 486**	**1 498**	**1 500**	**1 520**	**1 512**	**1 440**	**1 367**	**1 356**	**1 333**	**1 296**	**1 280**	**1 294**	**1 266**	**1 225**	**1 224**	**1 195**	**1 128**	**1 096**	**1 092**
1. Energy	**110**	**111**	**109**	**110**	**113**	**113**	**118**	**119**	**121**	**118**	**112**	**112**	**111**	**113**	**113**	**111**	**111**	**111**	**109**	**103**	**106**	**105**
A. Fuel Combustion (Sectoral Approach)	110	110	109	110	112	113	118	119	121	118	112	112	110	112	113	111	111	110	109	103	106	104
1. Energy Industries	35	35	34	33	33	29	30	28	29	28	28	29	30	31	31	31	32	32	31	30	31	31
2. Manufacturing Industries and Construction	24	23	23	22	22	22	22	22	22	21	21	21	21	21	21	22	22	22	21	18	19	19
3. Transport	24	25	26	28	32	37	40	43	45	44	37	36	35	34	34	32	32	32	32	30	30	30
4. Other Sectors	24	25	24	25	24	24	25	24	23	23	23	24	23	24	24	24	24	23	24	23	24	23
5. Other	2	2	2	2	2	2	2	2	2	2	1	1	1	2	2	1	2	1	1	1	1	1
B. Fugitive Emissions from Fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1. Solid Fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Oil and Natural Gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Industrial Processes	**375**	**359**	**349**	**332**	**347**	**346**	**355**	**341**	**269**	**204**	**210**	**209**	**184**	**185**	**191**	**181**	**152**	**152**	**122**	**94**	**60**	**45**
A. Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. Chemical Industry	374	359	348	332	347	346	355	341	269	203	210	208	184	185	190	181	151	151	122	93	60	45
C. Metal Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. Other Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. Production of Halocarbons and SF_6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F. Consumption of Halocarbons and SF_6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Solvent and Other Product Use	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**15**	**15**	**15**	**14**	**13**	**12**	**12**	**13**	**12**	**12**	**11**	**11**	**10**
4. Agriculture	**1 136**	**1 059**	**1 010**	**971**	**965**	**968**	**973**	**979**	**976**	**972**	**961**	**940**	**929**	**910**	**920**	**903**	**892**	**891**	**893**	**862**	**861**	**874**
A. Enteric Fermentation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. Manure Management	136	131	124	118	115	115	113	113	112	110	107	106	105	103	101	101	99	100	99	97	96	94
C. Rice Cultivation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. Agricultural Soils	999	927	885	852	848	852	859	866	863	862	853	833	824	807	819	802	792	790	794	764	765	779
E. Prescribed Burning of Savannas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F. Field Burning of Agricultural Residues	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1
G. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5. Land-Use, Land-Use Change and Forestry	**15**	**14**	**14**	**14**	**14**	**13**	**14**	**13**	**14**	**13**	**13**	**13**	**12**	**13**	**12**	**12**	**12**	**13**	**12**	**12**	**12**	**12**
A. Forest Land	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
B. Cropland	12	12	11	11	11	11	11	11	11	11	10	10	10	10	10	10	10	10	10	10	9	9
C. Grassland	1	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
D. Wetlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. Settlements	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F. Other Land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6. Waste	**43**	**43**	**43**	**43**	**43**	**43**	**44**	**44**	**44**	**45**	**45**	**45**	**46**	**46**	**46**	**46**	**46**	**46**	**46**	**46**	**46**	**46**
A. Solid Waste Disposal on Land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	(Gg)																					
B. Waste-water Handling	42	42	42	41	41	41	41	41	42	42	42	42	42	42	42	42	42	42	42	41	42	41
C. Waste Incineration	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D. Other	0	1	1	1	1	1	1	1	2	2	2	2	3	3	3	3	3	3	4	4	4	4
7. Other	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Memo Items:																						
International Bunkers	**5**	**5**	**6**	**6**	**6**	**7**	**7**	**6**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**8**	**10**	**9**	**8**	**8**	**8**
Aviation	2	2	2	2	2	3	3	3	3	3	3	3	3	3	4	4	4	4	5	4	4	4
Marine	3	3	4	4	4	4	4	3	4	3	3	3	3	3	3	3	4	5	4	4	4	4
Multilateral Operations	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

8.1.5. CTF Table 1 (EU-28): Emission trends: HFCs, PFCs and SF_6

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	CO_2 equivalent (Gg)																					
Emissions of HFCs	**27 882**	**27 537**	**29 447**	**31 880**	**36 039**	**40 426**	**45 761**	**52 796**	**54 214**	**47 681**	**47 142**	**46 846**	**49 574**	**54 878**	**57 111**	**61 686**	**64 537**	**69 319**	**72 745**	**75 989**	**80 181**	**81 761**
Emissions of PFCs	**21 304**	**19 470**	**15 763**	**14 890**	**14 303**	**14 028**	**13 496**	**12 527**	**11 871**	**11 560**	**9 876**	**8 904**	**10 389**	**8 635**	**7 327**	**6 129**	**5 497**	**5 083**	**4 376**	**2 844**	**3 329**	**3 602**
Emissions of SF_6	**10 958**	**11 396**	**12 216**	**13 147**	**14 231**	**15 332**	**15 136**	**13 509**	**12 622**	**10 284**	**10 282**	**9 629**	**8 553**	**8 001**	**8 274**	**8 192**	**7 575**	**7 318**	**6 868**	**6 471**	**6 559**	**6 429**

8.2. CTF Table 1 (EU-15): Emission trends

8.2.1. CTF Table 1 (EU-15): Emission trends: summary

GREENHOUSE GAS EMISSIONS	BY	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	CO_2 equivalent (Gg)																						
CO_2 emissions including net CO_2 from LULUCF	3 223 990	3 223 990	3 216 370	3 149 449	3 098 707	3 092 816	3 127 504	3 188 117	3 132 061	3 187 750	3 147 439	3 189 022	3 223 773	3 257 436	3 347 883	3 340 335	3 318 820	3 281 952	3 249 186	3 143 196	2 875 806	2 979 914	2 823 473
CO_2 emissions excluding net CO_2 from LULUCF	3 367 101	3 367 101	3 391 490	3 315 827	3 259 052	3 261 695	3 297 510	3 372 483	3 318 057	3 367 625	3 344 235	3 372 961	3 434 560	3 426 687	3 493 595	3 502 867	3 484 095	3 467 476	3 408 379	3 331 501	3 067 035	3 155 308	3 002 815
CH_4	437 846	437 846	434 068	426 997	423 313	413 852	410 365	405 672	394 752	385 604	376 516	369 034	357 171	347 149	338 016	326 974	319 572	313 264	308 412	303 879	298 333	295 750	289 256
N_2O	399 887	399 887	394 617	387 704	374 645	378 719	379 101	385 268	383 337	363 743	342 703	339 170	330 305	321 052	315 834	316 888	307 624	295 456	293 847	285 949	275 481	266 026	263 657
HFCs	41 368	27 882	27 537	29 428	31 859	35 976	39 992	45 077	51 649	52 756	45 831	44 952	43 710	45 730	50 025	51 154	54 418	55 866	58 818	62 768	66 040	69 311	70 746
PFCs	15 680	17 329	15 960	13 804	12 948	12 283	11 718	11 288	10 289	9 645	9 479	8 093	7 357	9 146	7 846	6 632	5 490	5 067	4 738	4 120	2 715	3 193	3 461
SF_6	13 861	10 768	11 191	12 013	12 910	13 950	15 012	14 811	13 130	12 315	9 923	9 867	9 155	8 228	7 617	7 782	7 721	7 135	6 828	6 421	6 081	6 184	6 073
Total (including net CO_2 from LULUCF)	**4 132 632**	**4 117 702**	**4 099 744**	**4 019 395**	**3 954 381**	**3 947 597**	**3 983 693**	**4 050 232**	**3 985 217**	**4 011 813**	**3 931 891**	**3 960 139**	**3 971 472**	**3 988 741**	**4 067 221**	**4 049 765**	**4 013 645**	**3 958 742**	**3 921 830**	**3 806 332**	**3 524 456**	**3 620 378**	**3 456 665**
Total (excluding net CO_2 from LULUCF)	**4 275 743**	**4 260 813**	**4 274 864**	**4 185 773**	**4 114 727**	**4 116 475**	**4 153 698**	**4 234 598**	**4 171 213**	**4 191 688**	**4 128 687**	**4 144 078**	**4 182 259**	**4 157 991**	**4 212 933**	**4 212 296**	**4 178 920**	**4 144 266**	**4 081 023**	**3 994 637**	**3 715 685**	**3 795 772**	**3 636 007**
Total (without LULUCF)	**4 269 434**	**4 254 504**	**4 268 722**	**4 180 145**	**4 108 992**	**4 108 710**	**4 146 316**	**4 227 322**	**4 164 403**	**4 184 702**	**4 122 541**	**4 137 544**	**4 176 335**	**4 152 190**	**4 206 200**	**4 206 622**	**4 172 776**	**4 138 444**	**4 074 904**	**3 989 311**	**3 710 157**	**3 790 225**	**3 630 657**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	BY	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	CO2 equivalent (Gg)																						
1. Energy	3 282 202	3 282 202	3 315 360	3 243 702	3 191 000	3 175 319	3 206 153	3 286 100	3 223 205	3 268 243	3 243 233	3 259 170	3 324 404	3 314 175	3 372 420	3 370 568	3 348 234	3 328 965	3 265 306	3 199 675	2 971 834	3 047 527	2 897 729
2. Industrial Processes	368 132	353 202	342 935	333 313	325 091	343 323	350 331	349 906	356 162	335 721	305 433	309 929	299 667	296 879	305 204	312 769	311 069	303 309	307 892	292 496	254 056	260 581	253 234
3. Solvent and Other Product Use	13 212	13 212	12 860	12 611	12 234	11 691	11 749	11 790	11 826	11 841	11 526	11 254	10 840	10 449	9 953	9 700	9 667	9 733	9 336	8 790	8 098	8 205	7 969
4. Agriculture	433 868	433 868	423 554	418 027	410 116	409 654	412 156	416 285	416 241	416 192	415 604	413 446	404 148	397 580	391 851	391 781	385 133	380 099	379 781	379 023	370 387	369 491	369 785
5. Land-Use, Land-Use Change and Forestry	-136 802	-136 802	-168 978	-160 749	-154 611	-161 113	-162 623	-177 091	-179 185	-172 890	-190 649	-177 405	-204 864	-163 449	-138 979	-156 858	-159 131	-179 703	-153 074	-182 978	-185 700	-169 847	-173 992
6. Waste	172 019	172 019	174 012	172 491	170 552	168 723	165 928	163 241	156 968	152 705	146 745	143 744	137 277	133 107	126 771	121 805	118 674	116 338	112 588	109 327	105 781	104 420	101 941
7. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Abbreviation: LULUCF = land use, land-use change and forestry. BY: base year

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[b] Includes net CO_2, CH_4 and N_2O from LULUCF.

