REPUBLIC OF CROATIA

MINISTRY OF ENVIRONMENT AND ENERGY

SEVENTH NATIONAL COMMUNICATION AND THIRD BIENNIAL REPORT OF THE REPUBLIC OF CROATIA UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC)

Zagreb, September 2018

CONTENTS

LIST OF ABBREVIATIONS

CAEN	Croatian Agency for Environment and Nature
CLC	Corine Land Cover
CMIP5	Coupled Model Intercomparison Project Phase 5
DZS	Croatian Bureau of Statistics
DHMZ	Meteorological and Hydrological Service
EC	European Commission
EE	Energy efficiency
EEA	European Economic Area
ETCCDI	Expert Team on Climate Change Detection and Indices
EU	European Union
EU ETS	EU Emissions Trading System
EUR	Euro
GCM	Global Climate Model
GDP	Gross domestic product
HERA	Croatian Energy Regulatory Agency
HRK	Croatian kuna
HROTE	Croatian Energy Market Operator
IPCC	Intergovernmental Panel on Climate Change
LULUCF	Land Use, Land-use Change and Forestry
NAPNAV	National irrigation program
NIR	National Inventory Report of the Republic of Croatia
NKD	National Occupational Classification
RegCM	Regional Climate Model
RES	Renewable energy sources
RH	Republic of Croatia
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WAM	With additional measures
WCRP/CLIVAR	World Climate Research Program: Climate and Ocean – Variability, Predictability, and Change
WEM	With existing measures
WMO	World Meteorological Organization
WMO/CCI	Commission for Climatology of the World Meteorological Organization
WOM	Without measures
ZERP	Ecological and Fisheries Protection Zone

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1. EXECUTIVE SUMMARY

1.1. INTRODUCTION

The Republic of Croatia became a party to the United Nations Convention on Climate Change (UNFCCC) on 17th January 1996 when the Croatian Parliament passed the law on its ratification (OG-IT 2/96). For the Republic of Croatia, the Convention came into force on 7th July 1996. As a country undergoing the process of transition to market economy, Croatia has, pursuant to Article 22, paragraph 3 of the Convention, took over the commitments of countries included in Annex I. By the amendment that came into force on 13 August 1998 Croatia was listed among Parties included in Annex I to the Convention.

The Republic of Croatia ratified the Kyoto Protocol in April 2007 and it entered into force on 28 August 2007. By ratifying the Protocol (OG-IT 5/07), the Republic of Croatia, as the Protocol Annex B party, took over the obligation of limiting the greenhouse gases emissions in the period 2008-2012 by 5% compared to total emission in the base year, i.e. 1990.

At the 18th Conference of the Parties to the Convention and the 8th Conference of Parties to the Kyoto Protocol, held in December 2012 in Doha, Qatar, Croatia agreed to be covered by the amendment to Annex B of the Kyoto Protocol. Obligations for the Republic of Croatia in the second binding period of the Kyoto Protocol, from 2013 to 2020, will be met jointly by the European Union and its Member States, and Iceland. In 2015. Croatian Parliament passed the Law on the Ratification on Doha Amendment on 25 September 2015 (OG-IT 06/15). Instrument of ratification has been deposited in December 2017. The Amendment will come into force in accordance with Articles 20 and 21 of the Kyoto Protocol, i.e. by the ratification of 144 Members, which has not yet been achieved[1].

The Paris Agreement (franc. *Accord de Paris*) is the climate agreement signed at the 21st Conference of the Parties (COP 21) of the Convention in Paris, 2015. The agreement was reached on 12th December 2015 and entered into force on 4th October 2016 after the ratification of the European Union. By December 2016 the agreement was signed by 194 Convention member states and 118 of them have ratified the agreement. The Republic of Croatia ratified the Paris Agreement on May 24th, 2017 and it entered into force in the Republic of Croatia on 23rd of June, 2017.

The Republic of Croatia is, pursuant to provisions in Articles 4 and 12 of the Convention, obliged to create a national greenhouse gas inventory and periodically national communication on climate change, according to which it reports on performing the obligations from the United Nations Framework Convention on Climate Change. Form and terms of submitting the national greenhouse gas inventory and national communication are defined by decisions and instructions of the Conference of Parties.

By accessing to the European Union (hereinafter referred to as the EU) on 1 July 2013, the Republic of Croatia has, due to the obligations arising from the EU acquis communautaire, implemented into its legal system obligations on reporting on implementation of policy and measures regarding the reduction of emissions and increase of greenhouse gases removal and long-term emission projections that will be periodically submitted to the EU authorities.

[1] Status on April 18th, 2018, https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-c&chapter=27&clang=_en.

Since 2002 the Republic of Croatia has prepared six national communications, whereat the Second, Third and Fourth National Communication were integrated into one national communication, while the last one, the Sixth National Communication was submitted to the Convention Secretariat in February 2014.

The content, format and deadline for submitting National Communications are given by the UNFCCC decisions. Decision 9/CP.16 established a deadline for the submission of the 7th National Report, with emission data for the period from 1990 to 2015. Instructions for drafting a national report are listed in the draft FCCC/SBI/2016/8 of 26th August 2016. (Annex I), the National Reporting Manual is set out in FCCC/CP/1999/7 (4/CP.5, pages 80-100), the Draft Report for the Preparation of the Fifth National Report to Parties to Annex I to the UNFCCC (Annotated outline for NC), including reporting elements according to the Kyoto Protocol and in the document "Preparation of the Biennial Report and 6th National Report of the European Union to the UNFCCC".

Moreover, in addition to the Seventh National Communication, a Third Biennial Report of the Republic of Croatia was prepared under the UNFCCC, in accordance with UNFCCC 2/CP.17 and 19/CP.18 Conferences of the Parties, and it is presented in the Appendix.

The emission calculation was made in accordance with the special instructions of the so-called. guidelines for reporting the numerical values in the standardized table system (CRF) and guidelines for the production of emission reports contained in the FCCC/CP/2002/8 document and in Decision 19/CP.18 (CTF tables for the UNFCCC, guidelines for making a two-year report for developed countries).

1.2. NATIONAL CIRCUMSTANCES

Social-political structure

The Republic of Croatia became an independent state on 8th October 1991 by a decision of the Croatian Parliament. The Croatian Constitution was adopted on 22nd December 1990. The Republic of Croatia is a member of the United Nations since 22nd May 1992 and the European Union since 1st July 2013. The state government is organized on the principle of powers division into the legislature (the Croatian Parliament), the executive (the President of the Republic, the Croatian Government) and the judicial power. The Croatian Parliament is a representative body of the citizens of the Republic of Croatia and is vested with legislative power. The government bodies comprise 20 ministries, 5 state administration offices, 7 state bureaus and 20 county offices of government bodies. The Ministry of Environmental and Energy is the central government authority in charge of administrative and expert environmental protection activities relating to the climate protection.

Population

According to the 2011 Census, the total number of inhabitants in the Republic of Croatia is 4 284 889, of which 2 218 554 women and 2 066 335 men. In 2011, there were 41 197 children born in the Republic of Croatia and 51 019 persons dead, which make negative natural population growth of 9 822 persons. Since 2009 the Republic of Croatia registers negative migration saldo. The area of the Republic of Croatia is not equally populated. In 2011, the average population density amounted 75.7 inhabitants/km^2 with range of 9.5 (Lika-Senj County) to 1 232.5 inhabitants/km^2 (City of Zagreb).

Economy

In the Republic of Croatia, an increase in real economic activity of 2.3% was recorded in 2015, which means the halt of six-year negative trends. A majority of other macroeconomic indicators also recorded slightly favourable trends in relation to the previous period. In 2015, the gross domestic product (GDP) amounted 338.98 billions of HRK (44.55 billions of EUR), which amounts HRK 80 555 per capita (EUR 10 586 per capita).

Geographic profile and land use

According to its position, the Republic of Croatia belongs to the Central European, Adriatic-Mediterranean and Pannonia-Danube group of countries. Total area of the Republic of Croatia amounts 87 661 km^2. The inland area amounts 56 594 km^2, while the area of territorial sea and internal sea waters amounts 31 067 km^2. Total length of inland borders of the Republic of Croatia towards neighbouring countries amounts 2 374.9 km (including river borders). The length of sea coast amounts 6 278 km (29.9 % of inland, 70.1 % of islands). The state sea border is 948 km long and extended at outer boundary of territorial sea. The Ecological and Fisheries Protection Zone of 23 870 km^2 reaches epicontinental border between the Republic of Croatia and Italy. In 2014, agricultural area occupied 27.48 %, while forest area occupied 34.35 % of the Republic of Croatia territory. The protected areas occupied 8.49 % of the territory of the Republic of Croatia ie 12.20% of terrestrial territory and 1.94 % of territorial sea. Majority of protected area are nature parks (4.54 % of total state territory).

Climate

According to Köppen classification for a standard period 1961-2010, the largest part of the Republic of Croatia belongs to the climate type C, a moderately warm rainy climate characterised by a mean monthly temperature ranging between -3 °C and +18 °C in the coldest month. Only the highest parts of mountains (above 1 200 m) of Lika and Gorski kotar have a snowy forested climate (class D) with a mean temperature below -3 °C in the coldest month. The annual mean air temperature in the lowland area of northern Croatia is 10-12 °C, at altitudes above 400 m it is lower than 10 °C and in the mountains it is 3 – 4 °C. In the coastal area it is 12 – 17 °C. The coldest regions of the Republic of Croatia are those of Lika and Gorski kotar, with the temperatures ranging between 8 °C and 10 °C at lower elevations and 2 °C and 4 °C on the highest peaks of the Dinara mountain range. Mean annual quantity of precipitation in the Republic of Croatia ranges from 600 mm to 3 500 mm. The mean annual precipitation attains a maximum quantity of up to 3 500 mm on the peaks of Gorski kotar (Risnjak and Snježnik). The least precipitation in Croatia is recorded on the outer islands of the central Adriatic (less than 400 mm) and in the eastern Slavonia and Baranja (up to 700 mm). Central Croatia has annual precipitation between 900 and 1 000 mm. The amount of precipitation in the Pannonian region decreases from the west towards the east. From the coast towards the inland the precipitation increases. The prevalent wind directions in the interior of the Republic of Croatia are the northeast and, to a lesser extent, southwest. The wind force is most often light to moderate. The sunniest parts of the Republic of Croatia are the outer islands of the middle Adriatic (Vis, Lastovo, Biševo and Svetac) and the western shores of the islands of Hvar and Korčula, with more than 2 700 sunshine hours each year. The coastal zone of Middle and South Adriatic are the fairest part of the Republic of Croatia with the annual cloudiness of 4/10 or 4.5/10. The majority of inland places in the Republic of Croatia have 1 700 – 2 000 hours of sunshine. The annual largest cloudiness is recorded in Gorski kotar (6-7/10), which has the least hours of sunshine yearly – about 1 700.

Energy

Primary energy generation in 2015 was decreased by 6.7 % from the previous year. Due to unfavourable hydrology, hydro power utilization decreased by as much as 30.7 %. The production of natural gas, crude oil and heat generated by use of heat pumps has increased. The natural gas production increased by 1.8 %, of crude oil by 12.7 % and of heat by 20.3 %. The production of fuel wood and biomass and of other renewables increased in 2015 by 10.7 % in relation to 2014. Renewable energy sources include wind energy, solar energy, geothermal energy, biodiesel and biogas, which total generation in 2015 increased by 3.4 % in relation to 2014. Total energy import in the Republic of Croatia increased by 0.8 % in the six year period 2010 - 2015, whereat the import of natural gas decreased, while the import of electricity, coal and coke, crude oil petroleum products and fuel wood and biomass increased. In relation to 2014, energy consumption in industry in 2015 decreased by 4.5 %. Energy consumption in transport was also increased by 4.5 %, as well as energy consumption in other sectors by 7.9 %.

Transport

The total length of public roads in 2016 was amounted to 26 953 km. Number of road vehicles in 2016 was amounted to 1 996 056 of which 77.7 % were passenger cars, 7. 3 % heavy duty vehicles, 0.2 % buses and 3.2 % of motorcycles. In the period 2007-2016 the total number of motor vehicles increased by 2.3 %. Most passengers are transported by road and railway transport, and the most goods by road, sea water and coastal transport. The length of railway lines has decreased since 2006 with a total of 2 604 km of which 2 350 km are single track and 254 km of double track railway. In 2016, a total of 970 km of railway lines were electrified, which amounts to 37.3 % of the total railway length. The Republic of Croatia has six ports of international economic interest in the cities: Rijeka, Zadar, Šibenik, Split, Ploče and Dubrovnik. The network of inland waterways of the Republic of Croatian is 804 km, of which 539 km are international waterways. Inland ports open to international public transport are: Osijek, Sisak, Slavonski Brod and Vukovar. The Republic of Croatia has 7 international airports: Zagreb, Split, Dubrovnik, Zadar, Osijek, Rijeka and Pula and 3 national airports: Brač, Mali Lošinj and Osijek for aircraft in commercial air transport. Pipeline transport includes transport of oil and gas. The length of the oil pipeline in 2016 amounted to 610 km and has not changed since 2005. The length of the gas pipeline in 2016 was amounted to 2 693 km and is steadily increasing.

Industry

Until the recession, industrial production in the Republic of Croatia was covered a significant place in the overall production. Manufacturing, petrochemical industries and shipbuilding especially stood out. Some companies were abolished in transition process and some were destroyed during war. Above mentioned mainly refers to companies that manufacture textiles, leather, metal and wood products. The production in construction and energy sectors was also significant. Some industry still continues to generate positive results and participate in international trade. The sale value of industrial products in 2016 amounted to HRK 120.48 billion. The value of sales on the foreign market amounted to HRK 53.55 billion, which is 44.5 % of the total value of industrial products sold. According to the total income, the leading industries were manufacturing and electricity, gas, steam and air conditioning supply. In exports, the most common industry were manufacture of refined petroleum products (9.1 %), food products (8.1 %), pharmaceutical products (6.8 %), chemical products (5.6 %), wood and products of wood (5.3 %).

Waste management

A total of 1 679 765 tonnes of municipal waste was produced in 2016. All municipalities and cities had organized collection and disposal of municipal waste. The annual amount of communal waste per capita was 392 kg. The share of mixed municipal waste in collected waste accounted for 74 % or 1 251 299 tonnes. The share of other types of communal waste in total municipal waste amounted to 26 %. Of the total quantity of wastes collected separately from municipal waste, only 21% (353 823 t) has been directly addressed to recovery. Production of biodegradable municipal waste per capita increased from 158 kg in 1997 to 250 kg in 2015. Around 20% of the total biodegradable municipal waste produced (1 072 439 t) was sent to recovery which is an increase of 2% in comparison with 2014. Amout of 29 989 t of bio-waste was composted from municipal waste. The recycling rate from municipal waste was 27%.

Construction and housing

Construction of buildings in the Republic of Croatia has continued a negative trend from 2004. The number of completed residential buildings was decreased by 4.2 % in 2015 comparing to 2014. Number of dwellings, however, showed upward trend for the first time after 2007. In 2015, 3.2 % more dwellers were constructed comparing to 2014. The number of completed non-residential buildings decreased by 14.7 % comparing to 2014. In the same period, out of all completed non-residential buildings, the most reductions were in Traffic and communication buildings, Public entertainment, education, hospital or institutional care buildings and Other non-residential buildings.

Agriculture

In 2016 from the total agriculture area (2.7 mil. ha) intensively used agricultural land was 1 546 019 ha which represents 27.31 % of the total land area of the Republic of Croatia. In the period from 2007 until today, there is a positive trend in the use of agricultural land in the Republic of Croatia. In 2016, the biggest share of 56.4 % take category of oranges and gardens and permanent grassland with 38.8 % which also shows an increase in the trend of use since 2007. The number of livestock in 2016 has declined compared with 2008. Total catches in 2016 amounted to 85 028 tonnes, of which 80.37% is blue fish, while remaining are other species of fish, oysters, shellfish and molluscs. Mariculture includes fish farms for white fish, blue fish and shellfish. The total production of freshwater fish in 2016 amounted about 4 099 tonnes, of which about 66% were carp cultivation. In 2016 total of 3 249 tonnes of young fish were raised.

Forestry

Pursuant to the Forest Management Plan in force for the period 2016-2025, total forest and forest land area in the Republic of Croatia amounted 2 759 039.05 ha in 2016, which as regarding total inland area of the Republic of Croatia represents forest cover of 49 %. Out of total forest area, productive forest land with tree cover amounts 2 492 676.33 ha (90 %) and the rest is productive forest land without tree cover (productive, non-productive and unfertile land). In total forest area, 76 % of forests is owned by the state, managed by the company Hrvatske šume Ltd., while the rest is privately owned. The Forest Management Plan in force determines growing stock of about 418 618 277 m^3 while its yearly increment amounts about 10.1 millions of m^3. The most abundant broadleaves in total growing stock are: Common beech 37.2 %, Pedunculate oak 11.6 %, Sessile oak 9.4 %. The most representative conifers are: Silver fir 7.9 %, Spruce 2.3 %, Black alder 2%, Black pine 1.4 %.

Inland waters and coastal area

All surface and ground waters are part of either Black Sea or Adriatic catchment area with the watershed running along the mountain and alpine area. Large watercourses dominate the Black Sea catchment area. In the Adriatic catchment area, the abundance and the length of surface watercourses are significantly lower. The majority of large watercourses of the Black Sea catchment area is of interstate significance (boundary or cross-border). The river of Danube is the largest and richest in water, flowing through the eastern borderland of the Republic of Croatia, while the rivers of Sava and Drava have the longest courses in the Republic of Croatia. There are not many natural lakes in the Republic of Croatia. The largest natural lakes are Vrana Lake near Pakoštane, Dubravsko, Peruća, Prokljan Lake and Vrana Lake on the island of Cres. The Republic of Croatia is also characterized by significant wetland areas. Locations included in the Ramsar list are: Kopački rit in the Drava and Danube cathments, Lonjsko and Mokro polje and Crna Mlaka in the Sava catchment, lower Neretva part in the Adriatic catchment and Vrana Lake near Pakoštane. The Adriatic Sea is the northernmost part of the Mediterranean Sea. The total length of Croatian coast is 6 278 km, out of which 1 800 km belongs to the mainland and 4 200 km to the island coastline. The highest measured depth is 1 233 m. The Croatian islands include almost all islands of the Adriatic eastern coast and its central part making the second Mediterranean archipelago by size. There are 1 244 islands which are geographically distinguished as 79 islands, 525 islets, 640 cliffs (top above sea-level) and reefs (top below sea-level).

Other national circumstances

Contamination with mines left over as a result of the war operations in the Republic of Croatia causes a whole range of economic, developmental and social disturbances, in particular, the problem of security of the population in areas that were in the fields of war. Defined size of mine suspected area in the Republic of Croatia on the 1st January 2017 was amounted to 446.6 km^2, which present 0.75 % of the land area of the Republic of Croatia. The largest share in the mine suspected area of the Republic of Croatian consists of forest areas with 92.6 % of total mine suspected area, then agricultural area with 7.1 % of suspected hazardous area. Counties of Lika-Senj, Sisak-Moslavina and Osijek-Baranja are the most mine polluted counties accounting for 62 % of total mine polluted areas in the Republic of Croatia.