8.2.2. CTF Table 1 (EU-15): Emission trends: CO_2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	BY	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	(Gg)																						
1. Energy	**3 156 875**	**3 156 875**	**3 190 657**	**3 122 375**	**3 071 199**	**3 064 837**	**3 097 155**	**3 178 821**	**3 119 175**	**3 168 185**	**3 146 198**	**3 167 401**	**3 236 554**	**3 228 815**	**3 288 978**	**3 290 969**	**3 272 434**	**3 256 041**	**3 194 465**	**3 129 276**	**2 904 512**	**2 978 979**	**2 831 237**
A. Fuel Combustion (Sectoral Approach)	3 136 785	3 136 785	3 170 557	3 101 797	3 050 376	3 043 307	3 074 338	3 155 329	3 096 921	3 146 879	3 126 414	3 147 752	3 216 941	3 209 147	3 269 086	3 271 531	3 252 499	3 235 965	3 174 608	3 110 262	2 885 954	2 960 440	2 813 538
1. Energy Industries	1 156 756	1 156 756	1 159 237	1 121 557	1 075 483	1 085 923	1 095 685	1 111 869	1 077 567	1 113 028	1 092 802	1 124 228	1 151 553	1 182 864	1 215 467	1 212 093	1 204 963	1 208 370	1 210 773	1 148 924	1 051 581	1 060 566	1 030 350
2. Manufacturing Industries and Construction	635 063	635 063	616 767	593 863	571 390	582 595	584 493	570 441	583 977	574 081	568 476	572 663	557 643	543 523	555 211	554 258	554 824	556 436	550 458	528 615	446 202	482 440	469 546
3. Transport	685 397	685 397	699 970	724 460	731 403	735 750	744 997	761 580	771 044	794 832	814 283	815 549	825 722	835 813	839 272	851 370	845 139	845 198	846 133	822 085	802 028	796 665	787 084
4. Other Sectors	638 235	638 235	677 273	646 805	658 314	625 698	636 727	700 282	653 551	654 668	641 059	626 360	674 185	638 958	650 633	645 383	639 275	617 499	558 858	603 123	578 693	613 658	519 802
5. Other	21 334	21 334	17 311	15 111	13 786	13 340	12 436	11 157	10 781	10 270	9 794	8 951	7 837	7 990	8 504	8 427	8 298	8 461	8 387	7 516	7 449	7 110	6 757
B. Fugitive Emissions from Fuels	20 090	20 090	20 100	20 578	20 823	21 530	22 817	23 492	22 254	21 306	19 783	19 649	19 613	19 668	19 892	19 438	19 935	20 076	19 856	19 014	18 558	18 539	17 699
1. Solid Fuels	1 301	1 301	992	922	832	762	775	1 049	997	685	590	560	548	569	661	762	808	835	615	994	725	1 236	948
2. Oil and Natural Gas	18 789	18 789	19 108	19 656	19 991	20 769	22 042	22 443	21 258	20 621	19 193	19 090	19 065	19 099	19 231	18 676	19 127	19 241	19 241	18 019	17 833	17 303	16 751
2. Industrial Processes	**197 064**	**197 064**	**187 926**	**180 817**	**175 728**	**185 481**	**189 311**	**182 730**	**188 367**	**188 985**	**187 890**	**195 692**	**188 379**	**188 187**	**195 107**	**202 490**	**202 117**	**201 946**	**204 779**	**193 472**	**154 452**	**167 841**	**163 456**
A. Mineral Products	112 504	112 504	106 846	105 213	101 483	107 039	110 808	106 736	109 576	112 007	113 134	115 574	113 877	114 536	116 075	119 713	118 971	120 386	122 408	113 049	91 319	92 782	90 400
B. Chemical Industry	30 407	30 407	29 367	28 293	27 778	29 027	30 805	30 894	30 897	31 841	31 663	33 070	31 368	31 896	31 971	32 170	33 146	31 743	33 384	32 067	29 243	31 608	31 070
C. Metal Production	53 794	53 794	51 284	46 853	46 075	49 029	47 353	44 722	47 543	44 781	42 727	46 656	42 751	41 372	46 683	50 223	49 576	49 425	48 640	47 970	33 543	43 076	41 625
D. Other Production	77	77	54	59	55	34	27	53	53	46	56	53	48	37	51	45	38	22	31	36	32	31	21
E. Production of Halocarbons and SF_6																							
F. Consumption of Halocarbons and SF_6																							
G. Other	282	282	375	400	338	352	318	325	299	310	310	338	334	346	328	339	385	370	316	350	315	343	339
3. Solvent and Other Product Use	**8 845**	**8 845**	**8 559**	**8 257**	**7 922**	**7 419**	**7 494**	**7 436**	**7 545**	**7 626**	**7 468**	**7 317**	**7 060**	**6 930**	**6 736**	**6 706**	**6 704**	**6 654**	**6 380**	**5 982**	**5 393**	**5 689**	**5 571**
4. Agriculture	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
A. Enteric Fermentation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. Manure Management	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C. Rice Cultivation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. Agricultural Soils	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. Prescribed Burning of Savannas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F. Field Burning of Agricultural Residues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5. Land-Use, Land-Use Change and Forestry	**-143 111**	**-143 111**	**-175 120**	**-166 378**	**-160 346**	**-168 878**	**-170 006**	**-184 366**	**-185 996**	**-179 875**	**-196 795**	**-183 939**	**-210 787**	**-169 251**	**-145 712**	**-162 532**	**-165 275**	**-185 524**	**-159 193**	**-188 305**	**-191 229**	**-175 394**	**-179 342**
A. Forest Land	-252 638	-252 638	-284 359	-278 817	-272 429	-279 313	-279 941	-293 108	-293 583	-288 469	-304 484	-288 040	-313 709	-271 397	-248 182	-263 845	-265 711	-281 947	-259 532	-282 712	-285 096	-263 351	-271 251
B. Cropland	78 455	78 455	78 473	81 592	79 047	78 314	80 036	78 331	77 737	77 370	78 568	75 633	75 120	75 684	75 832	73 635	72 984	69 638	69 758	69 691	68 872	68 739	72 202
C. Grassland	6 025	6 025	4 218	3 828	5 447	3 694	-71	651	1 404	2 041	-1 061	-787	-4 038	-4 763	-4 193	-5 048	-5 756	-6 324	-1 286	-7 435	-7 648	-9 775	-9 649
D. Wetlands	2 426	2 426	2 341	2 515	2 439	2 616	2 595	2 573	2 528	2 434	2 755	2 880	3 147	2 595	2 812	2 873	3 051	2 885	2 850	2 030	2 201	1 942	2 038
E. Settlements	25 885	25 885	26 182	26 496	27 032	27 467	27 993	28 475	28 659	29 250	30 708	29 287	30 235	30 567	30 776	32 195	33 061	33 980	34 432	35 370	34 601	34 585	34 533
F. Other Land	1 657	1 657	1 340	1 032	712	600	1 857	1 802	1 365	990	940	577	452	-129	-435	-584	-1 244	-1 681	-2 059	-2 899	-2 606	-3 606	-3 804
G. Other	-4 921	-4 921	-3 316	-3 023	-2 594	-2 256	-2 475	-3 091	-4 106	-3 491	-4 222	-3 489	-1 995	-1 808	-2 323	-1 757	-1 660	-2 075	-3 356	-2 348	-1 554	-3 928	-3 410
6. Waste	**4 316**	**4 316**	**4 348**	**4 378**	**4 204**	**3 958**	**3 550**	**3 496**	**2 969**	**2 828**	**2 679**	**2 551**	**2 567**	**2 755**	**2 774**	**2 702**	**2 841**	**2 835**	**2 755**	**2 771**	**2 678**	**2 800**	**2 552**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	BY	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	(Gg)																						
A. Solid Waste Disposal on Land	227	227	268	308	299	244	104	83	60	58	54	38	36	27	27	26	25	14	12	10	5	2	2
B. Waste-water Handling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C. Waste Incineration	4 071	4 071	4 062	4 051	3 886	3 696	3 426	3 392	2 890	2 752	2 606	2 495	2 513	2 710	2 728	2 658	2 798	2 802	2 723	2 740	2 652	2 779	2 532
D. Other	18	18	19	20	18	18	20	20	19	18	19	19	19	18	20	18	18	19	19	21	21	18	18
7. Other	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total CO_2 Emissions including net CO_2 from LULUCF	**3 223 990**	**3 223 990**	**3 216 370**	**3 149 449**	**3 098 707**	**3 092 816**	**3 127 504**	**3 188 117**	**3 132 061**	**3 187 750**	**3 147 439**	**3 189 022**	**3 223 773**	**3 257 436**	**3 347 883**	**3 340 335**	**3 318 820**	**3 281 952**	**3 249 186**	**3 143 196**	**2 875 806**	**2 979 914**	**2 823 473**
Total CO_2 Emissions excluding net CO_2 from LULUCF	**3 367 101**	**3 367 101**	**3 391 490**	**3 315 827**	**3 259 052**	**3 261 695**	**3 297 510**	**3 372 483**	**3 318 057**	**3 367 625**	**3 344 235**	**3 372 961**	**3 434 560**	**3 426 687**	**3 493 595**	**3 502 867**	**3 484 095**	**3 467 476**	**3 408 379**	**3 331 501**	**3 067 035**	**3 155 308**	**3 002 815**
Memo Items:																							
International Bunkers	**168 930**	**168 930**	**167 731**	**174 049**	**181 984**	**181 703**	**187 530**	**199 343**	**213 422**	**226 386**	**227 917**	**240 677**	**243 255**	**244 549**	**251 448**	**268 814**	**283 094**	**299 859**	**304 987**	**303 963**	**276 055**	**268 864**	**283 188**
Aviation	64 253	64 253	63 625	69 036	73 210	76 579	81 076	85 629	89 827	97 299	105 091	111 082	109 448	106 920	110 851	119 411	125 837	131 145	135 337	135 720	125 733	125 486	129 115
Marine	104 678	104 678	104 107	105 013	108 774	105 124	106 454	113 714	123 595	129 087	122 826	129 594	133 807	137 629	140 597	149 403	157 257	168 714	169 650	168 243	150 322	143 378	154 073
Multilateral Operations	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**1**	**3**	**4**	**3**	**4**	**3**	**4**	**3**
CO_2 Emissions from Biomass	**154 075**	**154 075**	**164 298**	**164 352**	**167 973**	**167 772**	**171 102**	**177 415**	**185 862**	**188 258**	**196 003**	**196 320**	**206 779**	**209 202**	**228 652**	**241 565**	**254 498**	**274 090**	**290 683**	**313 336**	**327 261**	**367 409**	**366 078**

BY: base year

8.2.3. *CTF Table 1 (EU-15): Emission trends: CH_4*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	BY	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	(Gg)																						
Total CH_4 Emissions	**20 850**	**20 850**	**20 670**	**20 333**	**20 158**	**19 707**	**19 541**	**19 318**	**18 798**	**18 362**	**17 929**	**17 573**	**17 008**	**16 531**	**16 096**	**15 570**	**15 218**	**14 917**	**14 686**	**14 470**	**14 206**	**14 083**	**13 774**
1. Energy	**4 546**	**4 546**	**4 501**	**4 354**	**4 282**	**3 797**	**3 729**	**3 591**	**3 423**	**3 200**	**3 100**	**2 936**	**2 749**	**2 648**	**2 538**	**2 356**	**2 204**	**2 069**	**1 976**	**1 982**	**1 910**	**1 934**	**1 862**
A. Fuel Combustion (Sectoral Approach)	893	893	891	842	816	753	742	763	723	705	686	643	633	594	611	612	600	593	600	620	604	647	610
1. Energy Industries	47	47	48	48	50	51	58	64	64	67	67	65	66	68	87	93	99	106	116	125	126	139	138
2. Manufacturing Industries and Construction	61	61	59	58	56	59	60	61	64	66	67	70	70	70	76	80	82	81	78	75	62	69	71
3. Transport	223	223	215	215	206	198	189	181	170	163	152	137	128	118	108	100	91	83	76	68	62	57	53
4. Other Sectors	551	551	560	516	499	443	433	455	424	409	398	370	368	337	339	338	327	321	330	351	353	381	347
5. Other	12	12	8	5	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
B. Fugitive Emissions from Fuels	3 653	3 653	3 610	3 512	3 467	3 045	2 987	2 828	2 699	2 495	2 414	2 293	2 117	2 054	1 927	1 744	1 604	1 476	1 375	1 362	1 306	1 287	1 252
1. Solid Fuels	2 195	2 195	2 145	2 001	1 952	1 579	1 639	1 514	1 461	1 271	1 262	1 157	994	953	838	690	564	500	423	401	341	322	316
2. Oil and Natural Gas	1 458	1 458	1 465	1 511	1 515	1 466	1 348	1 313	1 238	1 224	1 152	1 136	1 123	1 101	1 089	1 054	1 040	976	952	961	965	965	936
2. Industrial Processes	**39**	**39**	**38**	**39**	**38**	**41**	**39**	**38**	**37**	**35**	**35**	**34**	**34**	**34**	**36**	**36**	**37**	**36**	**37**	**34**	**29**	**33**	**30**
A. Mineral Products	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1
B. Chemical Industry	30	30	30	31	30	32	30	30	29	27	26	26	26	26	28	27	26	24	25	22	22	24	22
C. Metal Production	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	8	8	9	8	4	5	5
D. Other Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. Production of Halocarbons and SF_6																							0
F. Consumption of Halocarbons and SF_6																							0
G. Other	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
3. Solvent and Other Product Use	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4. Agriculture	**8 667**	**8 667**	**8 446**	**8 348**	**8 323**	**8 337**	**8 367**	**8 427**	**8 361**	**8 351**	**8 332**	**8 267**	**8 219**	**8 058**	**7 992**	**7 920**	**7 858**	**7 817**	**7 846**	**7 816**	**7 780**	**7 704**	**7 584**
A. Enteric Fermentation	6 743	6 743	6 560	6 462	6 430	6 431	6 447	6 487	6 407	6 382	6 371	6 309	6 247	6 102	6 038	5 967	5 919	5 875	5 895	5 885	5 847	5 803	5 726
B. Manure Management	1 781	1 781	1 747	1 752	1 769	1 773	1 790	1 803	1 813	1 837	1 834	1 836	1 850	1 833	1 822	1 816	1 812	1 812	1 819	1 808	1 795	1 759	1 714
C. Rice Cultivation	105	105	102	100	98	107	104	111	112	106	102	97	97	102	106	114	109	108	109	101	115	118	121
D. Agricultural Soils	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. Prescribed Burning of Savannas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F. Field Burning of Agricultural Residues	38	38	37	33	26	25	24	26	28	26	24	24	24	20	27	23	18	21	22	21	23	23	23
G. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5. Land-Use, Land-Use Change and Forestry	**108**	**108**	**106**	**87**	**92**	**189**	**177**	**163**	**153**	**158**	**127**	**144**	**121**	**118**	**154**	**115**	**135**	**124**	**132**	**99**	**107**	**109**	**100**
A. Forest Land	68	68	69	52	52	65	56	45	48	55	42	56	43	47	77	44	69	58	44	32	38	45	38
B. Cropland	7	7	8	7	7	7	7	7	6	7	7	6	6	6	9	7	7	7	7	7	7	8	7
C. Grassland	29	29	24	24	28	27	14	17	19	26	14	21	15	11	18	16	13	13	36	16	18	14	13
D. Wetlands		2	2	2	2	2	2	2	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3
E. Settlements		2	2	2	2	2	2	2	2	2	3	2	3	3	3	3	3	3	3	3	3	3	3
F. Other Land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. Other	0	0	0	0	0	85	95	90	75	65	58	55	50	48	45	42	40	39	38	38	37	37	36
6. Waste	**7 489**	**7 489**	**7 579**	**7 505**	**7 422**	**7 344**	**7 230**	**7 098**	**6 824**	**6 618**	**6 336**	**6 192**	**5 885**	**5 674**	**5 376**	**5 143**	**4 984**	**4 872**	**4 696**	**4 540**	**4 380**	**4 304**	**4 198**
A. Solid Waste Disposal on Land	6 797	6 797	6 900	6 833	6 756	6 676	6 563	6 445	6 185	5 981	5 711	5 584	5 300	5 087	4 787	4 546	4 386	4 275	4 114	3 977	3 842	3 750	3 634

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	BY	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	(Gg)																						
B. Waste-water Handling	664	664	647	638	631	629	624	607	595	593	578	557	535	535	537	545	546	545	528	510	487	502	513
C. Waste Incineration	9	9	10	9	9	7	7	7	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4
D. Other	19	19	22	25	26	31	35	39	41	41	43	47	47	48	48	48	48	49	51	49	47	48	48
7. Other	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Memo Items:																							
International Bunkers	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**7**	**7**	**7**	**7**	**6**	**6**	**6**
Aviation	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Marine	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	6	6	6	5	5	5
Multilateral Operations	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

BY: base year

8.2.4. *CTF Table 1 (EU-15): Emission trends: N_2O*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	BY	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	(Gg)																						
Total N_2O Emissions	**1 290**	**1 290**	**1 273**	**1 251**	**1 209**	**1 222**	**1 223**	**1 243**	**1 237**	**1 173**	**1 105**	**1 094**	**1 066**	**1 036**	**1 019**	**1 022**	**992**	**953**	**948**	**922**	**889**	**858**	**851**
1. Energy	**96**	**96**	**97**	**96**	**96**	**99**	**99**	**103**	**104**	**106**	**103**	**97**	**97**	**96**	**97**	**97**	**95**	**95**	**95**	**93**	**88**	**90**	**88**
A. Fuel Combustion (Sectoral Approach)	96	96	97	96	96	99	99	102	103	106	103	97	97	96	97	97	95	95	94	92	87	90	88
1. Energy Industries	29	29	30	29	27	28	24	24	23	24	23	24	24	25	26	26	26	26	27	26	25	26	25
2. Manufacturing Industries and Construction	22	22	22	21	20	20	20	20	20	20	20	20	20	20	20	20	20	20	21	20	17	18	18
3. Transport	21	21	22	23	25	29	32	35	38	40	38	32	30	29	29	28	26	26	26	25	24	24	24
4. Other Sectors	21	21	22	21	21	20	20	21	20	20	20	20	21	20	21	21	21	20	20	20	20	21	20
5. Other	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1
B. Fugitive Emissions from Fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1. Solid Fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Oil and Natural Gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Industrial Processes	**320**	**320**	**321**	**311**	**293**	**306**	**302**	**307**	**297**	**230**	**166**	**163**	**162**	**145**	**141**	**142**	**131**	**105**	**103**	**81**	**78**	**43**	**29**
A. Mineral Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. Chemical Industry	320	320	321	311	293	305	301	307	296	230	166	163	162	144	141	141	130	105	103	80	78	43	28
C. Metal Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. Other Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. Production of Halocarbons and SF_6																							0
F. Consumption of Halocarbons and SF_6																							0
G. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Solvent and Other Product Use	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**13**	**13**	**12**	**11**	**10**	**10**	**10**	**10**	**10**	**9**	**9**	**8**	**8**
4. Agriculture	**812**	**812**	**794**	**783**	**759**	**757**	**763**	**772**	**776**	**777**	**776**	**774**	**747**	**737**	**723**	**727**	**710**	**697**	**694**	**693**	**668**	**670**	**679**
A. Enteric Fermentation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. Manure Management	76	76	74	73	73	72	73	73	73	72	72	71	71	69	67	66	66	64	65	65	64	64	63
C. Rice Cultivation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. Agricultural Soils	736	736	719	709	686	684	690	699	703	704	704	703	676	668	655	660	644	632	628	628	603	606	616
E. Prescribed Burning of Savannas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F. Field Burning of Agricultural Residues	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
G. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5. Land-Use, Land-Use Change and Forestry	**13**	**13**	**13**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**10**	**11**	**10**	**11**	**11**	**10**
A. Forest Land	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
B. Cropland	11	11	11	10	10	10	10	10	10	10	10	9	9	9	9	9	9	9	9	9	9	9	9
C. Grassland	1	1	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
D. Wetlands		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. Settlements		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F. Other Land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6. Waste	**34**	**34**	**34**	**34**	**34**	**34**	**34**	**34**	**34**	**35**	**35**	**36**	**36**	**36**	**36**	**36**	**36**	**36**	**36**	**36**	**36**	**36**	**36**
A. Solid Waste Disposal on Land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	BY	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	(Gg)																						
B. Waste-water Handling	32	32	33	33	32	32	32	32	32	33	33	33	33	33	33	33	33	32	32	33	32	32	32
C. Waste Incineration	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D. Other	0	0	1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	3	3	3
7. Other	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Memo Items:																							
International Bunkers	**4**	**4**	**4**	**5**	**5**	**5**	**6**	**6**	**6**	**6**	**6**	**7**	**6**	**6**	**6**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**7**
Aviation	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4
Marine	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Multilateral Operations	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

BY: base year

8.2.5. CTF Table 1 (EU-15): *Emission trends: HFCs, PFCs and SF_6*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	BY	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	CO_2 equivalent (Gg)																						
Emissions of HFCs	**41 368**	**27 882**	**27 537**	**29 428**	**31 859**	**35 976**	**39 992**	**45 077**	**51 649**	**52 756**	**45 831**	**44 952**	**43 710**	**45 730**	**50 025**	**51 154**	**54 418**	**55 866**	**58 818**	**62 768**	**66 040**	**69 311**	**70 746**
Emissions of PFCs	**15 680**	**17 329**	**15 960**	**13 804**	**12 948**	**12 283**	**11 718**	**11 288**	**10 289**	**9 645**	**9 479**	**8 093**	**7 357**	**9 146**	**7 846**	**6 632**	**5 490**	**5 067**	**4 738**	**4 120**	**2 715**	**3 193**	**3 461**
Emissions of SF_6	**13 861**	**10 768**	**11 191**	**12 013**	**12 910**	**13 950**	**15 012**	**14 811**	**13 130**	**12 315**	**9 923**	**9 867**	**9 155**	**8 228**	**7 617**	**7 782**	**7 721**	**7 135**	**6 828**	**6 421**	**6 081**	**6 184**	**6 073**

BY: base year

8.3. CTF Table 2 (EU-28): Description of quantified economy-wide emission reduction target

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

Note: Tables 2(a), 2(b), 2(c), 2(d), 2(e) and 2(f), as defined in UNFCCC decision 19/CP.18 were merged into a single Table 2 in the electronic reporting facility provided by the UNFCCC Secretariat

Emission reduction target: base year and target

		Comments
Base year/ base period	1990	
Emission reductions target (% of base year/base period)	20.00%	Legally binding target trajectories for the period 2013-2020 are enshrined in both the EU-ETS Directive (Directive 2003/87/EC and respective amendments) and the Effort Sharing Decision (Decision No 406/2009/EC). These legally binding trajectories not only result in a 20% GHG reduction in 2020 compared to 1990 but also define the EU's annual target pathway to reduce EU GHG emissions from 2013 to 2020. The Effort Sharing Decision sets annual national emission targets for all Member States for the period 2013-2020 for those sectors not covered by the EU emissions trading system (ETS), expressed as percentage changes from 2005 levels. In March 2013, the Commission formally adopted the national annual limits throughout the period for each Member State. By 2020, the national targets will collectively deliver a reduction of around 10% in total EU emissions from the sectors covered compared with 2005 levels. The emission reduction to be achieved from the sectors covered by the EU ETS will be 21% below 2005 emission levels.
Emission reductions target (% of 1990) [b]	20.00%	
Period for reaching target	2020	

Gases and sectors covered. GWP values.				
Gases covered	**Covered**	**Base Year**	**GWP[c] reference source**	**Comments**
CO_2	Yes	1990	4nd AR	as adopted in UNFCCC reporting guidelines for national GHG inventories of Annex I Parties and as adopted under the EU Monitoring Mechanism Regulation
CH_4	Yes	1990	4nd AR	as adopted in UNFCCC reporting guidelines for national GHG inventories of Annex I Parties and as adopted under the EU Monitoring Mechanism Regulation
N_2O	Yes	1990	4nd AR	as adopted in UNFCCC reporting guidelines for national GHG inventories of Annex I Parties and as adopted under the EU Monitoring Mechanism Regulation
HFCs	Yes	1990	4nd AR	as adopted in UNFCCC reporting guidelines for national GHG inventories of Annex I Parties and as adopted under the EU Monitoring Mechanism Regulation
PFCs	Yes	1990	4nd AR	as adopted in UNFCCC reporting guidelines for national GHG inventories of Annex I Parties and as adopted under the EU Monitoring Mechanism Regulation
SF_6	Yes	1990	4nd AR	as adopted in UNFCCC reporting guidelines for national GHG inventories of Annex I Parties and as adopted under the EU Monitoring Mechanism Regulation
NF_3	Yes	1995/2000	4nd AR	as adopted in UNFCCC reporting guidelines for national GHG inventories of Annex I Parties and as adopted under the EU Monitoring Mechanism Regulation. Base year not yet determined.
Other gases (specify) [d]				

Sectors covered [e]	**Covered**	**Comments**
Energy	Yes	
Transport[f]	Yes	
Industrial processes[g]	Yes	
Agriculture	Yes	
LULUCF	No	
Waste	Yes	
Other sectors (specify) [h]		
Aviation	Yes	Aviation in the scope of the EU-ETS: CO_2 emissions from all flights falling within the aviation activities listed in Annex I of the EU ETS Directive which depart from an aerodrome situated in the territory of a Member State and those which arrive in such an aerodrome from a third country, excluding small commercial emitters.

Role of LULUCF sector		
		Comments
LULUCF in base year level and target	Excluded	
Contribution of LULUCF is calculated using		

Possible scale of contributions of market-based mechanisms under the Convention (estimated kt CO_2 eq)

		Comments
CERs		The exact number of units that can be used during the period 2013-2020 can only be determined following the availability of final data concerning the use of these units during the period 2008-2012 and relevant greenhouse gas emissions data. The use of these units under the ETS Directive and the Effort Sharing Decision is subject to the limits specified above which do not separate between CERs and ERUs, but include additional criteria for the use of CERs.
ERUs		The exact number of units that can be used during the period 2013-2020 can only be determined following the availability of final data concerning the use of these units during the period 2008-2012 and relevant greenhouse gas emissions data. The use of these units under the ETS Directive and the Effort Sharing Decision is subject to the limits specified above which do not separate between CERs and ERUs, but include additional criteria for the use of ERUs.
AAUs[i]		AAUs for the period 2013-2020 have not yet been determined. The EU expects to achieve its 20% target for the period 2013-2020 with the implementation of the ETS Directive and the ESD Decision in the non-ETS sectors which do not allow the use of AAUs from non-EU Parties.
Carry-over units[j]		The exact number of carry-over units for the EU and its Member States from the first commitment period that can be used for compliance during the period 2013-2020 can only be determined after the true-up period of the first commitment period. In the second commitment period the use of such units in the PPSR account depend on the extent by which emissions during the second commitment period exceed the assigned amount for that commitment period, which can only be determined at the end of the second commitment period. At CMP.9 the EU made a declaration when adopting the Doha amendment of the Kyoto Protocol that the European Union legislation on Climate-Energy Package for the implementation of its emission reduction objectives for the period 2013-2020 does not allow the use of surplus AAUs carried over from the first commitment period to meet these objectives.
Other mechanism units under the Convention (specify)[k]		There are general provisions in place in the EU legislation that allow for the use of such units provided that the necessary legal arrangements for the creation of such units have been put in place in the EU which is not the case at the point in time of the provision of this report.
Possible scale of contributions of other market-based mechanisms (estimated kt CO_2 eq)		None
Any other information:[l]		In December 2009, the European Council reiterated the conditional offer of the EU to move to a 30% reduction by 2020 compared to 1990 levels as part of a global and comprehensive agreement for the period beyond 2012, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities.

Abbreviations: LULUCF = land use, land-use change and forestry.

Abbreviations: GWP = global warming potential

Abbreviations: AAU = assigned amount unit, CER = certified emission reduction, ERU = emission reduction unit.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] Optional

[c] Please specify the reference for the GWP: Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) or the Fourth Assessment Report of the IPCC.

[d] Specify other gases

[e] More than one selection will be allowed. If Parties use sectors other than those indicated above, the explanation of how these sectors relate to the sectors defined by the IPCC should be provided.

[f] Transport is reported as a subsector of the energy sector.

[g] Industrial processes refer to the industrial processes and solvent and other product use sectors.

[h] Specify other sectors

[i] AAUs issued to or purchased by a Party.

[j] Units carried over from the first to the second commitment periods of the Kyoto Protocol, as described in decision 13/CMP.1 and consistent with decision XX/CMP.8.

[k] As indicated in paragraph 5(e) of the guidelines contained in annex I of decision 2/CP.17 .

[l] This information could include information on the domestic legal status of the target or the total assigned amount of emission units for the period for reaching a target. Some of this information is presented in the narrative part of the biennial report.