1.3. TRENDS IN GREENHOUSE GAS EMISSIONS

In this report the results of the greenhouse gas (GHG) emissions and removals calculation are presented for the period from 1990 to 2015. Inventory involves calculation of emissions which are the result of anthropogenic activities and these include the following GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), halogenated carbons (HFCs, PFCs) and sulphur hexafluoride (SF_6) and indirect GHGs: carbon monoxide (CO), oxides of nitrogen (NO_X), nonmethane volatile organic compounds (NMVOCs) and sulphur dioxide (SO_2). The GHGs covered by Montreal Protocol on the pollutants related to ozone depletion (freons) are reported in the framework of this protocol and therefore are included in a separate report.

The total GHG emissions in 2015, excluding removals by sinks, amounted to 23 502.1 kt CO_2-eq, which represents 24.6 % emission reduction compared to GHG emission in the year 1990.

Overall decline of economic activities and energy consumption in the period 1991-1994, which was mainly the consequence of the war in Croatia, had directly caused the decline in total emissions of GHGs in that period. Some energy intensive industries reduced their activities or phased out certain productions, which was considerably reflected in GHG emissions reduction. Emissions have started to increase in the 1995 at an average rate of almost 3 % per year, till 2007. Due to decreasing of economic activity and other factors within the period 2008-2014, emissions have been reducing at the average rate over around 4 % annually until 2014. In 2015, the emissions grew 2 5 compared to 2014.

The main reasons of GHG emission increase in the period 1995-2007 were in Energy sector (sub-sectors Public electricity and heat production and Transport), Industrial processes (subsectors Cement production, Lime production, Ammonia production, Nitric acid production and Consumption of HFCs) and Waste sector (sub-sectors Solid waste disposal on land and Waste water handling).

The main reason for GHG emission decrease in the period 2008-2014 was economic crisis and only partially it was due to the implementation of measures for the reduction of GHGs. Namely, because of the economic crisis, there was decrease in industrial production and consequently, decrease in fuel consumption (greatest reduction in fuel consumption was in Manufacturing industries and construction sector and also in Transport sector), as well as a reduction in cement, lime and steel productions, which was contributed to the GHG emission decrease.

The trend of aggregated emissions, divided by sectors, is shown in Figure 1-1.

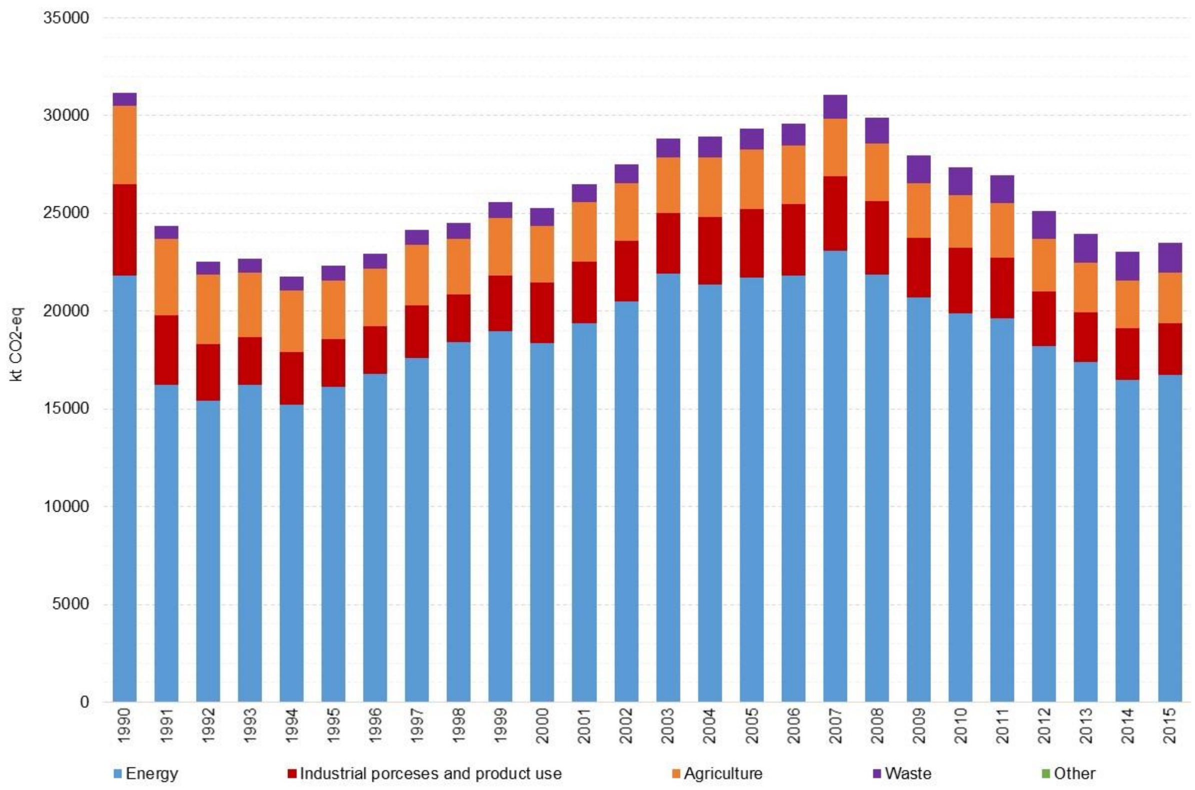

Figure 1-1: Trend of GHG emissions, by sectors

The most important IPCC sector in Croatia is Energy sector, which accounted for 71.2 % of the total national GHG emissions in 2015. In 2015, the GHG emission from Energy was 1.6 % higher compared to 2014 and 23.4 % lower compared to 1990. The total energy consumption in 2015 was 0.9 % lower than in the previous year. There was an increase in renewable energy sources (excluding hydro) while consumption of natural gas, liquid fuels and coal and coke decreased. However, due to poor hydrology conditions, hydro power energy supply decreased by 30.7 % with relation to the 2014. During the observed period between 1990 and 2015 in Croatia only 14 to 32 % of Croatian electricity demands were covered by thermal power plants. The largest contribution to electricity production in Croatia had hydro power plants 36 to 69 %. In 2015, the import of electricity was about 50 % of total electricity consumption in Croatia.

Industrial Processes and Product Use contributed to total GHG emission with 11.3 % in 2015. The emissions from this sector in 2015 decreased by 0.8 % compared to 2014, which is a 42.4 % decrease compared to 1990. GHG emissions fluctuate during reporting period with the following pattern: emissions from industrial processes declined from 1990 to 1995, due to the decline in industrial activities caused by the war in Croatia, while in the period 1996 - 2008 emissions slightly increased due to revitalization of the economy; the trend from 2008 onwards is dominated by the effects of the economic crisis, followed by a moderate recovery since 2013.

Agriculture contributes to total GHG emission with 10.9 % in 2015. The GHG emissions from Agriculture have been decreasing from 2006 mainly due to the decrease in the number of cattle. The GHG emission in 2015 was 36.7 % lower compared to 1990.

Waste contributes to total GHG emission with 6.6 % in 2015. Emissions from Waste sector have been constantly increasing in the period 1990-2015 as a consequence of greater quantities of waste, activities in waste water handling and waste incineration. The GHG emission in 2015 was 237.5 % higher compared to 1990.

The trend of aggregated emissions, divided by gasses, is shown in Figure 1-2

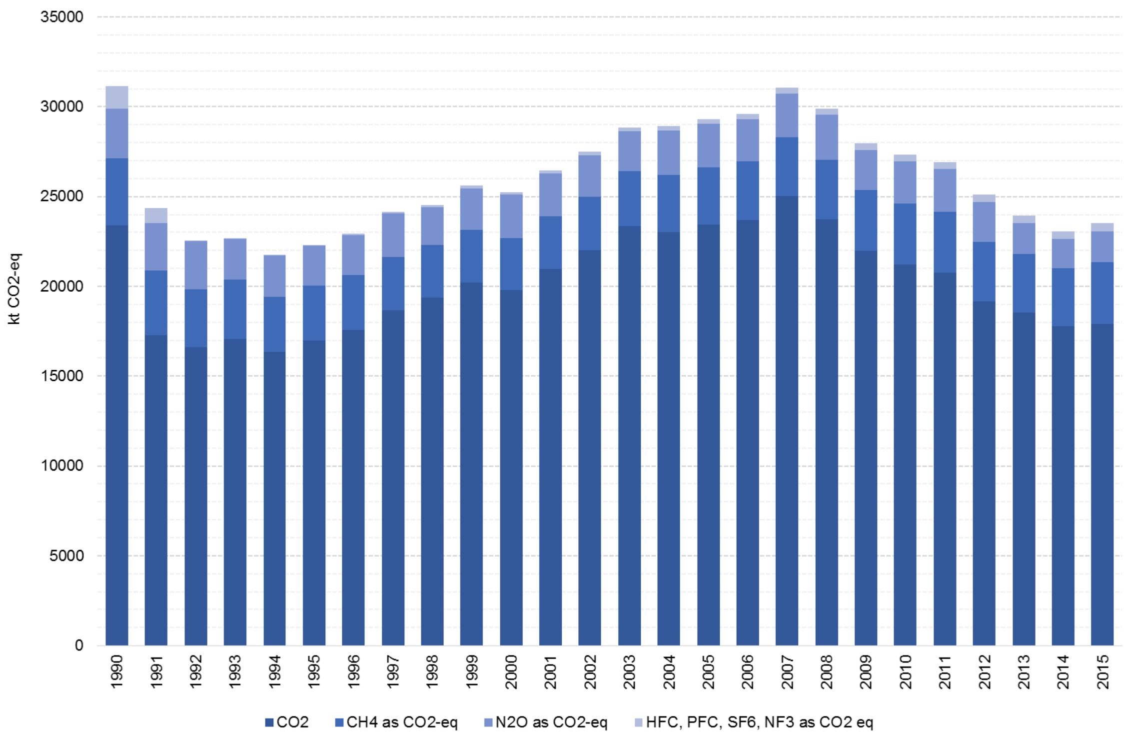

Figure 1-2: Trend of GHG emissions, by gases

The shares of GHG emission have not significantly changed during the entire period. In 2015, the shares of GHG emissions were as follows: 76.2 % CO_2; 14.6 % CH_4; 7.3 % N_2O; 1.7 % HFCs and PFCs and 0.02 % SF_6.

1.4. POLICIES AND MEASURES

Policies and measures to reduce emissions and mitigate climate change are in the function of fulfilling the internationally undertaken commitments of the Republic of Croatia within the framework of the UNFCCC and the EU acquis, and are the starting point for the long-term development of the low-emission economy.

The Republic of Croatia has fulfilled its obligations under the Kyoto Protocol to reduce greenhouse gas emissions by 5 % over the period 2008-2012 compared to 1990. By joining the EU, the Republic of Croatia has taken on a common European goal of reducing greenhouse gas emissions by 20 % by 2020 compared to 1990. By the Paris Accords, the EU committed itself to reduce greenhouse gas emissions by 40 % compared to 1990, by 2030.

The emission reduction obligation of the EU Member State is jointly implemented through the European Emission Trading System (EU ETS). A common 'cap' was established for the EU ETS system, in which 52 facilities from Croatia are also included. The emissions and sectors not covered by the EU ETS, the annual national allocation quotas are determined for the Member States and they must not be exceeded. These quotas are established on the basis of solidarity. A debate on the Proposal for a Regulation on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 for a resilient Energy Union and to meet commitments under the Paris Agreement has finished and the publication in the Official Journal of the EU is expected soon, and for the Republic of Croatia the goal of reducing emissions by 7 % compared to the 2005 level is determined. The EU set a goal of reducing emissions by at least 80 % compared to 1990 in 2050 in the Roadmap for the transition to a low-carbon economy by 2050 (COM (2011) 112).

An important role in the implementation of policies and measures to reduce greenhouse gas emissions is in the potential to use European structural and investment funds within the Common Strategic Framework to fund programs and projects that fulfil the strategic goals of the EU, including the reduction of greenhouse gas emissions, presented in the document "Europe 2020 a strategy for smart, sustainable and inclusive growth" (COM (2010) 2020 final). It should be stressed that at least 20 % of the total EU budget for the period 2014-2020 have to be allocated to the implementation of policies, measures and projects related to mitigation and adaptation to climate change, including the integration of this theme into other sectorial policies (developmental, agricultural, cohesion and so on).

The basic planning document that defines targets, priorities and measures for the reduction of greenhouse gas emissions for each five-year period, and the manner, order, deadlines and obligations of the implementation of the measures is the Plan for the protection of air ozone layer and mitigation of climate change in the Republic of Croatia for the planned period from 2018 to 2020. The measures provided in this Plan ensure the implementation of Croatian regulations as well as the acquis communautaire that has been transposed into the legislation of the Republic of Croatia in the field of air, ozone layer and mitigation of climate change. The Plan hasn't been adopted yet for the referenced period.

The Republic of Croatia has prepared a Draft of the Low-carbon Development Strategy of the Republic of Croatia by 2030 with a view to 2050 [2]. It is a multi-sectorial development strategy and a base for emission reduction by sectors in line with European strategic guidelines and UNFCCC commitments. This Strategy should provide a transition towards a low-carbon and competitive economy whose growth is based on sustainable development. The Strategy has gone through public consultations but has not yet been adopted. Also, the new Energy Development Strategy of the Republic of Croatia is in the process of preparation.

Below is an overview of policies and measures for reducing emissions and increasing greenhouse gas emissions in the Republic of Croatia which are implemented or planned:

Energy:

- MEN-1: National Plan for the Increase of the Number of Nearly-Zero Energy Buildings;
- MEN-2: Program for energy renovation of the apartment buildings;
- MEN-3: Program for the increase of energy efficiency and use of renewable energy sources in commercial non-residential buildings;
- MEN-4: Program for the Energy Renovation of the Family Dwellings;
- MEN-5: Program for the energy renovation of public buildings;
- MEN-6: Energy management in the public sector;
- MEN-7: Measurement and informative calculation of energy consumption;
- MEN-8: Labelling the energy efficiency of household appliances;
- MEN-9: Eco-design of energy-using products;
- MEN-10: Promotion of energy efficiency and implementation of measures through energy services model;
- MEN-11: Program for the reduction of energy poverty;
- MEN-12: Education in the area of energy efficiency;
- MEN-13: National Program for the Energy Efficiency in Public Lighting;
- MEN-14: Green public procurement;
- MEN-15: Energy audits in industry;
- MEN-16: Industrial Energy Efficiency Network (MIEE);
- MEN-17: Increase of the use of renewable energy sources and energy efficiency in industry sector;
- MEN-18: Feed-in tariffs and premium system for the support of the the use of renewable energy sources in electricity generation and for the efficient cogeneration;
- MEN-19: Program for the Energy Efficiency in Heating and Cooling;
- MEN-20: Promotion of the use of renewable energy sources and energy efficiency by HBOR-a (Croatian Bank for Reconstruction and Development);
- MEN-21: Promotion of the use of renewable energy sources and energy efficiency by FZOEU (Environmental Protection and Energy Efficiency Fund) resources;
- MEN-22: CO2 emission tax on the non-ETS stationary sources;
- MEN-23: Revitalization and energy efficiency in existing thermal and hydro power plants;
- MEN-24: Reconstruction and renovation of the heating and steam network;
- MEN-25: Operation of power system and development of the transmission and distribution network.

Transport:

- MTR-1: Providing information to consumers on fuel economy and CO2 emission of new passenger cars;

- MTR-2: Training for drivers of road vehicles for eco-driving;
- MTR-3: Obligation for the use of biofuels in transport;
- MTR-4: Special fee for environment on the motor vehicles;
- MTR-5: Special tax on motor vehicles;
- MTR-6: Financial incentives for the purchase of plug-in hybrid and electric vehicles;
- MTR-7: Development of infrastructure for alternative fuels;
- MTR-8: Promotion of integrated and intelligent transport systems and alternatives fuels in urban areas;
- MTR-9: Monitoring, reporting and verification of greenhouse gas emissions in the lifetime of liquid fuels.

Industrial processes:
- MIP-1: Reducing emissions of volatile organic compounds in solvent use sector;
- MIP-2: Handling of substances that deplete the ozone layer and fluorinated greenhouse gases;
- MIP-3: Technical and organizational measures for collection, reuse, recovery and destruction of controlled substances and fluorinated greenhouse gases;
- MIP-4: Capacity building and strengthening knowledge of authorized repairers;
- MIP-5: Leakage detection of controlled substances and fluorinated greenhouse gases;
- MIP-6: A fee to cover the costs of collection, reuse, recovery and destruction of controlled substances and fluorinated greenhouse gases.

Waste management:
- MWM-1: Preventing the generation and reducing the amount of municipal waste;
- MWM-2: Increasing the amount of separately collected and recycled municipal waste;
- MWM-3: Methane flaring;
- MWM-4: Reducing the amount of disposed biodegradable municipal waste;
- MWM-5: Use of biogas for electricity and heat generation.

Agriculture:
- MAG-1: Change in the diet of cattle and pigs and animal feed quality;
- MAG-2: Anaerobic decomposition of manure and biogas production;
- MAG-3: Improving cattle facilities and system of animal waste management;
- MAG-4: Improvement of mineral fertilizers application methods;
- MAG-5: Hydromeliorative interventions and systems of protection against natural disasters;
- MAG-6: Introduction of new cultivars, varieties and cultures;
- MAG-7: Rural Development Programme of the Republic of Croatia for the Period 2014-2020.

LULUCF:
- MLF-1: Improving the reporting in LULUCF sector;
- MLF-2: Preparation of cost-benefit analysis of afforestation on new areas and natural regeneration of forests as a measure of increasing sinks in LULUCF sector;
- MLF-3: Implementation of Action plan for LULUCF sector.

Other (cross-cutting) policy and measures:
- MCC-1: Committee for cross-sectoral coordination of policies and measures for mitigation and adaptation to climate change;
- MCC-2: System for the Measurement and Verification of Energy Savings;

- MCC-3: Promotion of the use of innovative information and communication technologies (ICT) to reduce greenhouse gas emissions;
- MCC-4: Emissions Trading System;
- MCC-5: Use of funds obtained from the sales of EU ETS emission allowances through auctions for the GHG emission reduction measures;
- MCC-6: Implementation of interdisciplinary research on the potential of geological storage of CO_2 in the Republic of Croatia;
- MCC-7: Energy efficiency obligation scheme.

1.5. PROJECTIONS AND THE TOTAL EFFECTS OF POLICIES AND MEASURES

Projections are presented for three scenarios: the ‘without measures’ scenario, ‘with measures’ scenario and ‘with additional measures’ scenario. Scenario ‘without measures’ assumes that implementation of adopted policies and measures as well as implementation of planned policies and measures, will not happen. Scenario ‘with measures’ assumes a consistent application of policies and measures, which application is already in progress and the application of adopted policies and measures, which application is likely, but still not begun. Scenario ’with additional measures’ is based on the application of planned policies and measures. Historical emissions and total projections of greenhouse gas emissions are presented below until 2035.