8.4. CTF Table 3 (EU-28): Progress in achievement of the quantified economy-wide emission reduction target: information on mitigation actions and their effects

Name of mitigation action [a]	Sectors affected [b]	GHGs affected	Objective and/or activity affected	Type of instrument [c]	Status of implementation [d]	Brief description [e]	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact [f] (not cumulative, in kt CO_2 eq)					Comment
									2010 [f]	2015 [f]	2020	2025 [f]	2030 [f]	
Directive 2009/29/EC and 2003/87/EC EU-Emission trading system	Cross sectoral	CO_2, N_2O,PFC	Cost-efficient reduction of emissions	regulatory	implemented	Putting a marked price to carbon and giving a financial value to each tonne of emissions saved	2005	CION/MS	NE	NE	NE	NE	NE	For 2020 the mitigation impact is estimated at 21% compared to 2005 levels. Source for the complete first and second trading period: Directives 2009/29/EC and 2003/87/EC; see chapter [BR1] 4.2.2
Effort Sharing Decision	Cross sectoral	CO_2,CH_4 N_2O,HFC, PFC, SF_2	GHG emissions reduction in sectors not included in the EU ETS.	regulatory	emission targets were adopted by EC in March 2013	Binding GHG emissions targets for MS for the years 2013-2020 for sectors not included in the EU ETS	Yet missing	MS need to implement national measures and policies to limit emissions from sectors covered here	NE	NE	NE	NE	NE	For 2020 the mitigation impact is estimated at 10 % compared to 2005 levels; see chapter [BR1] 4.2.3 emission targets were adopted by EC in March 2013
CCS Directive	Cross sectoral	CO_2	geological storage of CO_2	regulatory	adopted	Establishes a legal framework for the environmentally safe geological storage of CO_2	2009	MS	NE	NE	NE	NE	NE	see chapter [BR1] 4.2.4
Taxation of Energy Products and Electricity	Cross sectoral	CO_2, CH_4, N_2O	set minimum levels of taxation of energy products to reduce GHG emissions	regulatory	implemented, revision in adoption process	The Directive covers all taxes on energy consumption, except for VAT and provides for common taxation rules and common minimum levels of taxation	2003	MS	NE	NE	NE	NE	NE	see chapter [BR1] 4.2.5 revision in adoption process
Research and Innovation in Climate and Energy	Other (Cross sectoral)	Other (Not directly affected)	Research and Systematic Observation through involvement of multiple actors and multiple instruments, tools and programmes. New EU research and development programme (Horizon 2020) for 2014-2020. contains objective of reaching 35% climate related expenditures.	Research	Implemented	Includes research programmes and activities, such as • EU Framework Programmes (FP) for Research and Technological Development • LIFE+ (EU's funding instrument for the environment) • Competitiveness and Innovation Framework Programme • International Development Cooperation • Contribution to and/or financial support for major international institutions, research initiatives and programmes	NA	CION/EP, MS and others	NE	NE	NE	NE	NE	Targeted towards research and observation, see chapter [BR1] 4.2.6
Structural and Cohesion Funds	Cross sectoral	Not directly affected	Funds are financial instruments of European Union cohesion policy, to narrow the development disparities among regions and Member States	financial instrument	implemented	Funds are used to co-finance regional development related measures between 2007 and 2013	2007	EC/MS	NE	NE	Not directly affected	NE	NE	Not directly affected; see chapter [BR1] 4.2.7
National Emissions Ceilings Directive	Cross sectoral	Atmospheric pollutants: SO_2, NOx, VOC, NH3, O3.	Meet specified interim environmental and health objectives for acidification, eutrophication and ground-level ozone pollution in 2010	regulatory	implemented, revision underway	Directives sets sets upper limits for each Member State for the total emissions in 2010 of four atmospheric pollutants	2001	EC/MS	NE	NE	NE	NE	NE	revision underway see chapter [BR1] 4.2.8
Renewable Energy Roadmap / Directive 2009/28/EC on the promotion of the use of energy from renewable sources	Energy, transport	CO_2	20 % share of renewable sources in EU total gross final energy consumption in 2020 (electricity, heat and transport	regulatory	implemented	The Directive promotes the increase of renewables in the energy supply sector, such as the transport sector and it supports cooperation between Member States.	2010	MS	NE	NE	750000	NE	NE	Estimated impact range: 600-900 Mt (2020), Source: Citizens' Summary of 23 January 2008 see chapter [BR1] 4.3.2 and 4.3.3
Biomass Action Plan	Energy	CO_2	Increase use of biomass for electricity and heat production and transport	regulatory	published	Sets out Community actions to increase the demand for biomass, improve supply, overcome technical barriers and develop research.	2005	MS	148000	NE	NE	NE	NE	Impact includes reductions in the transport sector, SEC(2005) 1573 see chapter [BR1] 4.3.4
Directive 2004/8/EC on the promotion of cogeneration based on	Energy	CO_2	Promotion and development of high efficiency cogeneration	Regulatory	Implemented	It requires Member States to carry out analyses of their potential for high efficiency	2006 (end date: 04.06. 2014)	MS	33000	NE	NE	NE	NE	Estimated impact range: 24000-42000 kt (2010) Source: COM(2004) 366 final

Name of mitigation action [a]	Sectors affected [b]	GHGs affected	Objective and/or activity affected	Type of instrument [c]	Status of implementation [d]	Brief description [e]	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact [f] (not cumulative, in kt CO_2 eq)					Comment
									2010 [f]	2015 [f]	2020	2025 [f]	2030 [f]	
a useful heat demand in the internal energy market			of heat and power			cogeneration and to evaluate progress towards increasing the share of this technology								see chapter [BR1] 4.3.5
Directive 2006/32/EC on energy end-use efficiency and energy services	Energy, industry	CO_2	Remove barriers to promote energy efficiency and to achieve energy savings in energy consumption	Regulatory	Implemented	Member States are required to set themselves indicative national targets of at least 9 % of energy savings for the year 2016 based on the average final energy consumption of the last available five years.	2008 (end date: 04.06. 2014)	MS	NE	NE	NE	NE	NE	impact not estimated see chapter [BR1] 4.3.6
Directive 2010/31/EU on the energy performance of buildings	Energy	CO_2	Improve the energy performance of new buildings and of existing buildings	Regulatory	Implemented	The Directive obliges Member States to set minimum standards for the energy performance of new buildings and existing buildings that are subject to major renovation work.	2012	MS	NE	NE	185000	NE	NE	Estimated impact range: 160000-210000kt (2020), Source: SEC(2008) 2864 see chapter [BR1] 4.3.7
Energy Efficiency Plan 2011 COM(2011) 109 final	Energy, transport	CO_2	Reduction of primary energy consumption by 20% in 2020	Regulatory	Adopted	Member States have to set indicative national targets and develop energy efficiency programmes.	2011	MS	NE	NE	740000	NE	NE	SEC(2011) 277 final see chapter [BR1] 4.3.8
Directive 2012/27/EU on energy efficiency	Energy, industry	CO_2	Reduction of barriers in the energy market and avoiding market failure, increase of energy efficiency at all stages of the energy chain	Regulatory	Adopted	The Directive establishes a common framework of measures for the promotion of energy efficiency and supports the Energy Efficiency Plan 2011.	2014	MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.3.9
Directive 2009/72/EC concerning common rules for the internal market in electricity	Energy	CO_2	Develop a competitive, secure and sustainable electricity market.	Regulatory	Implemented	The Directive introduces common rules for the generation, transmission, distribution and supply of electricity. It lays down universal service obligations and consumer rights, and clarifies competition requirements.	2011	MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.3.10
Directive 2009/125/EC establishing a framework for the setting of eco-design requirements for energy-related products	Energy	CO_2	Reduce energy consumption	regulatory	implemented	This is the framework Directive for eco-design requirements and one of the major cornerstones of the Community Strategy on Integrated Product Policy, together with the Energy Labelling Directive.	2009	CION/MS	NE	NE	NE	NE	NE	Impact estimated separately for each product category (see related eco-design regulations below) see chapter [BR1] 4.3.11
Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products	Energy	CO_2	Help consumers to identify energy-saving products	regulatory	implemented	The Directive is part of the Community Strategy for Integrated Product Policy and introduces energy labels to sign energy-related products. The ranking scale ranges from A(+++) most efficient to G least efficient.	2010	CION/MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.3.12
Eco-design requirements for glandless standalone circulators and glandless circulators integrated in products (COM REG (EC) 641/2009)	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for glandless standalone circulators and circulator integrated products, including the requirement for Energy labelling (see Reg. (EC) 622/2012)	2009	CION/MS/ industry	NE	NE	12000	NE	NE	SEC(2009) 1016 final see chapter [BR1] 4.3.11
Eco-design requirements for fluorescent lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and luminaires able to operate such lamps (COM REG (EC) 245/2009 amended by	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for fluorescent lamps, high discharge lamps, ballasts and luminaires able to operate such lamps, including the requirement for Energy labelling. (see Reg. (EU) 874/2012)	2009	CION/MS/industry	NE	15300	NE	NE	NE	SEC(2009) 324 see chapter [BR1] 4.3.11

Name of mitigation action [a]	Sectors affected [b]	GHGs affected	Objective and/or activity affected	Type of instrument [c]	Status of implementation [d]	Brief description [e]	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact [f] (not cumulative, in kt CO_2 eq)					Comment
									2010 [f]	2015 [f]	2020	2025 [f]	2030 [f]	
COM REG (EU) 347/2010)														
Eco-design requirements for non-directional household lamps, amendment is replacing functionality requirements for lamps excluding compact fluorescent lamps and LED lamps (COM REG (EC) 244/2009 amended by COM REG (EC) 859/2009)	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for non-directional household lamps, including the requirement for Energy labelling (see Reg. (EU) 874/2012).	2009	CION/MS/industry	NE	NE	15400	NE	NE	SEC(2009) 327 see chapter [BR1] 4.3.11
Eco-design requirements for household refrigerating appliances (COM REG (EC) 643/2009)	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for household refrigerating appliances, including the requirement for Energy labelling (see Reg. (EU) 1060/2010).	2009	CION/MS/industry	NE	NE	2000	6000	NE	SEC(2009) 1020 final see chapter [BR1] 4.3.11
Eco-design requirements for televisions (COM REG (EC) 642/2009)	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for televisions, including the requirement for Energy labelling (see Reg. (EU) 1062/2010	2009	CION/MS/industry	NE	NE	165000	NE	NE	SEC(2009) 1011 final see chapter [BR1] 4.3.11
Eco-design requirements for electric motors (COM REG (EC) 640/2009)	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for electric motors; Energy labelling has not been introduced.	2009	CION/MS/industry	NE	NE	64000	94000	NE	SEC(2009) 1013 final see chapter [BR1] 4.3.11
Eco-design requirements for no-load condition electric power consumption and average active efficiency of external power supplies (COM REG (EC) 278/2009)	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for no-load condition electric power consumption and average active efficiency of external power supplies; Energy labelling has not been introduced.	2009	CION/MS/industry	NE	NE	36000	NE	NE	SEC(2009) 434 see chapter [BR1] 4.3.11
Eco-design requirements for simple set-top boxes (COM REG (EC) 107/2009)	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for simple set-top boxes; Energy labelling has not been introduced.	2009	CION/MS/industry	NE	NE	17000	NE	NE	SEC(2009) 114 final see chapter [BR1] 4.3.11
Eco-design requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment (COM REG (EC) 1275/2008)	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for standby and off mode electric power consumption of electrical and electronic household and office equipment; Energy labelling has not been introduced.	2009	CION/MS/industry	NE	NE	14000	NE	NE	SEC(2008) 3071 see chapter [BR1] 4.3.11
Eco-design requirements for household tumble driers (COM REG (EU) 932/2012)	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for household tumble driers, including the requirement for Energy labelling (see Reg. (EU) 392/2012)	2012	CION/MS/industry	NE	400	1500	2900	38000	Impact assessment draft 2012 see chapter [BR1] 4.3.11
Eco-design requirements for water pumps (COM REG (EU) 547/2012)	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for water pumps; Energy labelling has not been introduced.	2012	CION/MS/industry	NE	NE	NE	NE	NE	Impact assessment shows ranges between 1200 and 2100 kt in 2020, Source: SWD(2012) 178 final see chapter [BR1] 4.3.11
Eco-design requirements for air conditioners and comfort fans (COM REG (EU) 206/2012)	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for air conditioners and comfort fans, including the requirement for Energy labelling (see Reg. (EU) 626/2011)	2012	CION/MS/industry	NE	17000	3800	5500	6000	SWD(2012) 35 final see chapter [BR1] 4.3.11

Name of mitigation action [a]	Sectors affected [b]	GHGs affected	Objective and/or activity affected	Type of instrument [c]	Status of implementation [d]	Brief description [e]	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact [f] (not cumulative, in kt CO_2 eq) 2010 [f]	2015 [f]	2020	2025 [f]	2030 [f]	Comment
Eco-design requirements for industrial fans (COM REG (EU) 327/2011)	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for industrial fans; Energy labelling has not been introduced.	2011	CION/MS/industry	NE	9600	24800	41600	NE	SEC(2011) 384 final see chapter [BR1] 4.3.11
Eco-design requirements for household dishwashers (COM REG (EU) 1016/2010)	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for household dishwashers, including the requirement for Energy labelling (see Reg. (EU) 1059/2010)	2010	CION/MS/industry	NE	NE	500	1800	NE	SEC(2010) 1356 final see chapter [BR1] 4.3.11
Eco-design requirements for household washing machines (COM REG (EU) 1015/2010)	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for household washing machines, including the requirement for Energy labelling (see Reg. (EU) 1061/2010)	2010	CION/MS/industry	NE	NE	800	NE	NE	SEC(2010) 1354 see chapter [BR1] 4.3.11
Eco-design requirements for directional lamps, light emitting diode lamps and related equipment (COM REG (EU) 1194/2012)	Energy	CO_2	Reduce energy consumption	regulatory	implemented	The Regulation sets minimum standards for directional lamps, light emitting diode lamps and related equipment, including the requirement for Energy labelling (see Reg. (EU) 874/2012)	2013	CION/MS/industry	NE	NE	9500	10300	NE	SWD(2012) 0419 see chapter [BR1] 4.3.11
Voluntary eco-design scheme for complex set-top boxes	Energy	CO_2	Reduce energy consumption	voluntary	implemented	Voluntary agreement on energy consumption targets for set-top boxes without Energy labelling.	2010	CION/MS/industry	NE	NE	NE	NE	NE	Cumulative impact 2020: 21000kt, SWD(2012) 391 final see chapter [BR1] 4.3.11
Voluntary eco design scheme for imaging equipment	Energy	CO_2	Reduce energy consumption	voluntary	implemented	Voluntary agreement on energy consumption targets for imaging equipment without Energy labelling.	2011	CION/MS/industry	NE	NE	10200	NE	NE	SWD(2013) 15 final see chapter [BR1] 4.3.11
Draft for eco-design requirements for space heaters and combination heaters	Energy	CO_2	Reduce energy consumption	regulatory	planned	The draft Regulation aims to set minimum standards for space heaters and combination heaters.	NA	CION/MS/industry	NE	NE	110000	NE	NE	Impact assessment draft 2013 see chapter [BR1] 4.3.12
Green Public Procurement	Energy	CO_2	Increase the share of efficient and environmentally friendly technologies, products, services in the public sector	Voluntary	Implemented	Provision of guidelines and criteria for GPP in public authorities	2004	MS	35000	NE	NE	NE	NE	Estimated impact range: 25000-45000kt (2010) Source: Second ECCP Progress Report (EU 15 only) see chapter [BR1] 4.3.13
Energy Star Programme	Energy	CO_2	promotion of less energy consuming office appliances	Voluntary	Implemented	The label shall help consumers to identify low energy consumption products.	2002	MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.3.14
Motor Challenge Programme	Industry	CO_2	Improve the energy efficiency of their electric Motor Driven Systems	Voluntary	Implemented	Companies receive aid, advice and technical assistance to undertake specific measures to reduce energy consumption.	2003	Companies	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.3.15
Strategic Energy Technology Plan (COM(2007) 723)	Energy	CO_2	Support introduction of low carbon technologies	Planning/Strategy	Implemented	The plan comprises measures relating to planning, implementation, resources and international cooperation in the field of energy technology	2007	CION	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.3.16
Intelligent Energy — Europe II Programme	Energy, transport	CO_2	Improve energy efficiency	Economic	Implemented	It is a funding instrument and provides grants and tenders in the four areas of: energy efficiency and rational use, new and renewable energy sources, energy in transport and integrated initiatives.	2007 (start of funding period)	CION (funding: MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.3.17
Covenant of Mayors	Energy	CO_2	Support and coordinate climate action on local level	Voluntary	Implemented	In order to translate their political commitment into specific measures and projects, Covenant signatories undertake to prepare and submit a Sustainable Energy Action Plan (SEAP).	2008	Local governments	NE	NE	420000	NE	NE	Impact compared to base year 1990. Source: Five-year assessment by JRC see chapter [BR1] 4.3.18

Name of mitigation action [a]	Sectors affected [b]	GHGs affected	Objective and/or activity affected	Type of instrument [c]	Status of implementation [d]	Brief description [e]	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact [f] (not cumulative, in kt CO_2 eq)					Comment
									2010 [f]	2015 [f]	2020	2025 [f]	2030 [f]	
CO_2 from cars (Regulation 443/2009)	Transport	CO_2	130 grams of CO_2 per kilometre (g/km) by 2015 and 95g/km by 2020.	Regulatory	Implemented	The Regulation is setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles	2009	MS	NE	NE	24900		43600	SWD(2012) 213 final Part II see chapter [BR1] 4.4.3
CO_2 from vans (Regulation 510/2011)	Transport	CO_2	175 grams of CO_2 per kilometre (g/km) by 2017 and 147g/km by 2020.	Regulatory	Implemented	The Regulation is similar to the one for new cars and sets CO_2emission targets for new vans sold on the EU market.	2011	MS	NE	NE	1900	NE	5300	Personal communication, I. Saleniece, DG Climate Action, European Commission, 31/5/2013 see chapter [BR1] 4.4.4
Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport	Transport	CO_2	Indicative target for biofuels and other renewable energy used in road transport: 5.75 % by 2010	Regulatory	Expired	The Directive was repealed on 31.12.2011 by the Renewable Energy Directive (see section 4.3.3), which sets mandatory targets.	2004 (end date: 31.12.2011)	MS	37500	NE	NE	NE	NE	Estimated impact range: 35000-40000kt, Sourced Second ECCP Progress Report (EU 15 only) see chapter [BR1] 4.4.5
Directive 2009/28/EC on the promotion of the use of energy from renewable sources (Transport sector)	Transport	CO_2	By 2020, the share of renewable energy shall amount to 10 % of fuels consumed in the transport sector	Regulatory	Implemented	The Directive sets a number of sustainability criteria that must be met for biofuels and bioliquids to count towards the target, including a minimum threshold of GHG savings for biofuels	2010	MS	NE	NE	NE	NE	NE	(impact not estimated for transport sector) see chapter [BR1] 4.4.5
Directive 2009/30/EC on the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions	Transport	CO_2	Reduce the greenhouse gas intensity of fuels used in road transport by 6% in 2020	Regulatory	Implemented	The reduction shall be obtained through the use of biofuels, alternative fuels or reductions in flaring and venting. The Directive applies to all petrol, diesel and biofuels used in road transport, as well as to gas oil used in non-road-mobile machinery.	2010	MS	NE	NE	55000	NE	NE	Personal communication, I. Saleniece, DG Climate Action, European Commission, 6/6/2013 see chapter [BR1] 4.4.6
Proposal for the amendment of the Fuel Quality Directive and the Renewable Energy Directive	Transport	CO_2	reduce GHG emissions from indirect land-use change	Regulatory	Planned	It is planned that both the Fuel Quality Directive and the transport-related section of the RES Directive will be amended because GHG emissions related to indirect land use changes (ILUC) are not taken into account under the current legislation.	NA	MS	NE	NE	48000	NE	NE	SWD(2012) 343 final This figure only includes emission reductions in the transport sector see chapter [BR1] 4.4.7
Euro 5 and 6 Standards Regulation (EC) No 692/2008	Transport	Indirect GHG, CO_2	Limitation of emissions of CO, non-methane hydrocarbons, total hydrocarbons, NOx and PM	Regulatory	Implemented/adopted	The Regulation applies to all passenger vehicles, vans, and commercial vehicles intended for the transport of passengers or goods weighing less than 2,610 kg.	2009 (Euro 5), 2014 (Euro 6)	Industry	NE	NE	2000	NE	NE	SEC(2005) 1745 see chapter [BR1] 4.4.8
Euro VI Standard for heavy duty vehicles (buses and trucks) Regulation (EC) No 595/2009	Transport	Indirect GHG	reduce harmful exhaust emissions, including ozone precursors, NOx, hydrocarbons, PM	Regulatory	Adopted	The Regulation provides harmonized technical rules for trucks, lorries and buses (vehicles over 2,610 kg) for type approval and standards for the durability of pollution control devices.	2013	Industry	NE	NE	NE	NE	NE	SEC(2007) 1718 see chapter [BR1] 4.4.9
General Safety Regulation (EC/661/2009) and Tyre Labelling and Minimum Rolling Resistance (EC1222/2009)	Transport	CO_2	Enhance safety of motor vehicles, increase fuel efficiency of motor vehicles and tyres, reduce noise emissions of tyres	Regulatory	Implemented	The regulation integrates environmental and safety requirements for type approval of vehicles and tyres. It applies to vehicles of passenger transport (category M), transportation of goods (category N) and trailers (category O).	2000	Industry	NE	NE	2750	NE	NE	Estimated impact range: 1500-5000 kt, Source: SEC(2008)2860 see chapter [BR1] 4.4.10
Infrastructure charging for heavy goods vehicles (1999/62//EC, amended by 2006/38/EC and 2011/76/EU)	Transport	CO_2	better functioning of the internal market and reduction of congestion, noise and air pollution	regulatory	Partly implemented	The Directive stipulates rules how and to what extent the cost of constructing, operating and developing infrastructure can be borne (through tolls and vignettes) by road users.	1999	MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.4.11
Clean Power for Transport package including the	Transport	CO_2	Reduce CO_2 emissions through shift of fuel type	Planning/Strategy	adopted	The Communication lays out a comprehensive European alternative fuels strategy for the	2013	MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.4.12

Name of mitigation action [a]	Sectors affected [b]	GHGs affected	Objective and/or activity affected	Type of instrument [c]	Status of implementation [d]	Brief description [e]	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact [f] (not cumulative, in kt CO_2 eq) 2010 [f]	2015 [f]	2020	2025 [f]	2030 [f]	Comment
deployment of alternative fuel infrastructure COM(2013) 18 final						long-term substitution of oil as energy source in all modes of transport and a proposal for a Directive on the deployment of alternative fuels infrastructure.								
Clean vehicles Directive (2009/33/EC)	Transport	CO_2	Reduce CO_2 emissions through procurement of green vehicles	regulatory	implemented	The Directive requires that energy and environmental impacts linked to the operation of vehicles over their whole lifetime, including CO_2 emissions, are taken into account in public procurement decisions.	2010	MS	NE	1900	NE	NE	NE	Impact estimated for year 2017, Impact assessment report see chapter [BR1] 4.4.13
White Paper: Roadmap to a Single European Transport Area COM(2011) 144 final	Trans-port	CO_2	Create a competitive and efficient internal EU transport system, cut transport emissions by 60% by 2050	Strategy	adopted	The 2011 White Paper, which forms an integral part of the "Resource Efficiency" initiative of the Commission, defines a long-term strategy to achieve a competitive and resource efficient transport system.	2011	CION	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.4.14
Integrating maritime transport emissions in the EU's greenhouse gas reduction policies COM(2013) 479 final	Trans-port	CO_2	Include GHG emissions from maritime transport in the EU's emission reduction policy	Strategy	adopted	The strategy proposes an MRV system, reduction targets and further measures, including market-based instruments	2013	CION	NE	NE	NE	NE	4400	SWD(2013) 237 final/2 see chapter [BR1] 4.4.15
F-gas Regulation 2006/842/EC	Industrial Processes	HFCs, PFCs, SF_6	Reduce consumption and use of F-gases	Regulatory	Implemented	The Regulation has been supplemented by ten implementing acts or "Commission Regulations", which stipulate reporting format, form of labels, standard leaking checking requirements, training of companies and personnel, etc.	2006	CION, MS	NE	27000	33000	NE	NE	Consultancy report see chapter [BR1] 4.5.2
Proposed revision of the F-gas regulation	Industrial processes	HFCs, PFCs, SF_6	Reduce consumption and use of F-gases	Regulatory	planned	The new proposal anticipates bold steps to limit the use of F-gases in new equipment, which includes a limitation of the total amount of HFCs sold in the EU.	2014	CION, MS	NE	NE	NE	NE	72000	SWD(2012) 363 see chapter [BR1] 4.5.3
European Directive on mobile air-conditioning systems (MACs) (2006/40/EC)	Industrial Processes	HFCs	Reduce use and consumption of F-gases	Regulatory	Implemented	The Directive lays down the requirements for the EC type approval or national type-approval of vehicles as regards emissions from, and the safe functioning of, air-conditioning systems.	2006	CION, MS, industry	NE	3000	13000	NE	NE	COM (2011) 581 final see chapter [BR1] 4.5.4
Industrial Emissions Directive (2010/75/EU)	Industrial processes	All gases	Reduction of harmful industrial emissions across the EU	Regulatory	Implemented	The Directive is a recast of existing legislation aiming at achieving benefits to the environment and human health by reducing polluting emissions as well as waste from industrial and agricultural installations in particular through Best Available Techniques (BAT).	2011	CION, MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.5.5
Common Agricultural Policy	Agriculture	CO_2, CH_4, N_2O	Ensure sustainable agriculture	Regulatory, economic information	implemented	The CAP is based on two pillars: the first one focuses on direct income support for farmers and measures aimed at better functioning of markets, the second pillar supporting rural development based on a programming approach.	1962	CION/MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.6.2
Rural Development Policy	Agriculture	CO_2, CH_4, N_2O	Preserve, enhance ecosystems dependent on agriculture and forest; Resource efficiency, low carbon and climate resilient agriculture	regulatory, economic	RDPs 2007-2013 under implementation; RDPs 2014-2020 to be adopted.	The EU's rural development policy (RDP) addresses the multiple roles of farming in society and, in particular, challenges faced in its wider rural context.	current legal framework: 2007 -13, new legal framework 2014-20	CION/MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.6.3
Thematic Soil	Agriculture,	CO_2	protect soil as carbon	information,	Strategy adopted,	The proposed Directive aims at	2006, Directive	CION/MS	NE	NE	NE	NE	NE	(impact not estimated)

Name of mitigation action [a]	Sectors affected [b]	GHGs affected	Objective and/or activity affected	Type of instrument [c]	Status of implementation [d]	Brief description [e]	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact [f] (not cumulative, in kt CO_2 eq)					Comment
									2010 [f]	2015 [f]	2020	2025 [f]	2030 [f]	
Strategy (COM(2006) 231)/ Soil Framework Directive	LULUCF		pool	education, research, regulatory	Directive planned	establishing a common strategy for the protection and sustainable use of soil based on the principles of integration of soil concerns into other policies.	being negotiated							see chapter [BR1] 4.6.4
Nitrates Directive (91/676/EEC)	Agriculture	N_2O	prevent water pollution	regulatory	implemented	The Directive contains actions and measures to be elaborated by the Member States, such as monitoring of waters, identification of nitrates vulnerable zones (NZV), establishment of Codes of Good Agricultural Practices (CGAP) and implementation of actions plans.	1991	CION/MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.6.5
EU Forest Strategy/EU Forest Action Plan (SEC(2006) 748)	LULUCF	CO_2	Sustainable forest management	Planning	adopted	The Forest Action Plan includes several key actions referring to climate change mitigation: promotion of forest biomass for energy generation, EU compliance with UNFCCC and Kyoto obligations, protection of EU forests.	1998/2006	CION/MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.7.1
Forestry measure within the Rural Development Policy	LULUCF, Agriculture	CO_2	Sustainable forest management	economic	implemented	Forestry is an integral part of rural development; support for sustainable and climate-friendly land use should encompass forest area development and sustainable management of forests.	2007, reformed in 2013	CION/MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.7.2
LULUCF accounting	LULUCF, Agriculture	CO_2, (CH_4, N_2O)	Robust accounting of LULUCF activities across Europe	regulatory	Adopted	Provides the basis for a formal inclusion of the LULUCF sector and ensures a harmonized legal framework allowing the collection of reliable data by robust accounting and reporting in a standardized way.	2013 (as together with start of second commitment period)	CION (DG Clima)	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.7.3
Waste Framework Directive (2008/98/EC)	Waste, Energy, Industry	CH_4, CO_2	Promote prevention and recycling of waste	regulatory	implemented	The Directive is a legal framework for the management of waste to cope with the challenge of decoupling economic growth from waste generation and promoting strict hierarchy of intervention for waste prevention and management. It has been amended in 2006 and 2008.	1975	CION/MS	NE	NE	40100	NE	NE	Consultancy report see chapter [BR1] 4.8.2
Landfill Directive (1999/31/EC)	Waste, Energy	CH_4	prevent or reduce as far as possible negative effects on the environment resulting from landfilling	regulatory	implemented	The Landfill Directive defines the different categories of waste (municipal waste, hazardous waste, non-hazardous waste and inert waste) and applies to all landfills, defined as waste disposal sites for the deposit of waste onto or into land.	1999	CION/MS	48000	NE	44000	NE	NE	2010 impact compared to 1995 levels, 2020 impact compared to 2008 levels (if all MS fully meet the targets: 62000kt in 2020), Source: EEA report see chapter [BR1] 4.8.3
Waste Incineration (2000/76/EC)	Waste, Industry, Energy	CO_2, CH_4	avoid or minimize polluting emission due waste (co)-incineration	regulatory	Implemented	The objective of the Directive is to prevent or to limit negative effects on the environment from the incineration and co-incineration of waste, in particular pollution by emissions into air, soil, surface water and groundwater, and the resulting risks to human health.	2000	CION/MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.8.4
EU policies targeting waste streams	Waste, Industry, energy	CO_2, CH_4, F-gases	Saving of resources	regulatory	implemented	These policy group targets different waste streams to promote recycling, re-use and waste recovery.	Different for each directive, first in 1994	CION/MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.8.5
Management of biodegradable waste	Waste, Energy	CO_2, CH_4	Make us of bio-waste as energy or material	NA	planned	The CION published a Green Paper on the Management of	NA	CION/MS	NE	NE	NE	NE	NE	Reduction potential ranges between 1500 and 6000 kt