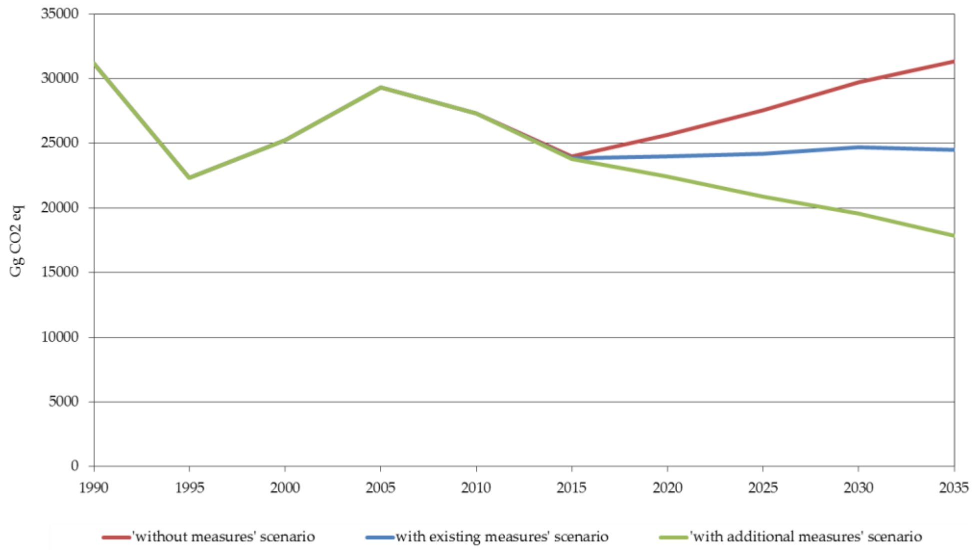

Figure 1-3: Total projections of greenhouse gas emissions (without LULUCF) for period until 2035

Table 1-1: Historical emissions and projections of greenhouse gas emissions by sectors, kt CO_2-eq

'Without measures' scenario	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Energy	17.951	12.754	13.851	16.169	13.952	11.496	11.975	13.098	14.395	15.215
Transport	3.881	3.368	4.499	5.561	5.952	5.703	6.050	6.373	6.692	6.973
Industry	4.629	2.441	3.128	3.508	3.315	2.781	3.157	3.287	3.457	3.626
Waste management	654	740	889	1.045	1.392	1.612	1.931	2.205	2.450	2.708
Agriculture	4.039	3.008	2.888	3.030	2.718	2.414	2.523	2.591	2.713	2.820
TOTAL	**31.154**	**22.310**	**25.255**	**29.312**	**27.329**	**24.006**	**25.636**	**27.553**	**29.707**	**31.341**
'With existing measures' scenario	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
Energy	17.951	12.754	13.851	16.169	13.952	11.433	11.169	10.944	10.967	10.434
Transport	3.881	3.368	4.499	5.561	5.952	5.603	5.422	5.514	5.595	5.561
Industry	4.629	2.441	3.128	3.508	3.315	2.781	3.009	3.060	3.147	3.229
Waste management	654	740	889	1.045	1.392	1.599	1.854	2.072	2.256	2.444
Agriculture	4.039	3.008	2.888	3.030	2.718	2.414	2.523	2.591	2.713	2.820
TOTAL	**31.154**	**22.310**	**25.255**	**29.312**	**27.329**	**23.830**	**23.977**	**24.182**	**24.677**	**24.488**
'With additional measures' scenario	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
Energy	17.951	12.754	13.851	16.169	13.952	11.412	10.847	9.741	8.840	7.677
Transport	3.881	3.368	4.499	5.561	5.952	5.599	5.421	5.128	4.827	4.286
Industry	4.629	2.441	3.128	3.508	3.315	2.781	2.447	2.484	2.547	2.586
Waste management	654	740	889	1.045	1.392	1.597	1.449	1.185	974	845
Agriculture	4.039	3.008	2.888	3.030	2.718	2.387	2.266	2.318	2.395	2.459
TOTAL	**31.154**	**22.310**	**25.255**	**29.312**	**27.329**	**23.777**	**22.430**	**20.855**	**19.583**	**17.854**

1.6. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

Climate change in Croatia over the period 1961–2010 has been determined by trends in annual and seasonal mean air temperature, mean minimum and mean maximum temperature; and in indices of temperature extremes; then in precipitation amounts and precipitation indices, as well as in dry and wet spells.

Over the past 50 years (1961 – 2010), the air temperature trends (mean, mean minimum and mean maximum) indicate the trend of warming throughout the Republic of Croatia. Annual air temperature trends are positive and significant, and changes are greater in the continental part of the country than on the coast and in the Dalmatian hinterland. The observed warming is also reflected in all the temperature extremes indexes with the positive trends of warm temperature indices (warm days and nights and duration of warm periods) and negative trends of cold temperature indices (cold days and cold nights and the length of cold periods).

Likewise, over the past 50 years (1961 –2010), annual rainfall shows predominant non-significant trends, which are positive in the eastern lowlands and negative in other parts of the Republic of Croatia. A statistically significant reduction of rainfall was observed at the meteorological stations in the mountain region of Gorski kotar and in Istria as well as in the southern coastal area.

Weather changes of dry and rainy periods in the Republic of Croatia are shown by annual and seasonal trends of their maximum duration. According to the trends, the most significant changes in the dry periods were in the autumn months when a statistically significant negative trend was observed throughout the Republic of Croatia. In other seasons, the trend of dry periods for both categories is weaker than in the autumn.

The latest results of the climate projections for the Republic of Croatia were published AS part of the "Draft Climate Change Adaptation Strategy in the Republic of Croatia for the period to 2040 with a view to 2070(White book)". The results were obtained using the RegCM model at a spatial resolution of 12.5 km and they indicate a similarity in the modeled air temperature and total rainfall patterns and on basically derived sizes such as those obtained in 50 km simulations. The mean seasonal air temperatures of 2 m and the resulting temperature values indicate a very likely possibility of warming in all seasons with the amplitude of changes as a function of scenario and time horizon and regional part of the Republic of Croatia. Depending on the temperature parameter, the projected heat range is 1 to 2.7 °C in relation to the reference period 1971–2000. The changes in mean seasonal precipitation amounts depend on the season: winter amounts are expected to increase and summer rainfall is expected to be reduced within the whole the territory of the Republic of Croatia. Projections for maximum wind speeds of 10 m indicate much greater variability (and unreliability) in the signal of climate change and in dependence to spatial resolution.

1.7. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

Article 4, paragraph 3 of the Convention stipulates that the Parties to the Convention which are developed and other developed parties included in Annex II shall provide new and additional financial resources to fully meet the costs incurred by the developing country Parties in meeting their obligations under Article 12 Paragraph 1. They shall also provide financial means, including those for the transfer of technology required by developing country Parties in order to fully comply with the costs incurred for the implementation of the measures covered by Article 4, paragraph 1 of the Convention.

In this sense, the Air Protection Act stipulates the use of revenues from the greenhouse gas emissions auctioning, including the financing of mitigation measures for climate change and adaptation in third countries. The development of the Plan for using of these funds is also stipulated and it should be adopted by the Government of the Republic of Croatia. The plan for the use of funding from the auction for the period until 2020 was adopted in February 2018. It is foreseen that in that period the Republic of Croatia will finance mitigation measures and adaptation to climate change in the third countries.

1.8. RESEARCH AND SYSTEMATIC OBSERVATION

Global Climate Observation System

The Global Climate Observation System (GCOS) was established in 1992 and the Republic of Croatia, represented by the state Meteorological and Hydrological Service, has been a member since the establishment. This system includes monitoring in all parts of the climatic system: atmosphere, sea and land. GCOS's mission is to define and cover the monitoring of all necessary climate monitoring requirements including satellite monitoring at the global, regional and national level and create conditions for improving the monitoring system.

The Global Observation System (GEOSS) is a relatively new initiative for coordinating and improving the existing global surveillance systems to meet customer requirements on natural disasters, health, energy, climate, water, weather, ecosystems, agriculture and biodiversity. The Republic of Croatia joined GEOSS in 2004.

Data collection and systematic monitoring in the Republic of Croatia

The Croatian institutions that maintain observation systems in the atmospheric, sea, land and biological diversity areas are: Meteorological and Hydrological Service, Croatian Agency for Environment and Nature, Ministry of the Sea, Transport and Infrastructure, Ministry of Environment and Energy, Institute for Medical Research and Occupational Health, Croatian Institute of Public Health, Institute of Oceanography and Fisheries, Hydrographic Institute of the Republic of Croatia, Ruđer Bošković Institute, Andrija Mohorovičić Geophysical Institute and Croatian Forest Research Institute.

1.9. EDUCATION, TRAINING AND PUBLIC AWARENESS

The education system in the Republic of Croatia consists of pre-school education, primary education, secondary education and higher education. The Ministry of Science and Education, in whose scope the institutional education is, considers that the ecological awareness of pupils has to develop throughout the education system and also environmental education has to be carried out. Education on Climate Change does not exist as a separate theme in curriculum and activity is already contained in environmental education, or in concise form in some regular subjects. The number of workshops, seminars, roundtables and various printed publications on the subject of climate change and the related themes are gradually increasing in many Croatian institutions. The civil sector in the field of environmental protection in the Republic of Croatia, and in particular some associations, were intensively educational and project-oriented in the period 2014-2017 on topics related to climate change.

There are a number of reputable professional institutions operating in the Republic of Croatia which, over a longer period, conduct continuous informational and educational project activities, education and training of professionals, as well as interested public and economic entities on climate change and specific measures and instruments for mitigating them.

2. NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

2.1. SOCIAL-POLITICAL STRUCTURE

The Republic of Croatia became an independent state on 8th October 1991 by a decision of the Croatian Parliament. The Croatian Constitution was adopted on 22nd December 1990. The Republic of Croatia is a member of the United Nations since 22nd May 1992 and the European Union since 1st July 2013.

The state government is organized on the principle of powers division into the legislature (the Croatian Parliament), the executive (the President of the Republic, the Croatian Government) and the judicial power. The Croatian Parliament is a representative body of the citizens of the Republic of Croatia and is vested with legislative power. Under the Constitution, the Croatian Parliament is a unicameral representative body which may have at least 100 and no more than 160 members on the basis of universal and equal suffrage by secret ballot. Deputies are elected for four years, have no binding mandate and have immunity. The working bodies of the Parliament for specific sectorial issues are boards and committees, including the Committee for Environmental Protection.

The Croatian President has a representative and executive function and can be elected to a maximum of two terms. He represents the Republic of Croatia at home and abroad. He is responsible for the defence of the independence and territorial integrity of the Republic of Croatia, as well as stable, normal and concerted action by the state government. The president is elected through direct elections by secret ballot for a period of five years. In cooperation with the Croatian Government, the President participates in the formulation and implementation of foreign policy. The President performs other duties specified by the Constitution.

The Government of the Republic of Croatia exercises the executive power in conformity with the Constitution and the law. The Government consists of the Prime Minister, Deputy Prime Ministers and Ministers and assumes the office when given a vote of confidence by the majority of all members of the Croatian Parliament. The organization, operation and decision-making are regulated by the Law on the Government of the Republic of Croatia and its rules of procedure. The Government of the Republic of Croatia proposes laws and other acts to the Croatian Parliament, the state budget and final financial statement, implements the laws and other decisions of the Croatian Parliament, adopts regulations for the enforcement of laws, conducts the foreign and domestic policy, directs and controls the work of the state administration, takes care of economic development of the country, directs and controls activities and development of public services and conducts other affairs as determined by the Constitution and the law. The Government of the Republic of Croatia, besides the aforementioned, within the framework of its authorities, adopts regulations, administrative acts and decisions on appointing and releasing of officials and public servants. The Government of the Republic of Croatia makes a decision in case of conflict for jurisdiction of public institutions, gives answers on representatives' questions, establishes proposals of laws and other regulations, gives opinion on laws and other regulations and adopts development strategies of economic and social activities. The Government of the Republic of Croatia is responsible to the Croatian Parliament. The Prime Minister and members of the Government of the Republic of Croatia are responsible for decisions made by the Government of the Republic of Croatia and individually they are responsible for their fields of operation.

The judicial power in the Republic of Croatia is exercised by magistrate courts, municipal courts, county courts, commercial courts, High Magistrate Court of the Republic of Croatia, High Commercial Court of the Republic of Croatia, High Administrative Court of the Republic of Croatia and Supreme Court of the Republic of Croatia.

The State Administration is responsible for direct enforcement of laws, adoption of regulations for their enforcement, carrying out administrative and inspection supervision, as well as other administrative and expert activities. The activities of State Administration are carried out by state administration bodies and certain activities could be entrusted to the local and regional selfgovernment units and other legal entities having public authorities. The government bodies comprise 20 ministries, 5 state administration offices, 7 state bureaus and 20 county offices of government bodies.

Local and regional self-government is a citizen right guaranteed by the Constitution of the Republic of Croatia. Right to local and regional self-government includes right to: independence in carrying out local activities, own incomes, free income management, independent organization of internal structure, independent organization of scope of activities and direct election of members of representative bodies. Right to local and regional self-government is acquired by local and regional bodies comprised of members elected through direct elections by secret ballot, based on direct, equal and general voting right. Citizens are allowed to directly participate in local activities management through meetings, referendums and other forms of direct decision making in accordance with law and statute. Local self-government units are municipalities and cities responsible for issues of local importance directly fulfilling the citizens' needs.

The Republic of Croatia territory is administratively divided into 128 cities and 428 municipalities. Municipalities and cities in the Republic of Croatia represent the lowest level of self-government. Regional self-government units are counties responsible for activities of the regional importance. The Republic of Croatia is divided into 21 regional self-government units: 20 counties and the City of Zagreb with the county status. County includes physically connected municipalities and cities in its area.

2.2. POPULATION

According to the 2011 Census the total number of inhabitants in the Republic of Croatia is 4 284 889, of which 2 218 554 women and 2 066 335 men. The average population age in 2011 was 41.7 years (43.4 for women and 39.9 for men). The expected lifetime in 2011 was 79.9 for women and 73.8 for men.

In 2011, there was 41 197 children born in the Republic of Croatia and 51 019 persons dead, which makes negative natural population growth of 9 822 persons. The natality rate amounted 9.4 ‰, while the mortality rate was 11.6 ‰. Since 2009 the Republic of Croatia registers negative migration saldo, i.e. more persons are moving out from the Republic of Croatia than moving in. In 2011, there was 8 534 persons moved in to the Republic of Croatia, while 12 699 persons moved out.

The area of the Republic of Croatia is not equally populated. In 2011, the average population density amounted 75.7 inhabitants/km^2 (table 2-1).

Table 2-1: Population density per counties in 2011

Counties	Population per km2
Zagrebačka	103.8

Counties	Population per km2
Krapinsko-zagorska	108.1
Sisačko-moslavačka	38.6
Karlovačka	35.5
Varaždinska	139.4
Koprivničko-križevačka	66.1
Bjelovarsko-bilogorska	45.4
Primorsko-goranska	82.6
Ličko-senjska	9.5
Virovitičko-podravska	41.9
Požeško-slavonska	42.8
Brodsko-posavska	78.1
Zadarska	46.6
Osječko-baranjska	73.4
Šibensko-kninska	36.7
Vukovarsko-srijemska	73.2
Splitsko-dalmatinska	100.2
Istarska	74.0
Dubrovačko-neretvanska	68.8
Međimurska	156.1
Grad Zagreb	1 232.5

Source: 1) Data of the State Geodesic Administration (calculated from the graphic database of official spatial units registry), as at 31 March 2011, are related to the land area

2.3. ECONOMY

In 2015, the Croatian economy recorded a period of stagnation of real economic activity (GDP – 2.3 %), while gross domestic product (GDP) in 2015 amounted HRK 338.98 bilion (EUR 44.55 billion), which amounts HRK 80 555 per capita (EUR 10 586 per capita) (table 2-2). In 2009, there was a significant deceleration of economic activity due to spillover of consequences of global crisis, thus gross domestic product was reduced to 7.4 %, which is the lowest growth rate since 1999. During 2010, there was a mitigation of these negative trends. Selected macroeconomic indicators for the Republic of Croatia and their trend within the period 2008–2016 are indicated in table 2-2.

Table 2-2: Macroeconomic indicators for the Republic of Croatia within the period 2008–2016

Macroeconomic indicators	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016***
GDP (mil. HRK)	347 685	330 966	328 943	333 326	330 925	331 374	331 266	338 975	348 678
Average annual exchange rate HRK/EUR	7.22317	7.33955	7.28623	7.43420	7.51734	7.57354	7.63001	7.60960	7.52938
Population, annual population average, thous.	4 311	4 306	4 296	4 283	4 269	4 254	4 236	4 208	4 181
GDP (mil. EUR)	48 135	45 093	45 146	44 837	44 022	43 754	43 416	44 546	46 309
GDP per capita (HRK)	80 653	76 856	76 570	77 825	77 518	4 254	78 203	80 555	83 396
GDP per capita (EUR)	11 166	10 471	10 509	10 469	10 312	10 285	10 249	10 586	11 076
Growth rate (%)	2.1	-7.4	-1.4	-0.3	-2.2	-0.6	-0.1	2.3	3.0
Average annual inflation rate expressed by annual consumer price index growth (%)	6.1	2.4	1.1	2.3	3.4	2.2	0.2	-0.5	-1.1
Export of goods and services (% GDP)	38.5	34.5	37.8	40.5	41.7	43.1	45.8	40.9	50.0
Import of goods and services (% GDP)	46.5	38.2	38.1	40.9	41.2	42.7	43.8	46.5	46.9
External debt (million EUR end	40 590.0	45 244.3	46 908.4	45 900.5	45 297.2	45 803.4	46 416.3	45 383.5	41 668.3

Macroeconomic indicators	2008	2009	2010	2011	2012	2013	2014	2015	2016*
of the period)									
Unemployment rate (%, according to ILO)	8.4	9.1	11.8	13.5	15.9	17.3	17.3	16.2	13.1

Source: Statistical Yearbook 2017; Notice 12.1.5. Annual gross domestic product for he period 2010-2016, revised data, CBS
*data for 2016 is provisional

Macroeconomic projections for the period 2018-2020 are based on the Guidelines for the Economic and Fiscal Policy for the period 2018 – 2020 adopted by the Government of the Republic of Croatia in July 2017. Real growth of gross domestic product is projected to accelerate by the end of the projection period. A growth rate of 3.2 % is projected for 2017, 2.8 % for 2018, and 2.6 % for 2019 and 2.5 % for 2020. Economic recovery is projected to be driven by the positive contribution of export of goods and services (especially in tourism). Projected economic trends in Croatia in the observed period will be bolstered by more favourable economic trends in the international environment, primarily stronger economic activity in the European Union. European Union is the main Croatian foreign-trade partner with 70 % of total foreign trade.

2.4. GEOGRAPHIC PROFILE AND LAND USE

According to its position, the Republic of Croatia belongs to the Central European, Adriatic-Mediterranean and Pannonia-Danube group of countries. Total area of the Republic of Croatia amounts 87 661 km^2. It is located between 42°23′ and 46°33′ of north latitude and 13°30′ and 19°27′ of east longitude. The inland area amounts 56 594 km2, while the area of territorial sea and internal sea waters amounts 31 067 km^2. Total length of inland borders of the Republic of Croatia towards neighbouring countries amounts 2 374.9 km (including river borders). The length of inland border towards Bosnia and Herzegovina amounts 1 011.4 km, Hungary 355.5 km, Slovenia 667.8 km, Serbia – Vojvodina 317.6 km and Montenegro 22.6 km. The state sea border is 948 km long and extended at outer boundary of territorial sea. The Ecological and Fisheries Protection Zone of 23 870 km^2 reaches epicontinental border between the Republic of Croatia and Italy.

There are three large geomorphological natural units in the Republic of Croatia: the Pannonian basin, mountain system of Dinarides and Adriatic basin. Lowland areas of up to 200 m a.s.l. represent 53 % of area of the Republic of Croatia, hillies and sub-mountains from 200 up to 500 m represent 26 %, while there is 21 % of mountain areas exceeding 500 m.

The highest mountain top in the Republic of Croatia is Dinara (1 831 m a.s.l.). Carstic area is relief particularity occupying about 54 % of the Republic of Croatia territory. Karstic forms are developed particularly in limestones in mountainous and coastal area of Croatia and as separated form in Sava-Drava area.

In 2011, used agricultural area occupied 27.48 %, while forest area occupied 34.35 % of the Republic of Croatia territory[2]. Spatial distribution of group categories of land cover in the Republic of Croatia for 2006 is indicated in Figure 2.3-1.

[2] Statistical Yearboook 2017

Figure 2-1: Spatial distribution of land types (1. level CLC categories) in Republic of Croatia in 2012[3]

The Nature Protection Act (»Official Gazette«, No. 80/13, 5/18) defines nine categories of protected areas (strict nature reserve, national park, special nature reserve, nature park, regional park, natural monument, significant landscape, park-forrest and park architecture monument). In the year 2016, there were 408 protected areas in total value of 747 619.63 ha, which occupy 8.49 % of the total area of the Republic of Croatia: 12.20 % of the land territory and 1.94 % of the territorial sea[4]. A majority of protected area are 11 nature parks (4.54% of the total state territory).

The ecological network of the Republic of Croatia became part of the NATURA 2000 European Ecological Network in September 2013. The ecological network is a system of interconnected or spatially close ecologically important areas which, by balanced biogeographic allocation, contribute significantly to the conservation of natural balance and biodiversity. Ecological network areas in the Republic of Croatia are divided into internationally important areas for birds and areas important for other wild taxa and habitat types, and cover a significant part of Croatian territory, including agricultural and forest areas. The NATURA 2000 ecological network comprises 36.73 % of the land area and 15.42 %, respectively 29.08% of the surface of the Republic of Croatia[5].

[3] Source: Croatian Agency for Environmental and Nature, Corine Land Cover, Land Cover and Land Use in the Republic of Croatia – state and trends, Zagreb, 2015

[4] Ministry of Environmental Protection and Energy, source: Register of Protected Areas

[5] Ministry of Environment and Energy, source: Bioportal

In 2016, total of 5 020 plant taxa (species and subspecies) was recorded and 789 vascular flora species was estimated as endangered. The Red Book of Vascular Flora of the Republic of Croatia provides basic information on Croatia's flora and and threats to flora as well as detailed information on 12 species that are extincted (IUCN categories - EX and RE) and 242 threatened species (CR, EN and VU categories). Besides the aforementioned one, there are seven more red books (cave dvelling fauna, sea fish, dragonflies, fungi, mammals, amphibians and reptiles and freshwater fish) and 17 red lists of threatened taxa.

2.5. CLIMATE

According to Köppen classification for a standard period 1961-1990, the largest part of Croatia belongs to the climate type C, a moderately warm rainy climate. The southernmost part of the island of Lošinj, the Dalmatian coast and islands have the Mediterranean climate with dry and hot summers (Csa), whereas the coastal areas of Istria, the Kvarner littoral and the Dalmatia's interior have a moderately warm and humid climate with hot summers (Cfa). The moderately warm and humid climate with warm summers (Cfb) prevails in the major part of Croatia, in the continental Pannonian region and the interior of Istria. Only the regions of Gorski kotar, Lika and the Dinaric Alps above altitude of 1200 m belong to the climate type D, subtype Df, a humid snowy forest climate.

The annual mean air temperature in the lowland area of northern Croatia is 10 – 12 °C, at altitudes above 400 m it is lower than 10 °C and in the mountains it is 3 – 4 °C. In the coastal area it is 12 – 17 °C. January is the coldest month on average, with the temperature in the Pannonian region ranging from 0 to -2 °C. Along the Adriatic coast winters are milder; January temperatures are 4 – 6 °C. In the north and east of Croatia average July temperatures are 20 – 22 °C and on the Adriatic coast 23 – 26 °C. The absolute minimum temperature of -35.5 °C was measured in Čakovec on 3rd February 1929 and the absolute maximum of 42.8 °C in Ploče on 5th August 1981.

The least precipitation in Croatia is recorded in the open part of the central Adriatic (Palagruža, 304 mm) and in the eastern Slavonia and Baranja (Osijek, 650 mm). Central Croatia and the coastal zone have annual precipitation between 900 and 1 000 mm. The amount of precipitation in the Pannonian region decreases from the west towards the east. From the coast towards the inland the precipitation increases. Most of the precipitation is recorded on the coastal slopes and peaks of the Dinarides (Risnjak, 3 470 m), from Gorski Kotar in the northwest to the southern Velebit in the southeast.

In Croatia's inland the north-easterly winds prevails. Bora (bura) is a cold descending wind blowing from the north-eastern direction on the eastern Adriatic coast. It blows in gusts over 110 km/h, which sometimes can exceed 250 km/h. It is more frequent and stronger in winter than in other seasons. Sirocco (jugo) is a warm and wet, moderate or strong south-easterly wind accompanied by cloudy and rainy weather. It is the most frequent and the strongest in the cold half of the year. It is stronger on the open sea, making the waves up to 10 m high.

The duration of sunshine depends directly on the cloudiness. The coastal zone of Middle and South Adriatic are the fairest part of the Republic of Croatia with the annual cloudiness of 4/10 or 4.5/10 (from Dugi otok to Prevlaka). The islands of the central and southern Adriatic (Hvar, Vis and Korčula) have 2 700 hours of sunshine per year. The majority of inland places in Croatia have 1 700 – 2 000 hours of sunshine. The annual largest cloudiness is recorded in Gorski kotar (6-7/10), which has the least hours of sunshine yearly – about 1700.

2.6. ENERGY

Primary energy generation in the period from 2010 to 2015 is described in table 2-3. Primary energy generation in 2015 was decreased by 6.7 % from the previous year. Due to unfavourable hydrology, hydro power utilization decreased by 30.7 %. The production of all other primary energy commodities increased. Increase for the other renewable sources (such as the wind energy, solar energy, biogas, liquid biofuels and geothermal energy), amounted to 3.4 %. Also the production of the fool wood and other types of biomass increased by 10.7 %. Production of crude oil is increased by 12.7 % and of the natural gas by 1.8 %. Also the production of the heat from heat pumps increased by 20.3 %. During the six-year period, from 2010 until 2015, primary energy production in Croatia decreased at an average annual rate of 3.4 %.

Table 2-3: Primary energy generation in the period 2010-2015

Primary energy production, PJ	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Fuel Wood and Biomass	56.20	59.01	60.39	61.45	57.67	64.19
Crude Oil	30.69	28.37	25.62	25.71	25.38	28.62
Natural Gas	93.88	85.02	69.19	63.11	60.52	61.61
Hydro Power	87.24	47.58	47.32	84.92	88.99	61.63
Heat	0.63	0.61	0.62	0.63	0.53	0.64
Renewables	2.63	2.97	5.66	7.71	10.70	11.06
TOTAL	271.26	223.56	208.79	243.53	244.09	227.75

Source: Energy in Croatia 2015, Ministry of Environment and Energy

Table 2-4 shows energy import in the period from 2010 to 2015. The import of natural gas decreased by 7.3 %, while the import of all other forms of energy increased. The import of fuel wood and other biomass increased by 141.8 % and electricity by 30.9 %. The import of crude oil increased by 25.8 %, petroleum products by 5.8 %, of coal and coke by 5.4 %. During the period from 2010 until 2015, energy import in Croatia decreased at an average annual rate of 0.8 %.

Table 2-4: Energy import in the Republic of Croatia within the period 2010 – 2015

Energy import, PJ	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Coal and Coke	33.13	31.92	26.30	36.10	30.46	32.11
Crude Oil	150.64	121.2	99.28	105.12	79.05	99.41
Petroleum Products	53.81	68.05	67.47	60.30	80.78	85.49
Natural Gas	36.37	29.79	46.16	43.19	39.19	36.33
Electricity	24.06	31.43	33.23	24.64	24.40	31.93
Biomass	0,.2	0.23	0.25	0.42	0.49	1.18
TOTAL	298.2	282.61	272.69	269.77	254.36	286.45

Source: Energy in Croatia 2015, Ministry of Environment and Energy

The structure of energy forms exported from Croatia in the period from 2010 until 2015 are given in Table 2-5. In 2015, the total energy export from Croatia increased by 8.9 %. At the same time, the export of electricity decreased by 26.3 %, of natural gas by 15.3 % and coal and coke by 2.2%. The export of other energy forms increased. The export of petroleum products increased by 21 % and of biomass by 4.1 %. In the period from 2010 till 2015, energy export increased at an average annual rate of 0.02 %. It is a consequence of the increased export of biomass by 22.5 %.

Table 2-5: Energy export from the Republic of Croatia within the period 2010–2015

Energy export, PJ	2010	2011	2012	2013	2014	2015
Coal and coke	1.67	0.69	0.91	0.93	1.24	1.21
Wood and biomass	4.52	7.92	8.50	10.28	11.99	12.48
Petroleum products	80.34	66.71	66.07	65.30	65.26	79.00
Natural gas	16.46	8.79	8.73	12.79	15.01	12.71
Electricity	9.77	5.67	6.48	10.71	10.17	7.49
TOTAL	112.76	89.78	90.69	100.02	103.67	112.89

Source: Energy in Croatia 2015, Ministry of Environment and Energy

The shares of specific energy forms in total primary energy supply during the period 2010-2015 are given in table 2-6. In 2015, total primary energy supply in Croatia was lower by 0.9 % from the previous year. Consumption of coal and coke decreased by 5.5 % and hydropower decreased by 30.7 % due to unfavorable hydrological conditions. Also, the consumption of other energy sources increased and the consumption of the imported electricity increased by 71.7 %. The consumption of heat from heat pumps increased by 20.3 %, of fuel wood and biomass by 14.2 % and of other renewable energy sources by 7.4 %. The consumption of natural gas increased by 3.0 % and the consumption of liquid fuels increased by 4.1 %. In the period from 2010 till 2015, the total primary energy supply decreased at an average annual rate of 2.5 %.

Table 2-6: Total primary energy supply in the Republic of Croatia within the period 2010–2015

Primary energy supply, PJ	2010	2011	2012	2013	2014	2015
Coal and coke	30.92	31.66	28.37	32.18	31.59	29.86
Wood and biomass	52.29	51.50	52.10	51.67	46.12	52.69
Liquid fuels	152.54	149.30	134.17	128.37	125.80	130.92
Natural gas	111.37	108.60	101.78	95.54	84.62	87.16
Hydro power	87.24	47.58	47.32	84.92	88.99	61.63
Electricity	14.28	25.76	26.75	13.93	14.23	24.44
Heat	0.63	0.60	0.62	0.63	0.53	0.64
Renewable sources	2.24	2.83	5.72	7.80	10.65	11.44
TOTAL	451.50	417.84	396.83	415.04	402.53	398.77

Source: Energy in Croatia 2015, Ministry of Environment and Energy

The total primary energy supply meets the demand for energy in an energy system – the total final energy consumption, non-energy use, energy sector own use, energy conversion losses, and energy transport and distribution losses. The structure of energy needs during the period from 2010 until 2015 is given in Table 2-7. In 2015, the total energy demand decreased by 0.9 %. Final energy consumption increased by 5.5 %, whereas transport and distribution losses increased by 3.8 %. All other energy needs decreased. Energy conversion losses decreased by 19.5 %, whereas energy consumption for energy sector own use decreased by 6.5 %. Non-energy use decreased by 1.9 %.

Compared to energy consumption in 2014, energy consumption in industry in 2015 decreased by 0.5 %. Also, energy consumption in other sectors increased by 7.9 %, whereas in the transport sector it increased by 4.5 %. In the period from 2010 till 2015, industrial sector reduced its energy consumption at an average annual rate of 4.3 %. In the transport sector, energy consumption increased at an average annual rate of 0.4 % and the consumption in other sectors decreased at an average rate of 2.2 % annually.

During the period from 2010 until 2015, the total primary energy supply decreased at an average annual rate of 2.5 %. All energy supply structures in total primary energy supply decreased.

Table 2-7: Total primary energy supply by sectors

Structure of total energy used, PJ	2010	2011	2012	2013	2014	2015
TOTAL PRIMARY ENERGY SUPPLY	451.50	417.84	396.83	415.04	402.53	398.77
Conversion Losses	84.50	60.39	60.30	84.07	83.49	67.23
Energy Sector Own Use	30.24	32.03	26.57	24.33	26.72	24.99
Transmission Losses	10.88	10.14	10.00	9.76	8.87	9.21
Non Energy Use	24.97	24.94	22.31	22.52	22.60	22.17
FINAL ENERGY CONSUMPTION	300.90	290.33	277.65	274.37	260.85	275.17
Industry	50.30	46.96	41.56	40.92	40.63	40.42
Transport	86.80	85.39	84.02	85.49	84.53	88.37
Other Sectors	163.81	157.98	152.08	147.95	135.70	146.38

Source: Energy in Croatia 2015, Ministry of Environment and Energy

According to data from annual energy reports „Energy in Croatia 2015", „National Action Plan for Renewable Energy Sources by 2020" (Ministry of Economy, October 2013), and 2016 annual report of the Croatian Energy Regulatory Agency and the Croatian Energy Market Operator for 2016, the increase of electricity generated from renewable energy sources and cogeneration from the financial indicatives was achieved mainly as a result of introduction of new plants in the network during 2016. In the total electricity consumption in the Republic of Croatia (17 674 GWh), the share of electricity produced in the plant in the incentive system was 9.7%.[6] Of the total produced electricity, a total of 1 485 154 730 kWh or 86.05 % was produced from renewable energy sources and cogeneration in renewable energy production facilities, and 240 781 241 kWh or 13.95 % was produced in micro, small, medium and large cogeneration plants.

In the Republic of Croatia, in the incentive system since 2007 have been installed 1 313 plants using renewable energy sources, with a total installed capacity of 766 446 kW (as on 31st December 2017). By installed power, the first are wind farms with a total of 519 000 kW, accounting for 67.7 % of total installed power. Next are the cogeneration plants with a total of 113 293 kW installed power and a solar power plant with a total of 51.89 kW. All installed production capacities of renewable energy and cogeneration in 2017 with total installed capacity of 766 446 kW had produced a total of 277 320 588 kWh.

The Republic of Croatia encourages the use of biofuels based on the Law on Biofuels for Transportation[7]. A financial incentive for biofuel production existed until 2014, based on the Decision on Unit Amount of Incentive Fee for Promoting the Biofuel Production[8] as indicated in table 2-8.

Decision on the Unit Amount of the Biofuels Fuel Efficiency Grant in 2011 and 2014 and is presented in Table 2-8.

[6] Croatian Energy Regulatory Agency (HERA), Annual Report for 2016
[7] »Official Gazette«, No. 65/2009, 145/2010, 26/2011, 144/2012, 14/2014
[8] »Official Gazette«, No. 37/2011, 141/2013

Table 2-8: Comparison of the incentives for biofuels production in 2011 and 2014

Biofuel production	Incentive fee amount	
	2011	2014
Biodiesel from vegetable oil, waste cooking oil and lignocellulosic biomass	4.02 HRK/l	1.7 HRK/l
Bioethanol from corn, sugar beet and lignocellulosic biomass	1.94 HRK/l	0.23 HRK/l

Source: Decision on Unit Amount of Incentive Fee for Promoting the Biofuel Production in 2011, Decision on Unit Amount of Incentive Fee for Promoting the Biofuel Production in 2014

2.7. TRANSPORT

Passenger and freight traffic in Croatia is carried out by road, railway transport, sea water and coastal transport, inland waterway transport, air transport and freight transport also via pipelines. Most passengers are transported by road and railway transport (Table 2–9), and the most goods by road and sea water and coastal transport (Table 2–10). The length of railway lines has not changed since 2006 with a total of 2 604 km of which 2 350 km are single track and 254 km of double track railway. In 2016, a total of 970 km of railway lines were electrified, which amounts to 37.3 % of the total railway length. Number of railway stations and other official places were amounted to 556 in 2016. Railway transport was carried out with 208 locomotives in 2016, of which 49.4% were electric and 60.5 % diesel locomotives.

The total length of roads in 2016 was amounted to 26 754 km of which, according to categorisation, there were: 1 310 km of motorways, 6 937 km of state roads, 9 504 km of county roads and 9 003 km of local roads. Road transport is carried out by passenger cars, duty vehicles, buses and motorcycles, and in two cities also by trams. Number of road vehicles is continuously increasing since 1993 and in 2016 was amounted to 1 996 056, of which 77.7 % were passenger cars, 7.3 % of duty vehicles, 0.2 % of buses and 3.2 % of motorcycles. In 1993 there were 140.7 passenger cars per 1 000 inhabitants, and in 2015, that number amounted to 385.

The Republic of Croatia has six ports of international economic interest in the cities: Rijeka, Zadar, Šibenik, Split, Ploče and Dubrovnik. The network of inland waterways of the Republic of Croatian is 804.1 km, of which 539.2 km are international waterways. Inland ports open to international public transport are: Osijek, Sisak, Slavonski Brod and Vukovar. Fleet of national inland waterway carriers in inland waterways is constitute of tug-boats and pusher vessels which in 2009 were amounted to 24 and with a total power of 10 661 kW, and self-propelled barges, self-propelled tanker barges and non-powered cargo vessels which in 2013 were amounted to 37, with a total capacity of 45 040 t.

The Republic of Croatia has 7 international airports: Zagreb, Split, Dubrovnik, Zadar, Osijek, Rijeka and Pula and 3 national airports: Brač, Mali Lošinj and Osijek for aircraft in commercial air transport. In 2016, in the Republic of Croatia, there was 25 aircraft, with a net capacity of 188 234 kg.

Pipeline transport includes transport of oil and gas. The 2016 length of the pipeline amounted to 610 km and has not changed since 2005. The length of the pipeline in 2016 was amounted to 2 693 km and is steadily increasing.