Name of mitigation action [a]	Sectors affected [b]	GHGs affected	Objective and/or activity affected	Type of instrument [c]	Status of implementation [d]	Brief description [e]	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact [f] (not cumulative, in kt CO_2 eq) 2010 [f]	2015 [f]	2020	2025 [f]	2030 [f]	Comment
(COM/2008/0811 final)			source			biodegradable waste to use the potential of bio-waste. Currently the MS follow different strategies to manage their bio-waste. A binding target is under discussion.								CO_2eq in 2020, depending on the target. Source: Feasibility assessment see chapter [BR1] 4.8.6
Urban Waste Water Treatment Directive (91/271/EEC)	Waste	N_2O, CH_4	protect the environment from the adverse effects of urban & industrial waste water discharges	regulatory	implemented	The Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors.	1991	EC/MS	NE	NE	NE	NE	NE	(impact not estimated) see chapter [BR1] 4.8.7

Abbreviations: GHG = greenhouse gas; LULUCF = land use, land-use change and forestry.; NE: not estimated

[a] Parties should use an asterisk (*) to indicate that a mitigation action is included in the 'with measures' projection.

On aggregated EU-level, detailed information on the inclusion of EU-wide PaMs in the 'with measures' projection is not available as this may differ between the 28 Member States. Such detailed information can be sought in the Member states' own Biennial Reports.

[b] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors, cross-cutting, as appropriate.

[c] To the extent possible, the following types of instrument should be used: economic, fiscal, voluntary agreement, regulatory, information, education, research, other.

[d] To the extent possible, the following descriptive terms should be used to report on the status of implementation: implemented, adopted, planned.

[e] Additional information may be provided on the cost of the mitigation actions and the relevant timescale.

[f] Optional year or years deemed relevant by the Party.

Abbreviations for implementing entities: CION: European Commission; EP: European Parliament; MS: Member States

8.5. CTF Table 4 (EU-28): Reporting on progress

	Unit	Base Year	2010	2011	2012	Comment
Total (without LULUCF)	kt CO_2 eq	5.791.121.99	4.733.815.65	4.578.468.64		
Contribution from LULUCF [c]	kt CO_2 eq		-83.976.59	-83.976.59	-83.976.59	Average projected accounting of activites under Article 3.3 and 3.4. see chapter [BR1] 4.11
Market-based mechanisms under the Convention	number of units		2.258.546.746.00	2.761.334.892.00	2.315.900.565.00	see chapter[BR1] 4.12
	kt CO_2 eq		2.258.546.75	2.761.334.89	2.315.900.57	see chapter[BR1] 4.12
Other market-based mechanisms	number of units					
	kt CO_2 eq					

Abbreviation: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] For the base year, information reported on the emission reduction target shall include the following: (a) total GHG emissions, excluding emissions and removals from the LULUCF sector; (b) emissions and/or removals from the LULUCF sector based on the accounting approach applied taking into consideration any relevant decisions of the Conference of the Parties and the activities and/or land that will be accounted for; (c) total GHG emissions, including emissions and removals from the LULUCF sector. For each reported year, information reported on progress made towards the emission reduction targets shall include, in addition to the information noted in paragraphs 9(a–c) of the UNFCCC biennial reporting guidelines for developed country Parties, information on the use of units from market-based mechanisms.

[c] Information in this column should be consistent with the information reported in table 4(a)I or 4(a)II, as appropriate. The Parties for which all relevant information on the LULUCF contribution is reported in table 1 of this common tabular format can refer to table 1.

8.5.1. *CTF Table 4(a)II (EU-28): Progress in achievement of the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the counting of emissions and removals from the land use, land-use change and forestry sector in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol*

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	Base year[d]	Net emissions/removals[e]					Accounting Parameters[h]	Accounting Quantity[i]
		2008	2009	2010	2011	Total[g]		
	(kt CO_2 eq)							
A. Article 3.3 activities								
A.1. Afforestation and Reforestation								-226 548.74
A.1.1. Units of land not harvested since the beginning of the commitment period[j]		-53 133.24	-56 592.49	-58 302.70	-58 230.82	-226 259.26		-226 259.26
A.1.2. Units of land harvested since the beginning of the commitment period[j]								-289.48
A.2. Deforestation		36 890.01	34 260.82	31 416.02	30 677.71	133 244.56		133 244.56
B. Article 3.4 activities								
B.1. Forest Management (if elected)		-337 739.62	-337 540.41	-307 270.05	-314 865.87	-1 297 415.94		-243 755.87
3.3 offset[k]							44 521.75	-45 816.80
FM cap[l]							197 939.08	-197 939.08
B.2. Cropland Management (if elected)	9 600.26	1 981.30	1 330.31	1 480.18	827.46	5 619.26	38 401.02	-32 781.76
B.3. Grazing Land Management (if elected)	2 218.92	-0.67	-130.96	-267.13	-430.03	-828.80	8 875.69	-9 704.49
B.4. Revegetation (if elected)	-1 274.97	-238.94	-253.57	-268.28	-286.95	-1 047.75	-5 099.88	4 052.13

Note: 1 kt CO_2 eq equals 1 Gg CO_2 eq.

Abbreviations: CRF = common reporting format, LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission

reduction targets.

[b] Developed country Parties with a quantified economy-wide emission reduction target as communicated to the secretariat and contained in document FCCC/SB/2011/INF.1/Rev.1 or any update to that document, that are Parties to the Kyoto Protocol, may use table 4(a)II for reporting of accounting quantities if LULUCF is contributing to the attainment of that target.

[c] Parties can include references to the relevant parts of the national inventory report, where accounting methodologies regarding LULUCF are further described in the documentation box or in the biennial reports.

[d] Net emissions and removals in the Party's base year, as established by decision 9/CP.2.

[e] All values are reported in the information table on accounting for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, of the CRF for the relevant inventory year as reported in the current submission and are automatically entered in this table.

[f] Additional columns for relevant years should be added, if applicable.

[g] Cumulative net emissions and removals for all years of the commitment period reported in the current submission.

[h] The values in the cells "3.3 offset" and "Forest management cap" are absolute values.

[i] The accounting quantity is the total quantity of units to be added to or subtracted from a Party's assigned amount for a particular activity in accordance with the provisions of Article 7, paragraph 4, of the Kyoto Protocol.

[j] In accordance with paragraph 4 of the annex to decision 16/CMP.1, debits resulting from harvesting during the first commitment period following afforestation and reforestation since 1990 shall not be greater than the credits accounted for on that unit of land.

[k] In accordance with paragraph 10 of the annex to decision 16/CMP.1, for the first commitment period a Party included in Annex I that incurs a net source of emissions under the provisions of Article 3 paragraph 3, may account for anthropogenic greenhouse gas emissions by sources and removals by sinks in areas under forest management under Article 3, paragraph 4, up to a level that is equal to the net source of emissions under the provisions of Article 3, paragraph 3, but not greater than 9.0 megatonnes of carbon times five, if the total anthropogenic greenhouse gas emissions by sources and removals by sinks in the managed forest since 1990 is equal to, or larger than, the net source of emissions incurred under Article 3, paragraph 3.

[l] In accordance with paragraph 11 of the annex to decision 16/CMP.1, for the first commitment period of the Kyoto Protocol only, additions to and subtractions from the assigned amount of a Party resulting from Forest management under Article 3, paragraph 4, after the application of paragraph 10 of the annex to decision 16/CMP.1 and resulting from forest management project activities undertaken under Article 6, shall not exceed the value inscribed in the appendix of the annex to decision 16/CMP.1, times five.

8.5.2. CTF Table 4(b) (EU-28): Reporting on progress

	Quantity of units	kt CO_2 eq	Comments
2011			
Kyoto Protocol Units [d]			
AAUs	2.603.870.003.00	2.603.870.00	
ERUs	20.506.866.00	20.506.87	
CERs	136.958.023.00	136.958.02	
tCERs	NO	NO	
lCERs	NO	NO	
Units from market-based mechanisms under the Convention [d, e]			
Units from other market-based mechanisms [d, e]			
Total			
2012			
Kyoto Protocol Units [d]			
AAUs	2.098.437.856.00	2.098.437.86	
ERUs	63.453.240.00	63.453.24	
CERs	154.009.469.00	154.009.47	
tCERs	NO	NO	
lCERs	NO	NO	
Units from market-based mechanisms under the Convention [d, e]			
Units from other market-based mechanisms [d, e]			
Total			In addition. 288 245 RMUs (= 288.25 kt CO_2 eq) were retired in 2012.

Abbreviations: AAUs = assigned amount units, CERs = certified emission reductions, ERUs = emission reduction units, lCERs = long-term certified emission reductions, tCERs = temporary certified emission reductions.

Note: 2011 is the latest reporting year.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] For each reported year, information reported on progress made towards the emission reduction target shall include, in addition to the information noted in paragraphs 9(a-c) of the reporting guidelines, on the use of units from market-based mechanisms.

[c] Parties may include this information, as appropriate and if relevant to their target.

[d] Units surrendered by that Party for that year that have not been previously surrendered by that or any other Party.

[e] Additional rows for each market-based mechanism should be added, if applicable

8.6. CTF Table 4 (EU-15): Reporting on progress

	Unit	Base Year	2010	2011	2012	Comment
Total (without LULUCF)	kt CO_2 eq	4.265.517.72	3.790.224.66	3.630.657.22		
Contribution from LULUCF [c]	kt CO_2 eq		-63.882.35	-63.882.35	-63.882.35	Average projected accounting of activites under Article 3.3 and 3.4. see chapter [BR1] 4.11
Market-based mechanisms under the Convention	number of units		1.621.787.612.00	2.172.851.039.00	2.114.032.058.00	see chapter[BR1] 4.12
	kt CO_2 eq		1.621.787.61	2.172.851.05	2.114.032.05	see chapter[BR1] 4.12
Other market-based mechanisms	number of units					
	kt CO_2 eq					

Abbreviation: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] For the base year, information reported on the emission reduction target shall include the following: (a) total GHG emissions, excluding emissions and removals from the LULUCF sector; (b) emissions and/or removals from the LULUCF sector based on the accounting approach applied taking into consideration any relevant decisions of the Conference of the Parties and the activities and/or land that will be accounted for; (c) total GHG emissions, including emissions and removals from the LULUCF sector. For each reported year, information reported on progress made towards the emission reduction targets shall include, in addition to the information noted in paragraphs 9(a–c) of the UNFCCC biennial reporting guidelines for developed country Parties, information on the use of units from market-based mechanisms.

[c] Information in this column should be consistent with the information reported in table 4(a)I or 4(a)II, as appropriate. The Parties for which all relevant information on the LULUCF contribution is reported in table 1 of this common tabular format can refer to table 1.

8.6.1. *CTF Table 4(a)II (EU-15): Progress in achievement of the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the counting of emissions and removals from the land use, land-use change and forestry sector in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol*

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	Base year[d]	Net emissions/removals[e]					Accounting Parameters[h]	Accounting Quantity[i]
		2008	2009	2010	2011	Total[g]		
	($kt\ CO_2$ eq)							
A. Article 3.3 activities								
A.1. Afforestation and Reforestation								-185 767.46
A.1.1. Units of land not harvested since the beginning of the commitment period[j]		-43 924.61	-46 786.57	-47 840.99	-47 215.28	-185 767.46		-185 767.46
A.1.2. Units of land harvested since the beginning of the commitment period[j]								0.00
A.2. Deforestation		31 457.68	30 447.20	27 834.81	27 456.75	117 196.44		117 196.44
B. Article 3.4 activities								
B.1. Forest Management (if elected)		-233 029.29	-228 901.50	-205 081.67	-215 247.36	-882 259.83		-170 225.14
3.3 offset[k]							41 494.39	-41 494.39
FM cap[l]							128 730.74	-128 730.74
B.2. Cropland Management (if elected)	9 600.26	1 981.30	1 330.31	1 480.18	827.46	5 619.26	38 401.02	-32 781.76
B.3. Grazing Land Management (if elected)	2 218.92	-0.67	-130.96	-267.13	-430.03	-828.80	8 875.69	-9 704.49
B.4. Revegetation (if elected)	NA	NA	NA	NA	NA	NA	NA	NA

Note: 1 kt CO_2 eq equals 1 Gg CO_2 eq.

Abbreviations: CRF = common reporting format, LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission

reduction targets.