Table 2-9: Inland transport of passengers in the Republic of Croatia, by types of transport (´000)

Year	Railway transport	Road transport	Seawater and coastal transport	Air transport
2008	70 961	62 064	12 861	2 329
2009	73 545	58 493	12 550	2 053
2010	69 564	56 419	12 506	1 861
2011	49 983	52 561	12 926	2 078
2012	27 669	52 293	12 474	1 961
2013	24 265	54 292	12 770	1 812
2014	21 926	54 000	13 029	1 860
2015	21 683	52 126	13 082	1 919
2016	20 742	50 423	13 525	2 102

Source: Statistical Yearbook 2017

Table 2-10: Transport of goods in the Republic of Croatia, by types of transport (´000 t)

Year	Railway transport	Road transport	Seawater and coastal transport	Inland waterway transport	Air transport	Pipeline transport of oil and gas
2008	14 851	110 812	30 768	6 415	5	8 765
2009	11 651	92 847	31 371	5 381	4	9 201
2010	12 203	74 967	31 948	6 928	3	8 936
2011	11 794	74 645	30 348	5 184	3	7 772
2012	11 088	65 439	25 636	5 934	4	6 878
2013	10 661	67 500	24 744	5 823	3	7 617
2014	10 389	66 146	20 335	5 377	3	6 918
2015	9 939	66 491	21 376	6 642	3	8 162
2016	9 985	72 503	20 951	6 409	3	8 970

Source: Statistical Yearbook 2017

Table 2-11: Realized passenger kilometres (mln)

Godina	Railway transport	Road transport	Seawater and coastal transport	Air transport
2008	1 810	4 093	491	1 945
2009	1 835	3 438	486	1 636
2010	1 742	3 284	493	1 510
2011	1 486	3 145	583	1 591
2012	1 104	3 249	602	1 451
2013	948	3 507	613	1 340
2014	927	3 648	621	1 366
2015	951	3 377	624	1 438
2016	836	3 802	652	1 649

Source: Statistical Yearbook 2017

Table 2-12: Realized tonne kilometres (mln)

Godina	Railway transport	Road transport	Seawater and coastal transport	Inland waterway transport	Air transport	Pipeline transport of oil and gas
2008	3312	11 042	142 972	843	3	1 677
2009	2 641	9 429	137 345	727	3	1 797
2010	2 618	8 780	162 751	941	2	1 703
2011	2 438	8 926	155 437	692	2	1 477
2012	2 332	8 649	125 678	772	3	1 216
2013	2 086	9 133	127 283	771	2	1 485
2014	2 119	9 381	107 709	716	2	1 447
2015	2 183	10 439	122 223	879	2	1 740
2016	2 160	11 337	113 103	836	2	1 921

Source: Statistical Yearbook 2017

2.8. INDUSTRY

The structure of the industry in the Republic of Croatia is divided into manufacturing, mining and quarrying and electricity, gas, steam and air conditioning supply. The manufacturing industry in 2015 was covered 77.9 %, mining and quarrying 6.90 %, and electricity, gas, steam and air conditioning supply 15.20 %. of the total composition of the industrial production. Manufacturing industry is along with the sector of financial intermediation, real estate, renting and business services sector, of the economy with the main ingredients in the share of gross domestic product (GDP) and total employment of Croatian and absolutely the largest share in total exports.

The area of the manufacturing industry (according to National Classification of Activities – NKD 2007.) is divided into:

1. Manufacture of food products
2. Manufacture of beverages
3. Manufacture of tobacco products
4. Manufacture of textiles
5. Manufacture of wearing apparel
6. Manufacture of leather and related products
7. Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
8. Manufacture of paper and paper products
9. Printing and reproduction of recorded media
10. Manufacture of coke and refined petroleum products
11. Manufacture of chemicals and chemical products
12. Manufacture of basic pharmaceutical products and pharmaceutical preparations
13. Manufacture of rubber and plastic products
14. Manufacture of other non-metallic mineral products
15. Manufacture of basic metals
16. Manufacture of fabricated metal products, except machinery and equipment
17. Manufacture of computer, electronic and optical products
18. Manufacture of electrical equipment
19. Manufacture of machinery and equipment n. e. c.
20. Manufacture of motor vehicles, trailers and semi-trailers
21. Manufacture of other transport equipment

22. Manufacture of furniture
23. Other manufacturing
24. Repair and installation of machinery and equipment

Until the recession, industrial production in the Republic of Croatia was covered a significant place in the overall production. The manufacturing and petrochemical industries and shipbuilding stood out. Some companies were abolished in transition process and some were destroyed during war. Above mentioned, mainly refers to companies that manufacture textiles, leather, metal and wood products. The production in construction and energy sectors was also significant. Some industry still continues to generate positive results and participate in foreign trade. The sale value of industrial products in 2016 amounted to HRK 120 480 billion (EUR 16.2 billion), of which HRK 53.550 billion (EUR 7.2 billion) goes to export. According to the total income, the leading industries were manufacturing and electricity, gas, steam and air conditioning supply. In exports, the most common industry were manufacture of refined petroleum products (9.1 %), food products (8.1 %), pharmaceutical products (6.8 %), chemical products (5.6 %), wood and products of wood (5.3 %).

2.9. WASTE MANAGEMENT

The waste, in accordance with the Sustainable Waste Management Act (»Official Gazette«, No. 94/13, 73/17) means any substance or object which the holder discards or intends or is required to discard. Waste is divided into industrial waste generated in the production processes in industry, trade and other processes, municipal waste generated by household (including any other waste comparable in nature and composition to household waste) also green waste coming from agriculture and forestry.

The waste is managed in a way that it is collected, transported, recovered, disposed and treated in other ways, including the supervision of such operations, and the supervision and after-care of disposal sites, as well as the operations undertaken by dealers or brokers. Implementation and establishment of an integrated waste management system in the Republic of Croatia is enabled by applying and fulfilling the objectives defined in the Sustainable Waste Management Act, Strategy[9] and Plan[10] .

Waste management is based on the principles of environmental protection laid down by the environmental protection acts, the acquis communautaire of the European Union, the principles of international environmental law, scientific knowledge, the best global practice and rules of profession, and in particular on the following principles: the polluter-pays principle, the principle of proximity, the principle of self-sufficiency and the principle of traceability.

The Republic of Croatia has established a Waste Management Information System which is used in supervising the implementation and management of the waste management system and is the part of the Environmental Information System which is laid down by the environmental protection legislation, and maintained by the Croatian Agency for Environment and Nature.

According to the Report on municipal waste (Croatian Agency for Environment and Nature, 2017), all cities and municipalities had organized the collection and disposal of municipal waste, while the population covered by organized collection amounted to 99 %. In 2016 municipal waste collectors

[9] Waste Management Strategy of the Republic of Croatia (»Official Gazette«, No. 130/05)
[10] Waste Management Plan of the Republic of Croatia for the Period 2017-2022 (»Official Gazette«, No. 3/17)

signed by 1.56 % more municipal waste from households in comparison to 2015. Total municipal waste produced in 2016 amounted to 1 679 765 tonnes. The annual amount of municipal waste per capita was 392 kg and the daily amount per capita of about 1.07 kg. The share of mixed municipal waste (key number 20 03 01) in collected waste accounted for 74 %, or 1 251 299 tonnes. The share of other collected types of waste from municipal waste was 26 %, what is 2 % more in comparison to 2015. Of the total quantity of wastes collected separately from municipal waste, the amount of 353 823 tonnes was sent to recyling. Thus, the recovery rate of municipal waste in 2016 was 21 %, which is 3 % more than in 2015. Total produced biodegradable municipal waste was 1 072 439 t while 20 % was sent to the recovery what is 2 % more comparing to the previous year. Amount of 29 989 t of bio-waste was composted from municipal waste, while in the two biogas plants 964 tons of municipal waste were digested. The recycling rate in 2016 was 21 %. The rate of recycling from communal waste was 27 %, ie just more than half of the target for 2020 which amount 50 % by Article 55 of the Sustainable Waste Management Act (»Official Gazette«, No. 94/13, 73/17).

2.10. CONSTRUCTION AND HOUSING

Buildings in the Republic of Croatia are residential and non-residential buildings. Nonresidential buildings include hotels and similar buildings, office buildings, wholesale and retail trade buildings, traffic and communication buildings, industrial buildings and warehouses, public entertainment, education, hospital or institutional care buildings, and other non-residential buildings.

Construction of buildings in the Republic of Croatia had a negative trend in period from 2004 to 2016 (Table 2-13). The number of completed residential buildings were decreased by 4.2 % in 2015 comparing to 2014. Number of dwellings, however, showed upward trend for the first time after 2007. In 2015, 3.2 % more dwellers were constructed comparing to 2014. The number of completed non-residential buildings were decreased by 14.7 % comparing to 2014. In the same period, the number of most reduced completed non-residential were traffic and communication buildings (decrease of 36.8 %) and public entertainment, education, hospital or institutional care buildings (decrease of 24 %).

Table 2-13: The number of completed buildings and dwellings

Year	2008	2009	2010	2011	2012	2013	2014	2015
Buildings, total	9 923	8 434	7 491	6 777	6 047	5 739	4 971	4 641
Residential buildings, total	8 148	6 733	6 108	5 468	4 948	4 566	3 841	3 678
Dwellings, total	25 368	18 740	14 972	12 390	11 792	10 090	7 805	8 059
Non-residential buildings, total	1 775	1 701	1 383	1 309	1 099	1 173	1 130	963
Hotels and similar buildings	156	146	128	121	108	116	88	101
Office buildings	102	82	75	60	60	44	30	36
Wholesale and retail trade buildings	300	284	197	178	133	132	97	98
Traffic and communication buildings	243	244	210	181	176	234	254	175
Industrial buildings and warehouses	356	325	269	269	194	167	163	171
Public entertainment, education, hospital or institutional care buildings	141	128	89	90	67	76	56	44
Other non-residential buildings	477	492	415	410	361	404	442	338

Source: Statistical Yearbook 2017

2.11. AGRICULTURE

Agriculture in the Republic of Croatia, is divided into crop production, livestock production and fishing. Crop production is realized on agricultural land, which includes arable land and gardens, kitchen gardens, orchards, olive groves, vineyards, meadows and pastures, nurseries and land with osier willows. In 2016. from the total agriculture area (2.7 mil. ha) intensively used agricultural land was 1 546 019 ha which is 27.31 % of the total land area of the Republic of Croatia. Since 2007 the Republic of Croatia has a positive trend in the use of agricultural land. Most utilized categories in 2016 were the arable land and gardens with 56.4 % and permanent grassland with 38.3 %, while other categories of utilised agricultural land together constitute 4.8 % (Table 2-14). Utilisation of arable land and gardens increased by 1.98 % in the period from 2008 to 2016, and permanent grassland by 75.2 %. On arable land and gardens following types of crops are cultivated: cereals (maize, wheat and barley), dried pulses, root and tuber crops, industrial plants (soy-bean, sugar beet, sunflower, rape seed), vegetables, green fodder from arable land and other arable crops, flowers and ornamental plants, seed crops and seedlings and fallow land.

Table 2-14: Intensively utilised agricultural area by categories, ha

Intensively utilised agricultural area, ha	2008	2009	2010	2011	2012	2013	2014	2015	2016
Intensively utilised agricultural area, total	1 289 091	1 299 582	1 333 835	1 326 083	1 330 973	1 568 881	1 508 885	1 537 629	1 546 019
Arable land and gardens	855 416	863 023	899 594	892 221	903 508	874 863	811 067	841 939	872 406
Kitchen gardens	5 337	5 315	4 902	4 233	2 933	2 250	2 150	2 150	1 885
Permanent grassland (meadows and pastures)	342 430	343 306	345 389	346 403	345 561	618 070	618 070	618 070	600 000
Orchards	35 933	36 659	32 889	32 560	30 846	28 392	31 724	30 112	29 476
Vineyards	32 741	34 380	32 709	32 485	29 237	26 100	26 164	25 587	23 400
Olive groves	14 971	15 304	17 096	17 200	18 100	18 590	19 082	19 100	18 184
Nurseries	346	579	429	389	248	212	221	310	361
Osier willows	917	1016	827	592	540	404	407	361	326

Source: Statistical Yearbook 2017

In the Republic of Croatia 14 107 ha of arable land, or 1.4 % of utilized agricultural area were irrigated in 2011. National project of irrigation and agricultural land and water management in the Republic of Croatia (NAPNAV, 2005) has developed and improved irrigation infrastructure and improved management of natural resources.

Livestock number in the Republic of Croatia in the period 2008 – 2016 is shown in Table 2-15.

Table 2-15: Livestock number, ´000 head

Category	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cattle dairy	226	225	209	206	191	181	179	175	168
Cattle Non-dairy	31	28	48	27	29	39	45	67	72
Sheep	643	619	629	639	679	620	605	608	619
Goats	84	76	75	70	72	69	61	62	76
Horses	20	20	21	22	22	21	21	22	23

Mules/asses	4	4	4	3	3	3	2	2	3
Pigs	1 104	1 250	1 231	1 233	1 182	1 111	1 156	1 167	1 163
Poultry	10 015	10 787	9 469	9 523	10 160	9 280	10 268	10 168	9 835

Source: NIR 2018 (National Inventory Report of the Republic of Croatia for period 1990–2016)

In the Republic of Croatia fishing is divided into maritime and freshwater fishing. Maritime fishing take place in the Croatian sea and freshwater fishing in ponds and open freshwater. The fishing sea of the Republic of Croatia includes external and internal fishing sea, and is divided into 11 fishing zones. Maritime fishing in 2016 were performed with 628 ships, and total size of vessels of 34 040 GT. Total catches in 2016 was amounted to 85 028 tons, of which 80.37 % is blue fish and remaining are the other fish, crustaceans and oysters, other molluscs and shellfish.

Freshwater fishing in the Republic of Croatia consists of economic and recreational fishing. Economic fishing is carried out on the Sava and Danube rivers. Freshwater aquaculture involves cold- water and warm-water species, and the most important species are carp, trout, carp (silver and bighead), white amur, sheat-fish, tench, perch and pike. Total production of freshwater fish in 2016 was amounted to approximately 4 099 tonnes, of which about 66 % is the production of carp and other warm-water species. The Republic of Croatia in 2016 cltivated 3 249 tons of milt.

2.12. FORESTRY

Pursuant to the Forest Act[11] the forests in the Republic of Croatia are classified as continental forests and karst forests. According to their purpose, the forests are classified as commercial forests, protective forests and special purpose forests. Commercial forests are used for timber production, protective forests are used for protection of land, water, settlements, facilities and other goods. The special purpose forests are divided into: forests and parts of forest registered for forest seeds production, forests within protected areas or natural values protected based on the nature protection regulation and forests used for scientific research, teaching, defence requirements of the Republic of Croatia and purposes regulated by special regulations.

The basic principles of forest management are sustainable management with conservation of natural structure and forests diversity, as well as permanent increase of stability and quality of commercial forest functions and ecosystem services. The forest management includes cultivation, protection and use of forests and forest lands, as well as construction and maintenance of forest infrastructure, pursuant to the pan-European criteria for sustainable forest management. The Forest Act prescribes that by aiming at unique and permanent forest management, a unique forest management area is established in the Republic of Croatia, divided into management units. Forests and forest land in the forest management area in the Republic of Croatia are managed based on the forest management plans: Forest Management Area Plan for the Republic of Croatia (FMAP), Forest Management Plan for management units, Programmes for management of management units on karst, Programmes for management of private forests, Programmes for forest renewal and protection in specially endangered area. Programmes for management of forest with special purpose, Annual forest management plans and Annual operative plans. The management programmes are approved for the period of 10 years, along with orientation for the next 10 years. At this moment, the management is carried out based on the Forest Management Area Plan for the Republic of Croatia (FMAP) enforced from 2016 to 2025. The FMAP establishes ecological, economic and social basis for biological improvement of forests and increase of forest production. The

[11] »Official Gazette«, No. 140/2005, 82/2006, 129/2008, 80/2010, 124/2010, 25/2012, 68/12, 148/13, 94/14

management units are managed based on the following plans: Forest Management of Management Units, Karstic Management Units Programme and Management Programme for Forests owned by Private Forest Owners. The FMAP in force determines growing stock of 418 618 277 m3 while its yearly increment amounts about 10.1 millions of m3. Growing stock per hectare in forests owned by the Republic of Croatia is 275 m3/ha and it is 68 % higher in relation to growing stock per hectare in 2006. The growing stock of the total forest management area in 2016 increased by 5% compared to 2006. The most abundant broadleaves in total growing stock are: Common beech 37.2 %, Pedunculate oak 11.6 %, Sessile oak 9.4 %. The most representative conifers are: Silver fir 7.9 %, Spruce 2.3 %, Black alder 2%, Black pine 1.4 %.

Total forest and forest land area in the Republic of Croatia amounted 2 759 039.05 ha in 2016, which as regarding total inland area of the Republic of Croatia represents forest cover of 49 %. Out of total forest area, productive forest land with tree cover amounts 2 492 676.33 ha (90 %) and the rest is productive forest land without tree cover (productive, non-productive and unfertile land). In total forest area, 76 % of forests is owned by the state, managed by the company Hrvatske šume Ltd., while the remaining 24 % are privately owned. As compared to 2006, the total area of forests and forest land of the Republic of Croatia increased by 2.6 %. This increase was observed in privately owned forests and forest land, while the total area of forests and forest land owned by the Republic of Croatia slightly decreased (the separation of forests and forest land from the forest management area according to the Law on Forests).

The share of the total area of forests and forest land of the forest management area according to the purpose is as follows: 1 425 809.46 ha or 52% of the area in the category of commercial forests, 832 095.82 ha or 30% of protection forests and 501 133.77 ha or 18% of special purpose forests. According to the provisions of the Nature Protection Law, nature parks occupy 60 % (301 949.64 ha) of the forest and forest land area under the category of special purpose forests, and nature park account for 11 % (52 973.48 ha).

The Republic of Croatia lies at the crossroads of two large phytogeographical regions – the Euro-Siberian-North-American and the Mediterranean, which give the country a great variety of ecosystems, habitat types, and plant and wildlife species. The former includes 78 forest communities of the lowland, hilly, highland, mountain and pre-mountain vegetation belt and the latter 16 thermophilous, evergreen and deciduous forest communities of the Mediterranean coastal and insular Croatia.

2.13. INLAND WATERS AND COASTAL AREA

Spatial allocation of surface (rivers, lakes, transitional and coastal waters) and ground waters and their conjuctions are primarily determined by morphological and hydrogeological characterstics of the Croatian area. All waters are part of either Black Sea or Adriatic catchment area with the watershed running along the mountain and alpine area. Large watercourses like Sava, Drava and Danube with many smaller subcatchments dominate the Black Sea catchment area. In the Adriatic catchment area, the abundance and the length of surface watercourses are significantly lower, but there are significant groundwater flows through karst systems. The majority of large watercourses of the Black Sea catchment area is of interstate significance (boundary or crossborder). Among large watercourses in the Republic of Croatia following rivers flow into its cross-border watercourses as well: Sava, Drava and Mura from Slovenia, Danube from Hungary, Una, Vrbas, Ukrina and Bosna from Bosnia and Herzegovina. In the Adriatic catchment area, the boundary river with Slovenia is Dragonja, and the largest cross-border river is Neretva with more than 90 % of its catchment situated in Bosnia and

Herzegovina. Characteristics of own waters on the Republic of Croatia territory are presented in table 2.16.

Table 2-16: Characteristics of own waters on the Republic of Croatia territory

Hydrological unit	**Black Sea catchment area**	**Adriatic catchment area**	**Total**
Average precipitation / mm	1 001	1 426	1 162
Average evapotranspiration / mm	663	761	700
Average flow-rate / m3/s	376	451	827
Average specific discharge /l/s/km2	10.71	21.1	14.6

Source: Water Management Strategy, 2009

The Black Sea catchment area is more abundant in water if the own and transit waters are taken into consideration; however, own waters of the Adriatic catchment area are much more water abundant per catchment unit. Waters flowing from Bosnia and Herzegovina into the Adriatic catchment area are not transit waters literally because they drain into the Adriatic Sea. Islands are presented as a special unit. According to the average water balance, the Republic of Croatia abounds with water but the interannual distribution of water quantities is not favourable due to the significant spatial and time unequality in water resources distribution. Pursuant to the Water Management Strategy[12] the basic characteristics of water resources are presented in table -17.

Table 2-17: Basic characteristics of water resources

INDICATOR		**Black Sea catchment area**	**Adriatic catchment area**	**Croatia**
Waters -total	109 m^3/year	128.38	27.94	156.32
Water resources – total*	109 m^3/year	83.72	27.94	111.66
Water resources – per capita	103 m^3/year/capita	27 487	20 077	25 163
Own waters – total	109 m^3/year	11.86	14.22	26.08
Own waters – per capita	103 m^3/year/capita	3 894	10 218	5 877
Groundwater – total	109 m^3/year	2.66	6.47	9.13
Groundwater – per capita	103 m^3/year/capita	873	4 649	2 057
Independency coefficient**		0.142	0.509	0.234
Freedom coefficient***		0.00	1.00	0.25

* Including 50% of the Danube and the Sava waters downstream from the Una mouth

** Independency coefficient – the share of own waters in the renewable water resources

*** Freedom coefficient – the share of waters that do not flow into the territory of other states, i.e. that flow into the Adriatic Sea

River of Danube, the largest and richest in water, flows through the eastern borderland of the Republic of Croatia over a length of 188 km. The rivers of Sava (562 km) and Drava (505 km) have the longest courses in the Republic of Croatia. Kupa is the longest river whose entire course of 296 km flows through the Republic of Croatia. Rivers of the Adriatic catchment area are short, have rapids and canyons. The largest rivers in Istria are Mirna, Dragonja and Raša and innDalmatia these are Zrmanja, Krka, Cetina and Neretva.

There are not many natural lakes in the Republic of Croatia. The largest natural lakes are Vrana Lake near Pakoštane (30.7 km^2), Dubravsko Lake (17.1 km^2), Peruća (13.0 km^2), Prokljan Lake (11.1 km^2),

[12] Official Gazette No. 91/2008

Varaždin Lake (10.1 km^2) and Vrana Lake on the island of Cres (5.8 km^2).[13] The most famous Plitvice Lakes are the course of the river Korana transformed into 16 cascade lakes interconnected by travertine downstream beds.

The Republic of Croatia is also characterized by significant wetland areas, especially in flooded parts of Drava, Danube, Sava and Neretva catchments. Locations included in the Ramsar list in 1993 are: Kopački rit (17 700 ha) in the Drava and Danube cathments, Lonjsko and Mokro polje (50 560 ha) and Crna Mlaka (625 ha) in the Sava catchment and the lower Neretva part (11 500 ha) in the Adriatic catchment. In 2013, Vrana Lake (5 700 ha) was included into the list of internationally significant wetland areas.

The Adriatic Sea is the northernmost part of the Mediterranean Sea. Its salinity is by average 3.83 %, which is lower than the eastern Mediterranean Sea but higher than the western.[14] The total length of Croatia's coast is 6 278 km, out of which 1 800 km belongs to the mainland and 4 200 km to the island coastline. The highest measured depth is 1 233 m. The Croatian coastal area is separated from the inland with high mountains. Croatian islands include almost all islands of the Adriatic eastern coast and its central part making the second Mediterranean archipelago by size. There are 1 244 islands which are geographically distinguished as 79 islands, 525 islets, 640 cliffs (top above sea-level) and reefs (top below sea-level). Considering the number of islands, islets, cliffs and reefs, the Croatian Adriatic coast is one of the most indented in Europe. The islands are divided into the Istrian, Kvarner, north Adriatic, central Adriatic and south Adriatic group, with the largest islands of Cres (405.78 km^2), Krk (405.78 km^2), Brač (394.57 km^2) and Hvar (299.66 km^2).[15]

2.14. OTHER NATIONAL CIRCUMSTANCES

Contamination with mines left over as a result of the war operations in the Republic of Croatia causes a whole range of economic, developmental and social disturbances, in particular, the problem of security of the population in areas that were in the fields of war. Large agricultural areas, forest areas, border zone and parts of river banks are still inaccessible due to mine contamination or suspicion of mine contamination. Its decisiveness in solving the mine problem, the Republic of Croatia confirmed with the adoption of the Law on Demining in 1996, the establishment of the Croatian Mine Action Centre in 1998, with fulfilling the commitments undertaken by joining the Ottawa Convention, as well as providing for permanent and stable source of funding in the national budget, the World Bank loans and in the legal entities in the Republic of Croatia. The result of all anti-mine action activities since 1991 to the present includes following: suspected hazardous area is precisely defined, suspected hazardous area is significantly reduced, the number of mine incidents and mine victims are continuously reducing. In 2009 the National Mine Action Programme of the Republic of Croatia (»Official Gazette«, No. 120/2009) that gives, among other things, an overview of the current status of mine suspected area in the Republic of Croatia.

Defined size of mine suspected area in the Republic of Croatia on the 1st January 2017 was amounted to 446.6 km^2, which present 0.75 % of the land area of the Republic of Croatia. Mine suspected area encompasses 9 counties. Mine suspected area covers 60 cities and municipalities or almost one third of cities and municipalities of the Republic of Croatia. Almost 20 % of the total Croatian population live

[13] Statistical Yearbook 2017

[14] Croatian Hydrographic Institute

[15] Statistical Yearbook 2017

in the given number of cities and municipalities. According to the size of the mine suspected area, the mine most contaminated counties are the County of Lika-Senj, County of Sisak-Moslavina County of Osijek-Baranja, County of Karlovac, County of Zadar and County of Požega-Slavonija.

The largest share in the mine suspected area of the Republic of Croatian consists of forest areas with 92.6 % of total mine suspected area, then agricultural area with 7.1 % of suspected hazardous area. The most mine suspected areas are registered in the County of Lika-Senj (134 071 km2), County of Sisak-Moslavina (70 491 km^2), the County of Osijek-Baranja (55 649 km^2) and County of Karlovac (49 412 km^2).

3. GREENHOUSE GAS EMISSION INVENTORY INFORMATION FOR THE PERIOD 1990-2015

3.1. INTRODUCTION

In this chapter, the results of the greenhouse gas (GHG) emissions and removals calculation are presented for the period from 1990 to 2015, as calculated in National Inventory Report of the Republic of Croatia for the Period 1990-2015 (NIR 2017) [3]. The summary results of the greenhouse gas (GHG) emission calculation are presented for the period from 1990 to 2015. Further detail is provided in the Third Biennial Report.

3.2. OVERVIEW OF THE GREENHOUSE GAS EMISSION AND REMOVAL ESTIMATES AND TRENDS FOR THE PERIOD 1990-2015

Total emissions/removals of GHG and their trend in sectors are given in Tables 3-1, 3-2 and in Figure 3-1 while the contribution of the individual gases is given in Tables 3-3, 3-4 and Figure 3-2.

Table 3-1: Emissions/removals of GHG by sectors for the every five years from 1990 to 2005 (kt CO_2-eq)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1995	2000	2005
	CO_2 equivalent (kt)			
1. Energy	21 831.8	16 122.0	18 350.8	21 730.0
2. Industrial processes and product use	4 628.8	2 440.5	3 127.5	3 507.6
3. Agriculture	4 039.1	3 008.2	2 888.0	3 029.7
4. Land use, land-use change and forestry	-6 589.4	-9 109.3	-7 505.3	-7 808.1
5. Waste	654.0	739.5	889.0	1 045.0
6. Other	NO	NO	NO	NO
Total (with LULUCF)	**24 564.3**	**13 200.9**	**17 750.0**	**21 504.3**
Total (without LULUCF)	**31 153.7**	**22 310.2**	**25 255.3**	**29 312.4**

Table 3-2: Emissions/removals of GHG by sectors for the period from 2010-2015 (kt CO_2-eq)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	2012	2013	2014	2015
	CO_2 equivalent (kt)					
1. Energy	19 903.9	19 634.8	18 187.4	17 415.7	16 459.8	16 728.0
2. Industrial processes and product use	3 315.3	3 083.7	2 809.2	2 538.6	2 688.0	2 665.5
3. Agriculture	2 717.5	2 785.6	2 704.6	2 537.0	2 427.0	2 555.3
4. Land use, land-use change and forestry	-7 263.8	-6 250.8	-5 977.5	-6 521.8	-6 591.3	-4 991.7
5. Waste	1 392.4	1 424.6	1 420.7	1 431.3	1 474.1	1 553.3
6. Other	NO	NO	NO	NO	NO	NO
Total (with LULUCF)	**20 065.2**	**20 677.9**	**19 144.4**	**17 400.7**	**16 457.7**	**18 510.4**
Total (without LULUCF)	**27 329.0**	**26 928.7**	**25 121.9**	**23 922.5**	**23 049.0**	**23 502.1**

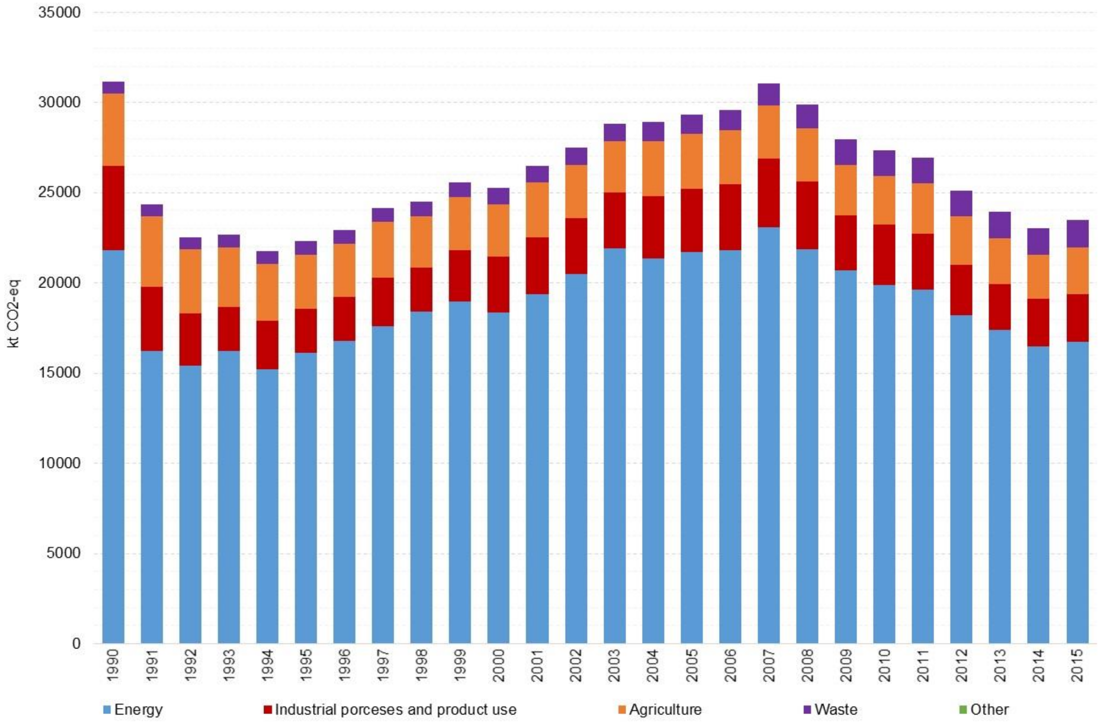

Figure 3-1: Trend of GHG emissions, by sectors

Table 3-3: Emissions/removals of GHG by gases for the every five years from 1990 to 2005 (kt CO_2-eq)

GREENHOUSE GAS EMISSIONS	**1990**	**1995**	**2000**	**2005**
	CO_2 equivalent (kt)			
CO_2 emissions without net CO_2 from LULUCF	23,390.1	16,992.8	19,789.1	23,451.8
CO_2 emissions with net CO_2 from LULUCF	16,762.7	7,837.6	12,088.4	15,572.3
CH_4 emissions without CH_4 from LULUCF	3,744.2	3,033.7	2,887.9	3,173.8
CH_4 emissions with CH_4 from LULUCF	3,745.4	3,041.2	2,984.8	3,176.5
N_2O emissions without N_2O from LULUCF	2,768.7	2,243.3	2,418.8	2,407.9
N_2O emissions with N_2O from LULUCF	2,805.5	2,281.7	2,517.4	2,476.7
HFCs	NO	29.3	147.9	265.8
PFCs	1,240.2	NO	NO	NO
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO
SF_6	10.5	11.1	11.6	13.0
NF_3	NO	NO	NO	NO
Total (without LULUCF)	**31,153.7**	**22,310.2**	**25,255.3**	**29,312.4**
Total (with LULUCF)	**24,564.3**	**13,200.9**	**17,750.0**	**21,504.3**
Total (without LULUCF, with indirect)	**NA**	**NA**	**NA**	**NA**
Total (with LULUCF, with indirect)	**NA**	**NA**	**NA**	**NA**

Table 3-4: Emissions/removals of GHG by gases for the for the period from 2010-2015 (kt CO_2-eq)

GREENHOUSE GAS EMISSIONS	2010	2011	2012	2013	2014	2015
	CO_2 equivalent (kt)					
CO_2 emissions without net CO_2 from LULUCF	21,203.7	20,759.4	19,172.4	18,525.4	17,777.1	17,918.7
CO_2 emissions with net CO_2 from LULUCF	13,863.6	14,402.2	13,054.5	11,925.0	11,109.4	12,826.7
CH_4 emissions without CH_4 from LULUCF	3,415.1	3,384.4	3,311.2	3,267.6	3,226.5	3,430.6
CH_4 emissions with CH_4 from LULUCF	3,416.8	3,403.1	3,350.1	3,269.5	3,226.9	3,444.6
N_2O emissions without N_2O from LULUCF	2,322.3	2,379.2	2,231.9	1,714.5	1,624.9	1,727.6
N_2O emissions with N_2O from LULUCF	2,396.9	2,467.0	2,333.3	1,791.2	1,701.0	1,813.9
HFCs	378.9	396.2	397.3	408.9	413.6	419.9
PFCs	0.0	0.0	0.0	0.1	0.1	0.0
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO
SF_6	9.0	9.4	9.2	6.1	6.8	5.3
NF_3	NO	NO	NO	NO	NO	NO
Total (without LULUCF)	**27,329.0**	**26,928.7**	**25,121.9**	**23,922.5**	**23,049.0**	**23,502.1**
Total (with LULUCF)	**20,065.2**	**20,677.9**	**19,144.4**	**17,400.7**	**16,457.7**	**18,510.4**
Total (without LULUCF, with indirect)	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total (with LULUCF, with indirect)	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

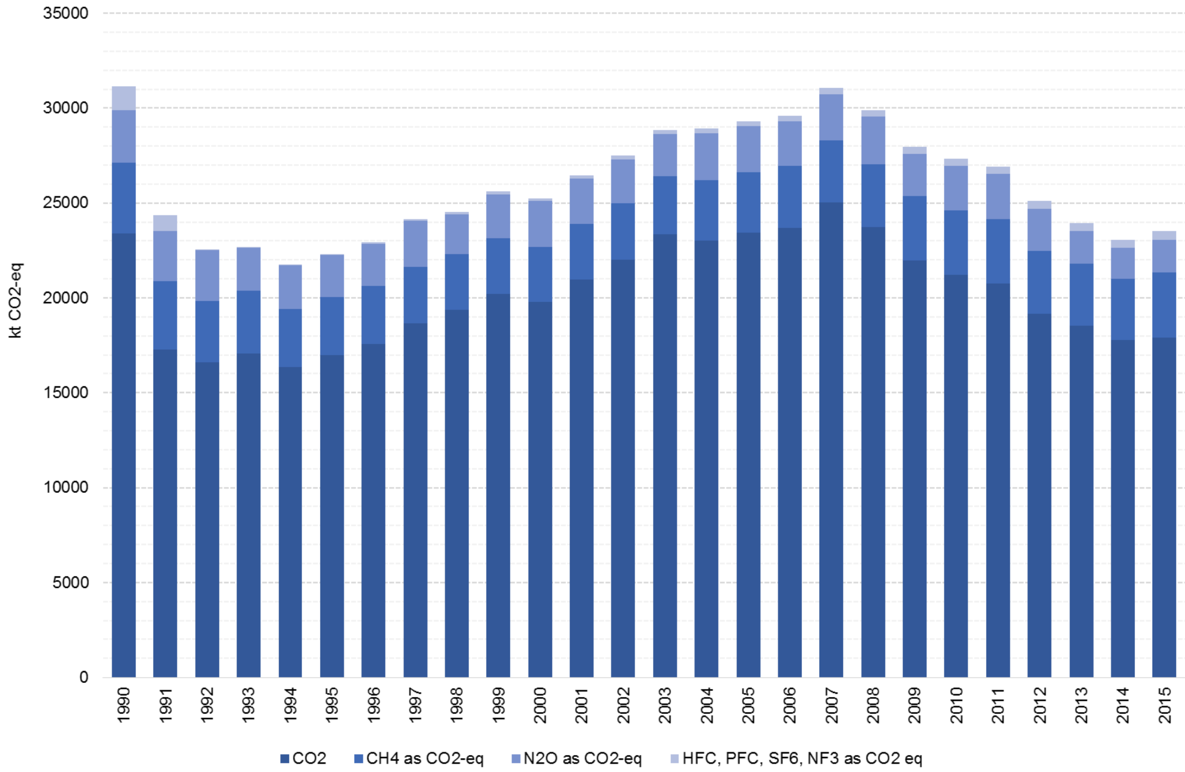

Figure 3-2: Trend of GHG emissions, by gases

3.3. DESCRIPTIVE SUMMARY OF THE GREENHOUSE GAS INVENTORY

3.3.1. Greenhouse gas emissions by sectors

The largest contribution to the GHGs emission in 2015 excluding LULUCF has the Energy sector with 71.2 %, followed by Industrial Processes and product use with 11.3 %, Agriculture with 10.9 % and Waste with 6.6 %. This structure is with minor changes consistent through all the observed period from 1990 to 2015. In the year 2015, the total GHG emissions in Croatia was 23 502.1 kt CO_2-eq excluding LULUCF sector while the total emission was 18 510.4 kt CO_2-eq including the LULUCF sector which represents removals by sink from 21.2 % in that year.

Energy sector

Energy sector is the largest contributor to GHG emissions. In the year 2015, the GHG emission from Energy sector was 1.6 % higher in relation to 2014 and 23.4 % lower in relation to 1990. Energy sector covers all activities that involve fuel combustion from stationary and mobile sources, and fugitive emission from fuels. The Energy sector is the main cause for anthropogenic emission of greenhouse gases. It accounts approximately 75 % of the total emission of all greenhouse gases presented as equivalent emission of CO_2. Looking at its contribution to total emission of carbon dioxide (CO_2), the energy sector accounts for about 90 %. The contribution of energy in methane (CH_4) in total CO_2-eq emission is substantially smaller (8 %) while the contribution of energy in nitrous oxide (N_2O) in total CO_2-eq emission is quite small (about 2 %). Emissions from fossil fuel combustion comprise the majority (more than 90 %) of energy-related emissions.

The largest part (35.6 % in 2015) of the emissions are a consequence of fuel combustion in Transport, then the combustion in Energy industries (28.7 % in 2015) and the combustion in small stationary energy sources, such as Commercial/ Institutional, Residential and Agriculture/ Forestry/ Fishing (19.3 % in 2015). Manufacturing Industries and Construction contribute to total emission from Energy sector with 13.3 %, while Fugitive Emissions from Fuels contribute with about 3.1 %.