[b] Developed country Parties with a quantified economy-wide emission reduction target as communicated to the secretariat and contained in document FCCC/SB/2011/INF.1/Rev.1 or any update to that document, that are Parties to the Kyoto Protocol, may use table 4(a)II for reporting of accounting quantities if LULUCF is contributing to the attainment of that target.

[c] Parties can include references to the relevant parts of the national inventory report, where accounting methodologies regarding LULUCF are further described in the documentation box or in the biennial reports.

[d] Net emissions and removals in the Party's base year, as established by decision 9/CP.2.

[e] All values are reported in the information table on accounting for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, of the CRF for the relevant inventory year as reported in the current submission and are automatically entered in this table.

[f] Additional columns for relevant years should be added, if applicable.

[g] Cumulative net emissions and removals for all years of the commitment period reported in the current submission.

[h] The values in the cells "3.3 offset" and "Forest management cap" are absolute values.

[i] The accounting quantity is the total quantity of units to be added to or subtracted from a Party's assigned amount for a particular activity in accordance with the provisions of Article 7, paragraph 4, of the Kyoto Protocol.

[j] In accordance with paragraph 4 of the annex to decision 16/CMP.1, debits resulting from harvesting during the first commitment period following afforestation and reforestation since 1990 shall not be greater than the credits accounted for on that unit of land.

[k] In accordance with paragraph 10 of the annex to decision 16/CMP.1, for the first commitment period a Party included in Annex I that incurs a net source of emissions under the provisions of Article 3 paragraph 3, may account for anthropogenic greenhouse gas emissions by sources and removals by sinks in areas under forest management under Article 3, paragraph 4, up to a level that is equal to the net source of emissions under the provisions of Article 3, paragraph 3, but not greater than 9.0 megatonnes of carbon times five, if the total anthropogenic greenhouse gas emissions by sources and removals by sinks in the managed forest since 1990 is equal to, or larger than, the net source of emissions incurred under Article 3, paragraph 3.

[l] In accordance with paragraph 11 of the annex to decision 16/CMP.1, for the first commitment period of the Kyoto Protocol only, additions to and subtractions from the assigned amount of a Party resulting from Forest management under Article 3, paragraph 4, after the application of paragraph 10 of the annex to decision 16/CMP.1 and resulting from forest management project activities undertaken under Article 6, shall not exceed the value inscribed in the appendix of the annex to decision 16/CMP.1, times five.

8.6.2. CTF Table 4(b) (EU-15): Reporting on progress

	Quantity of units	kt CO_2 eq	Comments
2011			
Kyoto Protocol Units [d]			
AAUs	2.060.295.747.00	2.060.295.75	
ERUs	12.003.006.00	12.003.01	
CERs	100.552.286.00	100.552.29	
tCERs	NO	NO	
lCERs	NO	NO	
Units from market-based mechanisms under the Convention [d. e]			
Units from other market-based mechanisms [d. e]			
Total			
2012			
Kyoto Protocol Units [d]			
AAUs	1.908.493.342.00	1.908.493.34	
ERUs	57.617.782.00	57.617.78	
CERs	147.920.934.00	147.920.93	
tCERs	NO	NO	
lCERs	NO	NO	
Units from market-based mechanisms under the Convention [d. e]			
Units from other market-based mechanisms [d. e]			
Total			In addition. 288 245 RMUs (= 288.25 kt CO_2 eq) were retired in 2012.

Abbreviations: AAUs = assigned amount units, CERs = certified emission reductions, ERUs = emission reduction units, lCERs = long-term certified emission reductions, tCERs = temporary certified emission reductions.

Note: 2011 is the latest reporting year.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] For each reported year, information reported on progress made towards the emission reduction target shall include, in addition to the information noted in paragraphs 9(a-c) of the reporting guidelines, on the use of units from market-based mechanisms.

[c] Parties may include this information, as appropriate and if relevant to their target.

[d] Units surrendered by that Party for that year that have not been previously surrendered by that or any other Party.

[e] Additional rows for each market-based mechanism should be added, if applicable

8.7. CTF Table 5 (EU-28): Summary of key variables and assumptions used in the projections analysis

Parameter	2015	2020	2025	2030
CO2-price (Euro (2010)/tCO2_eq)	12	17	21	27
GDP (Bio. Euro (2005))	13	14	16	17
International coal price (Euro (2010)/boe)	19	20	23	23
International gas price (Euro (2010)/boe)	50	54	58	61
International oil price (Euro (2010)/boe)	86	94	95	101
Population (Mio.)	506	514	518	510

Abbreviation: boe: barrel of oil equivalent

8.8. CTF Table 6(a)/(c) (EU-28): Information on updated greenhouse gas projections under a 'with measures' scenario and under a 'with additional measures' scenario

Sector/Gas	1990	1995	2000	2005	2010	2011	2015	2020	2025	2030
historic emissions (Gg CO2eq)										
1. Energy (excluding transport)	3 541 260	3 212 558	3 085 544	3 137 803	2 848 549	2 708 285				
1.A.3. Transport	778 344	833 370	914 698	969 045	935 862	926 442				
2. Industry / industrial processes	461 477	439 424	393 099	406 017	337 860	334 685				
4. Agriculture	604 008	520 030	508 448	481 543	463 189	464 418				
6. Waste / waste management	204 173	198 459	177 575	153 063	138 069	134 553				
7. Other sector (3+7)	16 855	13 904	13 442	12 188	10 415	10 215				
CH4 emissions excluding CH4 from LULUCF	594 692	531 372	477 428	425 851	395 550	387 667				
CO2-emissions excluding net CO2 from LULUCF	4 430 302	4 155 793	4 131 745	4 269 224	3 912 211	3 764 300				
N2O emissions excluding net N2O from LULUCF	520 980	460 796	416 334	388 578	336 115	334 839				
Total F-Gases	60 144	69 786	67 300	76 007	90 068	91 792				
Memo Item: International Bunker: Marine	*110 112*	*111 159*	*134 416*	*166 308*	*151 693*	*163 007*				
Memo Item: International Bunker: Aviation	*70 242*	*87 027*	*116 607*	*132 706*	*133 091*	*136 618*				
'with measures' scenario (WEM) (Gg CO2eq)										
1. Energy (excluding transport)					2 840 827	2 794 356	2 630 111	2 490 519	2 423 795	2 354 773
1.A.3. Transport					933 275	926 348	916 294	917 399	923 865	937 767
2. Industry / industrial processes					346 648	347 209	347 871	360 357	361 116	367 624
4. Agriculture					465 734	464 270	462 331	464 373	462 910	463 951
6. Waste / waste management					140 252	135 673	123 657	113 709	105 896	101 718
7. Other sector (3+7)					12 339	12 238	12 422	12 744	12 813	13 016
CH4 emissions excluding CH4 from LULUCF					397 984	391 950	375 926	363 186	350 057	346 120
CO2-emissions excluding net CO2 from LULUCF					3 906 391	3 853 181	3 687 433	3 561 272	3 478 999	3 458 596
N2O emissions excluding net N2O from LULUCF					342 310	338 837	335 120	339 257	338 896	340 862
Total F-Gases					92 389	96 089	94 254	95 436	92 379	93 319
Memo Item: International Bunker: Marine					*145 124*	*125 243*	*126 748*	*135 796*	*141 606*	*147 892*
Memo Item: International Bunker: Aviation					*127 986*	*129 963*	*129 916*	*139 734*	*151 078*	*163 235*
'with additional measures' scenario (WAM) (Gg CO2eq)										
1. Energy (excluding transport)					2 840 821	2 778 261	2 574 427	2 347 301	2 256 017	2 140 274
1.A.3. Transport					933 275	923 180	898 308	875 065	865 627	867 612
2. Industry / industrial processes					346 648	346 011	344 314	353 324	351 715	348 920
4. Agriculture					465 735	464 034	460 653	460 389	456 783	456 405
6. Waste / waste management					140 252	134 811	118 677	107 441	99 949	96 071
7. Other sector (3+7)					12 339	12 258	12 434	12 710	12 756	12 953
CH4 emissions excluding CH4 from LULUCF					397 982	390 751	370 145	354 605	340 103	334 816
CO2-emissions excluding net CO2 from LULUCF					3 906 391	3 833 698	3 613 283	3 376 322	3 253 904	3 168 076
N2O emissions excluding net N2O from LULUCF					342 307	338 653	333 784	333 533	331 836	333 423
Total F-Gases					92 287	95 438	91 761	91 884	87 007	86 036
Memo Item: International Bunker: Marine					*145 124*	*125 356*	*125 026*	*135 854*	*141 331*	*147 217*
Memo Item: International Bunker: Aviation					*127 986*	*128 901*	*128 427*	*136 485*	*145 940*	*155 516*

Abbreviations: WEM: With existing measures scenario; WAM: With additional measures scenario

Note: Historic GHG emissions are presented up to 2011. Projections are represented starting 2010. Thus, there is an overlap of historic and projected values. Note that if 2010 and 2011 GHG emission trajectories do not match this is due to the fact that projected GHG emissions were aggregated from individual Member State projections, which may not have taken into account the latest inventory values as the base year in the preparation of their projections.

8.9. CTF Table 7 (EU-28): Provision of public financial support: summary information

Allocation channels	European euro - EUR					USD [b]				
		Climate-specific [d]					Climate-specific [d]			
	Core/general [c]	Mitigation	Adaptation	Cross-cutting [e]	Other	Core/general [c]	Mitigation	Adaptation	Cross-cutting [e]	Other
2011										
Total contributions through multilateral channels										
Multilateral climate change funds [g]										
Other multilateral climate change funds [h]										
Multilateral financial institutions, including regional development banks										
Specialized United Nations bodies										
Total contributions through bilateral, regional and other channels		85,850,681.00	88,669,476.00	453,851,867.00			119,402,895.00	123,323,333.00	631,226,518.00	
Total		85,850,681.00	88,669,476.00	453,851,867.00			119,402,895.00	123,323,333.00	631,226,518.00	
2012										
Total contributions through multilateral channels										
Multilateral climate change funds [g]										
Other multilateral climate change funds [h]										
Multilateral financial institutions, including regional development banks										
Specialized United Nations bodies										
Total contributions through bilateral, regional and other channels		184,639,734.00	79,034,455.00	470,068,362.00			237,326,137.00	101,586,703.00	604,200,977.00	
Total		184,639,734.00	79,034,455.00	470,068,362.00			237,326,137.00	101,586,703.00	604,200,977.00	

Abbreviation: USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[b] Parties should provide an explanation on methodology used for currency exchange for the information provided in table 7, 7(a) and 7(b) in the box below.

[c] This refers to support to multilateral institutions that Parties cannot specify as climate-specific.

[d] Parties should explain in their biennial reports how they define funds as being climate-specific.

[e] This refers to funding for activities which are cross-cutting across mitigation and adaptation.

[g] Multilateral climate change funds listed in paragraph 17(a) of the “UNFCCC biennial reporting guidelines for developed country Parties” in decision 2/CP.17.

[h] Other multilateral climate change funds as referred in paragraph 17(b) of the “UNFCCC biennial reporting guidelines for developed country Parties” in decision 2/CP.17.

8.9.1. CTF Table 7(b) (EU-28): Provision of public financial support: contribution through bilateral, regional and other channels in 2011

Note: For some countries, more than one entry can be found. This means that more than one type of support (mitigation, adaptation or cross cutting) has been provided.

Recipient country/ region/project/programme[b]	*Total amount*		*Status*[c]	*Funding source*	*Financial instrument*	*Type of support*	*Sector*[d]	*Additional Information*[e]
	Climate-specific/							
	EUR	*USD*	*Provided, Committed, Pledged*	*ODA OOF Other*[g]	*Grant; Con-cessional loan; Non-concessional loan; Equity; Other*[g]	*Mitigation Adaptation Cross-cutting*[h] *Other*[g]	*Energy Transport Industry Agriculture Forestry Water and sanitation Cross-cutting Other*[g]	
Bangladesh	20 000 000	27 816 412	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Cross-cutting*	
Benin	8 000 000	11 126 565	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Water and Sanitation*	Flood prevention and control
Bhutan	3 600 000	5 006 954	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Agriculture*	
Burkina Faso	2 000 000	2 781 641	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Agriculture*	
Burkina Faso	1 200 000	1 668 985	*Committed*	*ODA*	*Grant*	*Adaptation*	*Other*	
Central African Republic	2 680 000	3 727 399	*Committed*	*ODA*	*Grant*	*Mitigation*	*Forestry*	
China	10 000 000	13 908 206	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Cross-cutting*	
China	2 000 000	2 781 641	*Committed*	*ODA*	*Grant*	*Adaptation*	*Other*	
Ivory Coast	3 120 000	4 339 360	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Agriculture*	
Cook Islands	600 000	834 492	*Committed*	*ODA*	*Grant*	*Adaptation*	*Cross-cuting*	
Cuba	7 000 000	9 735 744	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Agriculture*	
Democratic Republic of the Congo	14 000 000	19 471 488	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Forestry*	
Djibouti	4 800 000	6 675 939	*Committed*	*ODA*	*Grant*	*Mitigation*	*Energy*	
Egypt	1 250 953	1 739 851	*Committed*	*ODA*	*Grant*	*Mitigation*	*Energy*	
Egypt	8 000 000	11 126 565	*Committed*	*ODA*	*Grant*	*Adaptation*	*Transport*	*Urban Development*
Egypt	10 749 047	14 949 996	*Committed*	*ODA*	*Grant*	*Mitigation*	*Energy*	
Gabon	4 800 000	6 675 939	*Committed*	*ODA*	*Grant*	*Adaptation*	*Water and Sanitation*	
Gambia	3 860 000	5 368 567	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Cross-cutting*	
Grenada	1 000 000	1 390 821	*Committed*	*ODA*	*Grant*	*Mitigation*	*Energy*	
Guatemala	800 000	1 112 656	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Agriculture*	
Guyana	736 739	1 024 672	*Committed*	*ODA*	*Grant*	*Mitigation*	*Energy*	
Guyana	1 120 000	1 557 719	*Committed*	*ODA*	*Grant*	*Adaptation*	*Agriculture*	