Industrial processes and product use

In Industrial Processes sector, the key emission sources are Cement Production, Ammonia Production, Nitric Acid Production, Petrochemical and Carbon Black Production, Non-energy Products from Fuels and Solvent Use and Consumption of HFCs in Refrigeration and Air Conditioning Equipment, which all together contribute with 93.7 % in total sectorial emission in 2015. The iron production in blast furnaces and aluminium production ended in 1992, and ferroalloys production ended in 2003. Generally, GHG emissions from industrial processes declined from 1990 to 1995, due to the decline in industrial activities caused by the war in Croatia, while in the period 1996 - 2008 emissions slightly increased due to revitalization of the economy. The effects of the economic crisis influenced the emissions trend from 2008 onwards, followed by a moderate recovery since 2013. The decrease in emissions from chemical industry in 2013 and onwards is due to a strong reduction of N_2O emissions from the nitric acid production after applying abatement technology. In 2015 emissions from industrial processes were decreased by 0.8 % regarding 2014 and by 42.4 % regarding 1990. Industrial processes and product use contributes to total GHG emissions with 11.3 % in 2015.

Agriculture

Emission of CH_4 and N_2O in the Agricultural sector is conditioned by different agricultural activities. For the emission of CH_4, the most important source is livestock farming (Enteric Fermentation) which makes 40.1 % of sectoral CO_2-eq emission. The number of cattle showed continuous decrease in the period from 1990 to 2000. As a consequence, this led to CH_4 emission reduction. In the year 2000, the number of cattle has started increasing and this trend was mostly retained until 2006. From 2007 to 2010, cattle number decreased and remained at approximately the same level in 2013 and 2014. Compared to 2014, in 2015 CH_4 emission from Enteric fermentation increased by 4.83 %. As for Manure management emissions, CH_4 emission increased by 5.31 % in 2015 compared to 2014 while N_2O emission increased by 6.82 %. Emissions from Agricultural soils decreased after 1990 and during the war due to specific national circumstances and limited agricultural practice at that time. Afterwards, the emission trend is mostly influenced by the changes in the direct soil emissions; thus, emission increase can be noticed in 1997, 2001 and 2002 due to increase in mineral fertilizer consumption and crop production, later on also due to the increase of livestock population. N_2O emission from Agricultural soils increased in 2015 compared to 2014 by 5.22 percent. Overall, in the year 2015 the GHG emission from Agriculture sector increased by 5.02 % in comparison with 2014.

LULUCF

The Low on Forest (Official Gazette No. 140/05, 82/06, 129/08, 80/10, 124/10, 25/12, 68/12, 148/13, 94/14) regulates the growing, protection, usage and management of forests and forest land as a natural resource aimed to maintain biodiversity and ensure management based on principles of economic sustainability, social responsibility and ecological acceptability. Moreover, one of its the most important provisions, in the context of climate protection, is that forests should be managed in conformity with the sustainable management criteria, implying the maintenance and enhancement of forest ecosystems and their contribution to the global carbon cycle. Planning activities in forestry sector in Croatia are also regulated by the Low on Forest. Forest management plans determine conditions for harmonious usage of forest and forest land and procedures in that area, necessary scope regarding cultivation and forest protection, possible utilization degree and conditions for wildlife management. The Forest Management Area Plan (FMAP) for the Republic of Croatia determines the ecological, economic and social background for forest improvement in terms of biology and for the increase of forest productivity.

According to Forest Management Area Plan of the Republic of Croatia for the period 2016-2025, the forests and the forest land cover 47.5 % of the total surface area. By its origin, approximately 95 % of the forests in Croatia were formed by natural regeneration (according to the national definitions applied in the sector) and the 5 percent of the forests are grown artificially. The Plan determined the growing stock of 418 618 277 m^3 while its yearly increment amounts around 10.1 million of m^3. The most frequent species are Common Beech (Fagus sylvatica), Pedunculate Oak (Quercus robur), Sessile Oak (Quercus petrea), Common Hornbeam (Carpinus betulus), Silver Fir (Abies alba), Narrow-leafed Ash (Fraxinus angustifolia), Spruce (Picea abies), Turkey Oak (Quercus cerris), Black Locust (Robinia pseudoacacia), Black Alder (Alnus glutinosa) and other. The methodology used for CO_2 removal calculation is taken from the IPCC and it is based on data on increment and felling. The problem of deforestation in Croatia does not exist. According to present data the total forest area has not been reduced in the last 100 years.

Removal arisen in LULUCF sector contribute with 28.5 % to the total emissions of CO_2-eq in Croatia in year 2015.

Waste

Waste Waste sector includes following categories: solid waste disposal, biological treatment of solid waste, incineration and open burning of waste and wastewater treatment and discharge. Solid waste disposal represents dominant CH_4 emission source from that sector. Generally, 80.7 % of sectoral emissions refer to the emissions from solid waste disposal in 2015, compared to 53.3 % in 1990. An increase in generated solid waste exists during the entire reporting period, particularly until 2009. Starting with 2009 there is a decrease in registered waste quantities, caused primary by economic crisis but also other factors regarding to effects of measures undertaken to avoid/reduce and recycle waste. 18.6 % of sectoral emissions refer to the emissions from wastewater treatment and discharge in 2015, compared to 46.6 % in 1990. Decrease in emissions during the entire reporting period mainly is a result of population decrease (domestic wastewater) as well economic crisis that affected the reduction of economic activity from 2008 onwards (industrial wastewater). Biological treatment of solid waste and incineration and open burning of waste have considerably lower contribution to the sectoral emissions during the reporting period. Waste sector contributes to total GHG emissions with 6.6 % in 2015.

3.3.2. Greenhouse gas emissions by gases

The largest contribution to the GHGs emission in 2015 excluding LULUCF has CO_2 emission with 76.2 %, followed by CH_4 with 14.6 %, N_2O with 7.4 % and HFCs, PFCs and SF_6 with 1.8 %.

Carbon dioxide emission (CO_2)

Carbon dioxide is the most significant anthropogenic GHG. The most significant anthropogenic sources of CO_2 emissions in Croatia are the processes of fossil fuel combustion for electricity or/and heat production, transport and industrial processes (cement and ammonia production).

The energy most intensive stationary sub-sector is Energy Industries (electricity and heat production, refineries and oil and gas field combustion). In the framework of the sub-sector Manufacturing Industries and Construction, the largest CO_2 emissions are the result of fuel combustion in industry of construction material and petrochemical production, followed by food processing industry, chemical industry, industry of pulp, paper and print, iron and steel industry and non-ferrous metal industry. Furthermore, this sub-sector includes electricity and heat production in manufacturing industry for manufacturing processes.

Transport sector is also one of more important CO_2 emission sources. This sector includes emission from road transport, civil aviation, railways and navigation. In the year 2015, the CO_2 emission from Transport sector contributed with 32.8 % to the national total CO_2 emission. The largest part of the CO_2 emission from Transport sector arises from road transport (96.3 % of CO_2 emission from transport sector in 2015) followed by national navigation, domestic civil aviation and railways.

Biomass combustion (fuel wood and waste wood, biodiesel, biogas) also results in greenhouse gas emissions. CO_2 emission from biomass is not included in balance according the Guidelines, due to assumption that life-cycle CO_2 emitted is formerly absorbed for the growth of biomass. Sinks or CO_2 emissions resulted in change of forest biomass is calculated in LULUCF sector.

Fugitive GHG emission from coal, liquid fuels and natural gas, resulted from exploration of minerals, production, processing, transport, distribution and activities during mineral use is also included in this sector.

The most significant CO_2 industrial processes emission sources are production of cement, ammonia and lime. In 2015, mineral industry contributes in total sectorial CO_2 emission with 68.2 % and chemical industry with 27.9 %. Generally, CO_2 emissions from industrial processes declined from 1990 to 1995, due to the decline in industrial activities caused by the war in Croatia, while in the period 1996-2008 emissions slightly increased. Production of iron and aluminium was stopped in 1992. A decrease of economic activities after 2008 influenced a reduction in cement, lime, ammonia and steel productions. In 2015 CO_2 emissions from industrial processes decreased by 2.9 % compared to year 2014.

Methane emission (CH_4)

The major sources of methane (CH_4) emission are fugitive emission from production, processing, transportation and activities related with fuel use in Energy sector, Agriculture and Waste Disposal on Land.

In the Agricultural sector there are two significant methane emission sources present: enteric fermentation in the process of digestion of ruminants (dairy cows represent the major source) and different activities related with storage and use of organic fertilizers (manure management). The total methane emission for domestic animals is being calculated as a sum of emission from enteric fermentation and emission related to manure management. The emission trend depends on the livestock population trend.

Methane emission from solid waste disposal sites (SWDSs) is a result of anaerobic decomposition of organic waste by methanogenic bacteria. The amount of methane emitted during the process of decomposition is directly proportional to the fraction of degradable organic carbon (DOC) which is defined as carbon content in different types of organic biodegradable wastes. In Croatia, more than 1.6 million tons of municipal solid waste is produced annually and the average composition of it biodegradable part is: paper and textile (21-22 percent), garden and park waste (18-19 %), food waste (23-24 %), wood waste and straw (3 %). As for the Wastewater treatment and discharge in Croatia, aerobic biological process is used mostly in wastewater treatment. Anaerobic process is applied in some industrial wastewater treatment, which results with CH_4 emissions. Disposal of domestic and commercial wastewater, particularly in rural areas where systems such as septic tanks are used, are partly anaerobic without flaring, which results with CH_4 emissions.

Nitrous oxide emission (N_2O)

The most important sources of N_2O emissions in Croatia are agricultural activities, nitric acid production, but as well, the N_2O emissions occur in energy sector and waste management.

In the Agricultural sector, three N_2O emission sources are determined: direct N_2O emission from agricultural soils, direct N_2O emission from livestock farming and indirect N_2O emission induced by agricultural activities. According to IPCC methodology, the mineral nitrogen, nitrogen from organic fertilizers, amount of nitrogen in fixing crops, amount of nitrogen which is released from crop residue mineralization, soil nitrogen mineralization due to cultivation of histosols and amount of nitrogen from the application of sewage sludge is are separately analyzed.

In Industrial Processes sector, the N_2O emission occurs in nitric acid production, which is used as a raw material in nitrogen mineral fertilizers. In the framework of the N_2O reduction measure analysis, the possibility for application of non-selective catalytic reduction device was considered, whereby the nitric acid production influence on N_2O emissions would be practically eliminated.

In Energy sector the emission was calculated on the basis of fuel consumption and adequate emission factors (IPCC). The major sources of N_2O emission in Energy sector is use of three-way catalytic converters in road transport motor vehicles.

N_2O emission from the Waste sector indirectly occurs from human sewage. It is calculated on the basis of the total number of inhabitants and annual protein consumption per inhabitant. Data on the annual per capita Protein Intake Value were obtained by the FAOSTAT Statistical Database. Extrapolation method has been used for calculation of insufficient data.

Halogenated carbons (HFC, PFC), SF6 and NF3 emissions

Synthetic GHGs include halogenated carbons (HFCs and PFCs) and sulphur hexafluoride (SF_6). Although on an absolute scale their emissions are not great, due to their high global warming potential (GWP) their contribution to global warming is considerable. MEE is responsible for monitoring of consumption of substitutes and mixture of substitutes for gases that deplete the ozone layer. There is no production of HFCs PFCs, SF_6 and NF_3 in Croatia; therefore, all quantities of these gases are imported. Minor quantities of some substances are exported.

Croatia is an Article 5 country, according to the Montreal protocol, and has a longer period for using CFC, HCFC and halons. Because of that, Croatia started using HFCs 10 years later than other Annex I countries. According to survey carried out among major agents, users and consumers of these gases, information related to consumption of HFCs, PFCs, SF_6 and NF_3 (provided by the MEE) was used for emission calculation.

Other information (e.g. indirect ghgs)

The photochemicaly active gases, carbon monoxide (CO), oxides of nitrogen (NO_X) and non-methane volatile organic compounds (NMVOCs) indirectly contribute to the greenhouse gas effect. These are generally called indirect greenhouse gases or ozone precursors, because they are involved in creation and degradation of ozone which is also one of the greenhouse gases. Sulphur dioxide (SO_2), as a precursor of sulphate and aerosols, is believed to contribute negatively to the greenhouse effect. Emissions of indirect GHGs have been taken from the draft of emission inventory report 'Republic of Croatia Informative Inventory Report for LRTAP Convention for the Year 2015 Submission to the Convention on Long-range Transboundary Air Pollution'.

Although Parties may now choose to report indirect CO_2, in accordance with paragraph 29 of the UNFCCC Inventory Reporting Guidelines, Croatia does not choose to report indirect CO_2 emissions from the atmospheric oxidation of CH_4, CO and NMVOCs, or indirect N_2O emissions arising from sources other than those in the agriculture and LULUCF sectors.

3.3.3. Uncertainty assessment and verification

The uncertainties associated with both annual estimates of emissions and emission trends over time are reported according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The uncertainties are estimated using Tier 1 and Tier 2 (Monte Carlo analysis) methods described by the IPCC, which provide estimates of uncertainties by pollutant. The uncertainties are estimated for both excluding LULUCF and including LULUCF due to the Good Practice Guidance for Land Use, Land-Use Change and Forestry.

Uncertainty in the emissions and the trend excluding LULUCF

The estimate of CO_2-eq emissions in 2015 was estimated at 23 502.15 kt CO_2-eq. The estimate of CO_2-eq emissions in 1990 was estimated at 31 153.70 kt CO_2-eq. Monte Carlo analysis shows that with a certainty of 95 % it can be stated that the total simulated emissions of all categories excluding LULUCF for the year 1990 varies between 30 381.83 kt CO_2-eq (2.5 % percentile) and 32,804.17 kt CO_2-eq (97.5 % percentile). The Inventory trend excluding LULUCF is -24.56%, simulated trend is -24.44 % and the 95 % probability range of the trend is -28.78 % (2,5 % percentile) to -19.73 % (97.5 % percentile).

Uncertainty in the emissions and the trend including LULUCF

The estimate of CO_2-eq emissions in 2015 was estimated at 18 510.43 kt CO_2-eq. The estimate of CO_2-eq emissions in 1990 was estimated at 24 564.27 kt CO_2-eq. Monte Carlo analysis shows that with a certainty of 95 % we can say that the total emissions of categories for the year 2015 according to simulation varies between 15 727.38 kt CO_2-eq (2.5 % percentile) and 29 590.28 kt CO_2-eq (97.5 % percentile). The Inventory trend including LULUCF is -24,64 %, simulated trend is -18.64 % and the 95 % probability range of the trend is -46.56 % (2,5% percentile) to 14.97 % (97.5 % percentile), so the uncertainty introduced in trend varies from -21.91 % to 39.62 % with respect to the base year emissions.

The results of the uncertainty analysis are used to drive improvements of the inventory. Most efforts were made to collect detailed information on AD and EFs (especially country-specific EFs) in order to improve accuracy of the emission calculation.

Verification

The verification process of calculation is aimed at the improvement of the input quality and identification of the calculation reliability. The IPCC Guidelines recommend that inventories should be verified through the use of a set of simple checks for completeness and accuracy, such as checks for arithmetic errors, checks of country estimates against independently published estimates, checks of national activity data against international statistics and checks of CO_2 emissions from fuel combustion calculated using sectoral methods with the IPCC Reference Approach. Further verification checks may be done through comparison with other national inventory calculation data.

In the development of the Croatian inventory, certain steps and some of these checks were performed:

- Comparison with the national inventory data of other countries was conducted by comparing CRF tables or through a direct communication;
- Activity data were compared using different sources such as Croatian Bureau of Statistics and individual emission sources;

- The CO_2 emissions from fossil fuel combustion, within the framework of IPCC methodology, are estimated using two approaches: (1) Reference Approach and (2) Sectoral Approach (Tier 1).

3.3.4. Key categories

According to the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, key categories are those which represent 95% (Tier 1) or 90% (Tier 2) of the total annual emissions in the last reported year or belonging to the total trend, when ranked from contributing the largest to smallest share in annual total and in the trend.

Summary table with the key categories identified for the latest reporting year (by level and trend) on the basis of table 4.4 of volume 1 of the 2006 IPCC Guidelines is provided in Table 3-5.

Table 3-5: Key categories summary table for 2015

IPCC Source Categories	GHG	Criteria for Identification of key category			
1. Energy					
1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO_2	L1e, L2e	T1e	L1i	
1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO_2	L1e, L2e	T1e, T2e	L1i	T1i, T2i
1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO_2	L1e, L2e	T1e, T2e	L1i	T1i, T2i
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO_2	L1e	T1e, T2e	L1i	T1i
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO_2	L1e, L2e	T1e, T2e	L1i	T1i
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO_2	L1e	T1e, T2e	L1i,	T1i, T2i
1.A.3.b Road Transportation	CO_2	L1e, L2e	T1e, T2e	L1i, L2i	T1i, T2i
1.A.3.b Road Transportation	N_2O	L2e	T2e		
1.A.4 Other Sectors - Biomass	CH_4	L1e, L2e	T1e, T2e	L1i, L2i	T1i, T2i
1.A.4 Other Sectors - Biomass	N_2O	L2e	T2e		
1.A.4 Other Sectors - Gaseous Fuels	CO_2	L1e, L2e	T1e, T2e	L1i	T1i, T2i
1.A.4 Other Sectors - Liquid Fuels	CO_2	L1e, L2e	T1e, T2e	L1i	T1i
1.A.4 Other Sectors - Liquid Fuels	N_2O	L2e			
1.A.4 Other Sectors - Solid Fuels	CO_2		T1e, T2e		T1i,
1.B.2.a Fugitive Emissions from Fuels - Oil and Natural Gas - Oil	CO_2		T2e		T1i,
1.B.2.a Fugitive Emissions from Fuels - Oil and Natural Gas - Oil	CH_4		T1e, T2e		T1i, T2i
1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CH_4	L2e		L1i	
1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CO_2	L1e, L2e	T1e, T2e	L1i, L2i	T1i, T2i
2. Industrial Processes and Product Use					
2.A.1 Cement Production	CO_2	L1e	T1e	L1i	T1i
2.B.1 Ammonia Production	CO_2	L1e	T1e	L1i	T1i
2.B.2 Nitric Acid Production	N_2O	L1e	T1e	L1i	T1i
2.B.8 Petrochemical and Carbon Black Production	CO_2		T1e, T2e		T1i, T2i
2.C.2 Ferroalloys Production	CO_2		T1e		T1i
2.C.3 Aluminium Production	CO_2		T1e		T1i
2.C.3 Aluminium Production	PFCs		T1e		T1i

2.D Non-energy Products from Fuels and Solvent Use	CO_2		T2e		T1i
2.F.1 Refrigeration and Air conditioning - Aggregate	F-gases	L1e, L2e	T1e, T2e	L1i	T1i, T2i
3. Agriculture					
3.A Enteric Fermentation	CH_4	L1e, L2e	T1e, T2e	L1i, L2i	T1i, T2i
3.B Manure Management	CH_4	L1e	T1e	L1i	T1i
3.B Manure Management	N_2O	L1e, L2e	T1e, T2e	L1i	T1i, T2i
3.D.1 Direct N2O Emissions From Managed Soils	N_2O	L1e, L2e		L1i, L2i	
3.D.2 Indirect N2O Emissions From Managed Soils	N_2O	L1e, L2e	T2e	L1i, L2i	T2i
4. LULUCF					
4(III).Direct N2O emissions from N mineralization/immobilization	N_2O			L2i	T2i
4(V) Biomass Burning	CO_2				T1i
4.A.1 Forest Land Remaining Forest Land	CO_2			L1i, L2i	T1i, T2i
4.A.2 Land Converted to Forest Land	CO_2			L1i, L2i	T1i, T2i
4.B.1 Cropland Remaining Cropland	CO_2			L2i	T2i
4.B.2 Land Converted to Cropland	CO_2			L2i	
4.C.2 Land Converted to Grassland	CO_2			L2i	T2i
4.D.2 Land Converted to Wetlands	CO_2				T2i
4.E.2 Land Converted to Settlements	CO_2			L1i, L2i	T1i, T2i
4.G Harvested Wood Products	CO_2			L2i	T1i, T2i
5. Waste					
5.A Solid Waste Disposal	CH_4	L1e, L2e	T1e, T2e	L1i, L2i	T1i, T2i
5.D Wastewater Treatment and Discharge	CH_4	L1e, L2e		L1i	
5.D Wastewater Treatment and Discharge	N_2O	L2e	T2e		

L1e - Level excluding LULUCF - Tier1 T1e - Trend excluding LULUCF - Tier1
L2e - Level excluding LULUCF - Tier2 T2e - Trend excluding LULUCF - Tier2
L1i - Level including LULUCF - Tier1 T1i - Trend including LULUCF - Tier1
L2i - Level including LULUCF - Tier2 T2i - Trend including LULUCF - Tier2

3.4. INSTITUTIONAL AND ORGANIZATIONAL STRUCTURE FOR THE PREPARATION OF THE NATIONAL INVENTORY OF THE GREENHOUSE GAS EMISSIONS

3.4.1. National system

Institutional arrangement for inventory preparation in Croatia is regulated in Chapter II of the Regulation on the Monitoring of Greenhouse Gas Emissions, Policies and Mitigation Measures in the Republic of Croatia entitled National system for the estimation and reporting of anthropogenic greenhouse gas emissions by sources and removals by sinks. Institutional arrangements for inventory management and preparation in Croatia could be characterized as decentralized and out-sourced with clear tasks breakdown between participating institutions including Ministry of Environment and Energy (MEE), Croatian Agency for the Environment and Nature (CAEN) and competent governmental bodies responsible for providing of activity data. The preparation of inventory itself is entrusted to Authorised Institution which is elected for three year period by public tendering. Committee for inter-sectorial coordination for national system for monitoring of GHG emission (National System Committee) is included in the approval process; its members provide their opinion on certain parts of the Inventory within the frame of their speciality. Members of the National System Committee are nominated by the authorized Ministries and others relevant Institutions upon the request of the MEE.