Recipient country/ region/project/programme[b]	Total amount: Climate-specific/ EUR	USD	Status[c]: Provided, Committed, Pledged	Funding source: ODA OOF Other[g]	Financial instrument: Grant; Concessional loan; Non-concessional loan; Equity; Other[g]	Type of support: Mitigation Adaptation Cross-cutting[h] Other[g]	Sector[d]: Energy Transport Industry Agriculture Forestry Water and sanitation Cross-cutting Other[g]	Additional Information[e]
Guyana	6 880 000	9 568 846	*Committed*	*ODA*	*Grant*	*Adaptation*	*Agriculture*	
Haiti	7 480 000	10 403 338	*Committed*	*ODA*	*Grant*	*Mitigation*	*Cross-cutting*	
Indonesia	15 000 000	20 862 309	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Forestry*	
Jamaica	12 381 200	17 220 028	*Committed*	*ODA*	*Grant*	*Mitigation*	*Cross-cutting*	
Jamaica	172 742	240 253	*Committed*	*ODA*	*Grant*	*Mitigation*	*Energy*	
Jordan	14 000 000	19 471 488	*Committed*	*ODA*	*Grant*	*Mitigation*	*Energy*	
Laos	5 000 000	6 954 103	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Forestry*	
Lebanon	3 200 000	4 450 626	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Cross-cutting*	
Malawi	4 634 400	6 445 619	*Committed*	*ODA*	*Grant*	*Adaptation*	*Agriculture*	
Mozambique	1 966 800	2 735 466	*Committed*	*ODA*	*Grant*	*Adaptation*	*Agriculture*	
Mozambique	5 000 000	6 954 103	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Cross-cutting*	
Nicaragua	2 140 000	2 976 356	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Cross-cutting*	
Niger	6 000 000	8 344 924	*Committed*	*ODA*	*Grant*	*Adaptation*	*Agriculture*	
Sierra Leone	6 600 000	9 179 416	*Committed*	*ODA*	*Grant*	*Mitigation*	*Forestry*	
Solomon Islands	990 000	1 376 912	*Committed*	*ODA*	*Grant*	*Adaptation*	*Transport*	*Road Infrastructure*
Swaziland	4 800 000	6 675 939	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Water and Sanitation*	
South Sudan	16 800 000	23 365 786	*Committed*	*ODA*	*Grant*	*Adaptation*	*Agriculture*	*Food Security*
Sudan	9 200 000	12 795 549	*Committed*	*ODA*	*Grant*	*Adaptation*	*Agriculture*	*Food Security*
Suriname	78 276	108 868	*Committed*	*ODA*	*Grant*	*Adaptation*	*Agriculture*	*Water*
Tajikistan	6 400 000	8 901 252	*Committed*	*ODA*	*Grant*	*Adaptation*	*Agriculture*	
Tanzania	4 000 000	5 563 282	*Committed*	*ODA*	*Grant*	*Adaptation*	*Cross-cuting*	
Uganda	11 000 000	15 299 026	*Committed*	*ODA*	*Grant*	*Adaptation*	*Agriculture*	
Uganda	1 380 300	1 919 750	*Committed*	*ODA*	*Grant*	*Mitigation*	*Energy*	
Uganda	6 619 700	9 206 815	*Committed*	*ODA*	*Grant*	*Mitigation*	*Energy*	
Uzbekistan	4 000 000	5 563 282	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Cross-cutting*	*Rural Development*
Vietnam	1 200 000	1 668 985	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Cross-cutting*	
Western Samoa	3 000 000	4 172 462	*Committed*	*ODA*	*Grant*	*Adaptation*	*Water and Sanitation*	
Regional Africa	71 977 736	100 108 117	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Cross-cutting*	*Several projects*
Regional Asia	44 080 000	61 307 371	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Cross-cutting*	*Several projects*
Regional Latin America	16 000 000	22 253 129	*Committed*	*ODA*	*Grant*	*Mitigation*	*Cross-cutting*	

Recipient country/ region/project/programme[b]	Total amount		Status[c]	Funding source	Financial instrument	Type of support	Sector[d]	Additional Information[e]
	Climate-specific/							
	EUR	USD	Provided, Committed, Pledged	ODA OOF Other[g]	Grant; Concessional loan; Non-concessional loan; Equity; Other[g]	Mitigation Adaptation Cross-cutting[h] Other[g]	Energy Transport Industry Agriculture Forestry Water and sanitation Cross-cutting Other[g]	
Unspecified LDCs	154 374 131	214 706 719	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Cross-cutting*	*Several projects*
Regional Eastern Europe and Central Asia	70 200 000	97 635 605	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Cross-cutting*	*Several projects*
Regional Oceania	500 000	695 410	*Committed*	*ODA*	*Grant*	*Cross-cutting*	*Cross-cutting*	*Several projects*

Abbreviations: ODA = official development assistance, OOF = other official flows; USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[b] Parties should report, to the extent possible, on details contained in this table.

[c] Parties should explain, in their biennial reports, the methodologies used to specify the funds as provided, committed and/or pledged. Parties will provide the information for as many status categories as appropriate in the following order of priority: provided, committed, pledged.

[d] Parties may select several applicable sectors. Parties may report sectoral distribution, as applicable, under "Other".

[e] Parties should report, as appropriate, on project details and the implementing agency.

[f] Parties should explain in their biennial reports how they define funds as being climate-specific.

[g] Please specify.

[h] Cross-cutting type of support refers to funding for activities which are cross-cutting across mitigation and adaptation.

8.9.2. CTF Table 7(b) (EU-28): Provision of public financial support: contribution through bilateral, regional and other channels in 2011

Note: For some countries, more than one entry can be found. This means that more than one type of support (mitigation, adaptation or cross cutting) has been provided.

Recipient country/ region/project/programme[b]	Total amount Climate-specific/ EUR	USD	Status[c] Provided, Committed Pledged	Funding source ODA OOF Other[g]	Financial instrument Grant; Concessional loan; Non-concessional loan; Equity; Other[g]	Type of support Mitigation Adaptation Cross-cutting [h] Other[g]	Sector[d] Energy, Transport, Industry Agriculture Forestry Water and sanitation Cross-cutting Other [g]	Additional Information[e]
Afghanistan	24 000 000	30 848 329	Committed	ODA	Grant	Cross Cutting	Agriculture	
Algeria	13 600 000	17 480 720	Committed	ODA	Grant	Cross Cutting	Cross cutting	
Algeria	6 000 000	7 712 082	Committed	ODA	Grant	Adaptation	Other	
Bangladesh	12 100 000	15 552 699	Committed	ODA	Grant	Adaptation	Agriculture	
Belize	240 000	308 483	Committed	ODA	Grant	Adaptation	Other	
Bolivia	8 800 000	11 311 054	Committed	ODA	Grant	Adaptation	Water and Sanitation	
Burundi	6 400 000	8 226 221	Committed	ODA	Grant	Mitigation	Energy	
Burkina Faso	8 000 000	10 282 776	Committed	ODA	Grant	Cross Cutting	Forestry	
Cambodia	8 000 000	10 282 776	Committed	ODA	Grant	Adaptation	Agriculture	
Central African Republic	4 000 000	5 141 388	Committed	ODA	Grant	Cross Cutting	Forestry	
Chad	2 000 000	2 570 694	Committed	ODA	Grant	Cross Cutting	Other	
Chad	2 000 000	2 570 694	Committed	ODA	Grant	Mitigation	Other	
Congo (Brazzaville)	13 600 000	17 480 720	Committed	ODA	Grant	Mitigation	Transport	
Djibouti	40 500 000	52 056 555	Committed	ODA	Grant	Cross Cutting	Water and Sanitation	
Dominica	6 108 000	7 850 900	Committed	ODA	Grant	Cross Cutting	Other	
East Timor	4 000 000	5 141 388	Committed	ODA	Grant	Adaptation	Cross cutting	
Egypt	12 000 000	15 424 165	Committed	ODA	Grant	Mitigation	Energy	
Egypt	4 000 000	5 141 388	Committed	ODA	Grant	Cross Cutting	Cross cutting	
Gambia	1 900 000	2 442 159	Committed	ODA	Grant	Cross Cutting	Cross cutting	
Ghana	2 896 000	3 722 365	Committed	ODA	Grant	Cross Cutting	Agriculture	
Honduras	18 800 000	24 164 524	Committed	ODA	Grant	Cross Cutting	Forestry	
Jamaica	1 892 000	2 431 877	Committed	ODA	Grant	Adaptation	Other	
Kenya	2 701 600	3 472 494	Committed	ODA	Grant	Mitigation	Agriculture	
Kiribati	1 922 455	2 471 022	Committed	ODA	Grant	Adaptation	Water and Sanitation	
Lebanon	4 800 000	6 169 666	Committed	ODA	Grant	Cross Cutting	Cross cutting	
Lesotho	4 000 000	5 141 388	Committed	ODA	Grant	Adaptation	Cross cutting	
Liberia	2 000 000	2 570 694	Committed	ODA	Grant	Cross Cutting	Other	
Madagascar	13 600 000	17 480 720	Committed	ODA	Grant	Adaptation	Agriculture	
Malawi	4 000 000	5 141 388	Committed	ODA	Grant	Adaptation	Agriculture	

Recipient country/ region/project/programme[b]	Total amount Climate-specific/ EUR	USD	Status[c] Provided, Committed Pledged	Funding source ODA OOF Other[g]	Financial instrument Grant; Concessional loan; Non-concessional loan; Equity; Other[g]	Type of support Mitigation Adaptation Cross-cutting [h] Other[g]	Sector[d] Energy, Transport, Industry Agriculture Forestry Water and sanitation Cross-cutting Other [g]	Additional Information[e]
Malaysia	4 000 000	5 141 388	Committed	ODA	Grant	Cross Cutting	Forestry	REDD+ readiness
Morocco	37 000 000	47 557 841	Committed	ODA	Grant	Cross Cutting	Forestry	
Mozambique	2 000 000	2 570 694	Committed	ODA	Grant	Cross Cutting	Other	
Nicaragua	8 000 000	10 282 776	Committed	ODA	Grant	Cross Cutting	Forestry	
Palestine	5 780 000	7 429 306	Committed	ODA	Grant	Cross Cutting	Water and Sanitation	
Papua New Guinea	6 000 000	7 712 082	Committed	ODA	Grant	Mitigation	Other	
Philippines	2 400 000	3 084 833	Committed	ODA	Grant	Cross Cutting	Other	
Saint Lucia	4 140 000	5 321 337	Committed	ODA	Grant	Cross Cutting	Agriculture	
Saint Vincent and the Grenadines	3 972 000	5 105 398	Committed	ODA	Grant	Cross Cutting	Other	
Somalia	25 000 000	32 133 676	Committed	ODA	Grant	Cross Cutting	Agriculture	
Swaziland	2 800 000	3 598 972	Committed	ODA	Grant	Cross Cutting	Water and Sanitation	
Sudan	2 800 000	3 598 972	Committed	ODA	Grant	Adaptation	Agriculture	
Tanzania	20 604 000	26 483 290	Committed	ODA	Grant	Cross Cutting	Water and Sanitation	
Tonga	2 595 200	3 335 733	Committed	ODA	Grant	Cross Cutting	Energy	
Tuvalu	950 000	1 221 080	Committed	ODA	Grant	Mitigation	Energy	Also on Water and Sanitation
Uganda	12 200 000	15 681 234	Committed	ODA	Grant	Mitigation	Water and Sanitation	
Vanuatu	1 000 000	1 285 347	Committed	ODA	Grant	Cross Cutting	Energy	
Western Samoa	7 240 000	9 305 913	Committed	ODA	Grant	Adaptation	Water and Sanitation	
Zambia	4 440 000	5 706 941	Committed	ODA	Grant	Adaptation	Agriculture	
Regional ACP	27 705 562	35 611 262	Committed	ODA	Grant	Cross Cutting	Cross cutting	Transport Sector
Regional Africa	86 108 134	110 678 835	Committed	ODA	Grant	Mitigation	Energy	Including NIF
Regional Asia	34 400 000	44 215 938	Committed	ODA	Grant	Cross Cutting	Cross cutting	Including FLEGT Asia (Forestry) and SWITCH Asia
Regional Caribbean	26 000 000	33 419 023	Committed	ODA	Grant	Cross Cutting	Cross cutting	
Regional Latin America	47 000 000	60 411 311	Committed	ODA	Grant	Cross Cutting	Cross cutting	Including LAIF
Unspecified LDCs	14 824 984	19 055 249	Committed	ODA	Grant	Cross Cutting	Cross cutting	
Regional Eastern Europe and Central Asia	42 680 000	54 858 612	Committed	ODA	Grant	Mitigation	Energy	Including IFCA
Regional Oceania	7 200 000	9 254 499	Committed	ODA	Grant	Cross Cutting	Cross cutting	
Global	61 042 616	78 460 946	Committed	ODA	Grant	Cross Cutting	Cross cutting	Including 2012 AAP Part I; Sustainable Energy for All; CEPF and PMR;

Abbreviations: ODA = official development assistance, OOF = other official flows; USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[b] Parties should report, to the extent possible, on details contained in this table.

[c] Parties should explain, in their biennial reports, the methodologies used to specify the funds as provided, committed and/or pledged. Parties will provide the information for as many status categories as appropriate in the following order of priority: provided, committed, pledged.

[d] Parties may select several applicable sectors. Parties may report sectoral distribution, as applicable, under "Other".

[e] Parties should report, as appropriate, on project details and the implementing agency.

[f] Parties should explain in their biennial reports how they define funds as being climate-specific.

[g] Please specify.

[h] Cross-cutting type of support refers to funding for activities which are cross-cutting across mitigation and adaptation.

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