MEE is a national focal point for the UNFCCC, with overall responsibility for functioning of the National system in a sustainable manner, including:

- mediation and exchange of data on greenhouse gas emissions and removals with international organisations and Parties to the Convention;
- mediation and exchange of data with competent bodies and organisations of the European Union in a manner and within the time limits laid down by legal acts of the European Union;
- control of methodology for calculation of greenhouse gas emissions and removals in line with good practices and national circumstances;
- consideration and approval of the National Inventory Report prior to its formal submission to the Convention Secretariat.

CAEN is responsible for the following tasks:

- organisation of greenhouse gas inventory preparation with the aim of meeting the due deadlines;
- collection of activity data;
- development of quality assurance and quality control plan (QA/QC plan) related to the greenhouse gas inventory in line with the guidelines on good practices of the Intergovernmental Panel on Climate Change;
- implementation of the quality assurance procedure with regard to the greenhouse gas inventory in line with the quality assurance and quality control plan;
- archiving of activity data on calculation of emissions, emission factors, and of documents used for inventory planning, preparation, quality control and quality assurance;
- maintaining of records and reporting on authorised legal persons participating in the Kyoto Protocol flexible mechanisms;
- selection of Authorised Institution (in Croatian: Ovlaštenik) for preparation of the greenhouse gas inventory;
- provide insight into data and documents for the purpose of technical reviews.

Authorised Institution is responsible for preparation of inventory, which include:

- emission calculation of all anthropogenic emissions from sources and removals by greenhouse gas sinks, and calculation of indirect greenhouse gas emissions, in line with the methodology stipulated by the effective guidelines of the Convention, guidelines of the Intergovernmental Panel on Climate Change, Instructions for reporting on greenhouse gas emissions as published on the Ministry's website, and on the basis of the activities data;
- quantitative estimate of the calculation uncertainty for each category of source and removal of greenhouse gas emissions, as well as for the inventory as a whole, in line with the guidelines of the Intergovernmental Panel on Climate Change;
- identification of key categories of greenhouse gas emission sources and removals;
- recalculation of greenhouse gas emissions and removals in cases of improvement of methodology, emission factors or activity data, inclusion of new categories of sources and sinks, or application of coordination/adjustment methods;
- calculation of greenhouse gas emissions or removal from mandatory and selected activities in the sector of land use, land-use change and forestry;
- reporting on issuance, holding, transfer, acquisition, cancellation and retirement of emission reduction units, certified emission reduction units, assigned amount units and removal units, and carry-over, into the next commitment period, of emission reduction units, certified emission reduction units and assigned amount units, from the Registry in line with the effective decisions and guidelines of the Convention and supporting international treaties;

- implementation of and reporting on quality control procedures in line with the quality control and quality assurance plan;
- preparation of the greenhouse gas inventory report, including also all additional requirements in line with the Convention and supporting international treaties and decisions;
- cooperation with the Secretariat's ERTs for the purpose of technical review and assessment/evaluation of the inventory submissions.

EKONERG – Energy Research and Environmental Protection Institute was selected as Authorised Institution for preparation of inventory submission for present three year period.

Process of inventory preparation encompasses several steps starting with activity data collection on the basis of the Program of data collection and followed by emissions estimation and recalculations in accordance with the IPCC methodology and recommendations for improvements provided by the ERT, compilation of inventory including the NIR and the Common Reporting Format (CRF) tables and in parallel implementation of general and source category specific quality control procedures. Activity data sources for inventory preparation are presented in the Table 3-6.

3.4.2. National registry

Initially each EU member state had its own GHG register. Since June 2012, the GHG registries of the EU member states have been consolidated into one system - the EUCR (European Union Consolidated Registry), which is managed and maintained by the European Commission. The Union Registry is linked to the European Transaction Log (EUTL) and the International Transaction Log (ITL).

The Union Registry is a systematized and computerized database in which accounts of greenhouse gas emission trading participants are kept. It records and monitors compliance with the law on the obligations of the installation and aircraft operators, records the transactions and the amounts of the allocated free emission units. The registry ensures accuracy, transparency and public availability of data on the fulfilment of obligations. The functional requirements of the registry are determined by the European Commission through the Registry regulation and by the UNFCCC Secretariat through various COP/MOP decisions. All publicly available information from the Union Registry can be found on the European Transaction Log (EUTL) website. On 17.01.2013 the Croatian GHG register became part of the Union Registry, six months before Croatia became a full member of the EU. Within the unified Union Registry each member state has its own national part of the Registry and a national administrator.

The National Administrator of the Croatian part of the Union Registry is Croatian Agency for the Environment and Nature, pursuant to Art. 101, para 2, of Air Protection law (OG 130/11, 47/14, 61/17). The Agency is responsible for managing the Croatian part of the Union Registry, which includes opening and managing ETS accounts, performing transactions on national Kyoto and ESD accounts, producing public reports and publishing information in accordance with international and national regulations. Information on changes in the Registry, as defined in the NIR 2017, are shown in the table 3-6.

Table 3-6: Changes in Natioanl Registry

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(a) Change of name or contact	Addition of national administrator team member: Mr. Dino Križnjak Senior Adviser in Climate Change Unit, Croatian Agency for the environment and nature Radnička cesta 80, 10 000 Zagreb, Croatia

	Phone: +385 1 5581 676 Fax: +385 1 4886 850 E-mail: dino.kriznjak@azo.hr
15/CMP.1 annex II.E paragraph 32.(b) Change regarding cooperation arrangement	No change of cooperation arrangement occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(c) Change to database structure or the capacity of national registry	New tables were added to the CSEUR database for the implementation of the CP2 SEF functionality. Versions of the CSEUR released after 6.7.3 (the production version at the time of the last Chapter 14 submission) introduced other minor changes in the structure of the database. These changes were limited and only affected EU ETS functionality. No change was required to the database and application backup plan or to the disaster recovery plan. The database model, including the new tables, is provided in the document Annex A, available upon request due to the confidentiality of the data. No change to the capacity of the national registry occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(d) Change regarding conformance to technical standards	Changes introduced since version 6.7.3 of the national registry are listed in the document Annex B, available upon request due to the confidentiality of the data. Each release of the registry is subject to both regression testing and tests related to new functionality. These tests also include thorough testing against the DES and were successfully carried out prior to the relevant major release of the version to Production (see Annex B). Annex H testing was completed in January 2017 and the test report (document Annex H) is available upon request, due to the confidentiality of the data. No other change in the registry's conformance to the technical standards occurred for the reported period.
15/CMP.1 annex II.E paragraph 32.(e) Change to discrepancies procedures	No change of discrepancies procedures occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(f) Change regarding security	The mandatory use of hardware tokens for authentication and signature was introduced for registry administrators.
15/CMP.1 annex II.E paragraph 32.(g) Change to list of publicly available information	No change in the list of publicly available information with regards to confidentiality of information occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(h) Change of Internet address	No change of the registry internet address occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(i) Change regarding data integrity measures	No change of data integrity measures occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(j) Change regarding test results	Changes introduced since version 6.7.3 of the national registry are listed in the document Annex B, available upon request due to the confidentiality of the data. Both regression testing and tests on the new functionality were successfully carried out prior to release of the version to Production. The site acceptance test was carried out by quality assurance consultants on behalf of and assisted by the European Commission and the report (document Annex B) is available upon request due to the confidentiality of the data. Testing was carried out in January 2017 and the test report (document Annex H) is available upon request due to the confidentiality of the data.
1/CMP.8 paragraph 23 PPSR account	Previous period surplus reserve (PPSR) account will be stablished in the Consolidated System of European Registries (CSEUR).
The Annexes A, B and H are considered as confidential and are available upon request.	

4. POLICIES AND MEASURES

4.1. INTRODUCTION

4.1.1. General and development policy

In 2017, the Law on the System of Strategic Planning and Management of the Development of the Republic of Croatia (OG 123/17) was adopted. This Law regulates the system of strategic planning of the Republic of Croatia and the management of public policies, i.e. the preparation, development, implementation, reporting, monitoring of implementation and impacts and evaluation of strategic planning documents for the design and implementation of public policies which, in accordance with their competencies, authorities create.

The National Development Strategy is the highest hierarchical document. Subsequently, there are several sector and sector strategies, then plans and programs. It is currently drafting the first National Development Strategy of the Republic of Croatia until 2030, the plan is to be adopted by 2020 [4]. Currently, the strategic development of the Republic of Croatia is based on a series of multi-sectorial and sectorial strategies, plans and programs.

As an important current document defining development policy by 2020, the Government Program of the Republic of Croatia for the mandate of 2016-2020 [5] can be emphasized. The main goals are:

- achieving a stable and lasting economic growth;
- creation of new and quality jobs;
- stopping emigration of the population and demographic renewal;
- social justice and solidarity.

In the field of ecology, sustainable development and environmental protection, the following specific objectives are:

- protection of Croatian natural resources;
- integrated water management and protection of national water resources;
- adaptation to climatic change;
- efficient waste management.

In the area of energy, it is emphasized that new Energy Development Strategy is being developed with specific objectives:

- improving the security of oil supply in Croatia and the EU;
- Improving the security of gas supply in Croatia and the EU.

4.1.2. Environmental protection policy in the context of climate change mitigation

The Ministry of Environment and Energy (MEE) is responsible for the overall national policy of environmental protection, including climate change and reporting on the implementation of policies and measures and on emission projections. The Croatian Agency for the Environment and Nature (CAEN) is responsible for organizing the preparation of the Inventory of greenhouse gas emissions, data collection, preparation of quality assurance and quality control plan and selection of an authorized institution for a three-year period. Update of the Report on the implementation of policies and measures to reduce emissions and enhance sinks of greenhouse gases and Report on projections of greenhouse gas emissions is organized in two-year cycles, according to Regulation (EU) No 525/2013.

With the Decision of the Government in accordance with the Air Protection Act (OG 130/11, 47/14, 61/17) in 2014 was established Committee for inter-sectorial coordination of policies and measures for mitigation and adaptation to climate change (OG 114/14). This Committee was in charge for monitoring and evaluation of the implementation and planning of policies and mitigation and adaptation measures for climate change in the Republic of Croatia. To this Committee were appointed representatives of competent state administration bodies and other relevant institutions, agencies and non-governmental organizations. The composition of the Committee, the tasks and the manner of the work of the Committee were determined by the above mentioned Government decision.
The Commission consists of a Coordination Group and a Technical Working Group, and the Coordination Group carries out the following tasks:

- evaluates and proposes to the Government of the Republic of Croatia the adoption of strategic documents related to the policies and measures to mitigate and adapt to climate change, taking into account long-term goals and feasibility with regard to technical, economic, sociological constraints, compliance with sectorial and local planning documents, and international obligations in all sectors;
- provide suggestions of the goals, policies and measures, and ways of monitoring the effects of policies and measures;
- provide suggestions and support in promoting effective interdisciplinary and synergistic activities, policies and measures.

Regarding to changes in the Government during 2017, in the beginning of 2018 Ministry of Environment and Energy started with reconstruction of this Committee.

It is possible to highlight the drafting of the Low Carbon Development Strategy of the Republic of Croatia by 2030 with a view to 2050 [2]. It is a multi-sectorial development strategy and a base for emission reduction by sectors in line with European strategic guidelines and UNFCCC commitments. Low-carbon Development Strategy should provide the basis for policy decisions and guidelines that all sectors will have to implement in order to significantly reduce greenhouse gas emissions. This Strategy should provide a transition towards a low-carbon and competitive economy whose growth is based on sustainable development. The Strategy has gone through public consultations but has not yet been adopted.

4.2. POLICIES AND MEASURES BY SECTORS

Policies and measures that are subject of this report are included in the ‘with existing measures’ and ‘with additional measures’ scenarios along with ‘without measures’ scenario in the "Report on projections of greenhouse gas emissions." The above report has been prepared as a separate document.

Policies and measures to reduce emissions from sources and increase sinks of greenhouse gases are shown separately for the following sectors:

- energy
- transport
- industrial processes
- waste management
- agriculture

- land use, land use change and forestry (LULUCF)
- other (cross-cutting) policies and measures.

EU ETS, as a common EU, supranational, cross-cutting measure is listed with the other (cross-cutting) policies and measures.

4.2.1. Energy

The important currently actual strategies and plans include Energy Strategy (OG 130/09), Long-Term Strategy for Mobilising Investment in the Renovation of the National Building Stock (OG 74/14), Plan for protection of air, ozone layer and climate change mitigation in the Republic of Croatia for the period from 2013 to 2017 (OG 139/13), National Renewable Energy Action Plan (ME, 2013), Program for the Energy Efficiency in Heating and Cooling (ME, 2016), Plan for the use of Funds from the Sale of Emission Allowances in the EU ETS for the Period 2014-2016, new Plan for the use of Funds from the Sale of Emission Allowances in the EU ETS for the Period until 2020 (NN 19/18), set of national programs and plans for the renovation of existing buildings and increase of nearly-zero energy buildings (described later) and national Operational programs for the use of EU Funds [6].

Planning periods of some of the existing plans have expired, but important policy documents are either available in draft versions or in the process of development. Among them are Low-Carbon Development strategy until 2030 with a view to 2050, Energy Strategy, 4th National Energy Efficiency Action Plan for the Period 2017-2019, Action Plan for the Implementation of the Low-Carbon Development Strategy for the First 5-year Period, Program for the Energy Efficiency in Public Lighting until 2025 and Integrated Energy-Climate Plan for the Period 2021-2030.

The measures described below are taken from the listed documents, but also from the other national or EU legislation if applicable for the reduction of GHG emissions.

MEN-1: National Plan for the Increase of the Number of Nearly-Zero Energy Buildings

According to the Directive 2010/31/EU on Energy Performance of Buildings (EPBD), MS have to ensure that after 31st December 2020 all new buildings are build according to nearly zero energy (nZEB) standard for buildings, and all new buildings in which stay or are owned by the public bodies should be built according to the nZEB standard after 31st December 2018.

The calculations of the cost-optimal levels of minimum criteria for the energy performances of all types of buildings were done in 2013 and 2014. In Technical Regulation OG 128/15 the definitions of nZEB buildings were adopted to ensure to fulfilment of the requirements of the EPBD.

National Plan for the Increase of nZEB buildings was adopted in December 2014. The Program for the stimulation of the building new buildings and renovation of existing buildings according to the nZEB standard is in the development.

Also, The Long-term Strategy to Stimulate Investment in the Renovation of the National Building Stock in Croatia (OG 74/14) was adopted in 2014.

MEN-2: Program for energy renovation of the apartment buildings

This measure foresees the continuation for the implementation of The Program of Energy Renovation of Apartment Buildings for the Period from 2014 to 2020 (OG 78/14), with the focus on the buildings built before the 1987 and with the goal for their renovation to the B, A or A+ energy class.

The main source of the funding is based on the EU structural and investment funds (EU SIF), precisely from the European Fund for the Regional Development. The goal is to increase the yearly renovation share from 1% to 2% of the surface of the apartment buildings. The plan is to reallocate the funds available from the ESIF to enable the renovation to happen in the planned scope. Important source of funding of the renovations of apartment buildings in the Republic of Croatia were the revenues from the sales of the greenhouse gas emission allowances by the auctions [7].

<u>MEN-3: Program for the increase of energy efficiency and use of renewable energy sources in commercial non-residential buildings</u>

The measure builds up on The Program of Energy Renovation of Commercial Non-residential Buildings for the Period from 2014 to 2020 (OG 98/14) with the plan allocate the funds available from the EU SIF for the implementation of the measures, with the focus to tourism and trade sectors. The funds will be allocated in grants and through the advanced financial instruments and in accordance with the EU regulations 651/2014 and 1407/2013 on state aid in EU.

Important source of funding of the use of renewable energy sources in commercial non-residential buildings in the Republic of Croatia were the revenues from the sales of the greenhouse gas emission allowances by the auctions [7].

<u>MEN-4: Program for the Energy Renovation of the Family Dwellings</u>

The measure is based on The Program of Energy Renovation of Family Houses for the Period from 2014 to 2020 (OG 43/14), but with the plan to allocate also the funds from the EU SIF and to advance the financial models to activate the private capital. The goal is to support the renovation of 4000 houses in Croatia annually. Important source of funding of the renovations of family dwellings in the Republic of Croatia were the revenues from the sales of the greenhouse gas emission allowances by the auctions [7].

<u>MEN-5: Program for the energy renovation of public buildings</u>

The measure is based on the Programme for the Energy Renovation of Public Buildings 2014 - 2015 (Ministry of Construction and Physical Planning, 2014) and the Programme for the Energy Renovation of Public Buildings 2016 - 2020 (Ministry of Construction and Physical Planning, 2017). The plan is to renovate the 9.46% of the total surface of the public buildings until 2020.

The main source of finances in period 2016-2020 will be on the EU SIF, Operational Programme Competitiveness and cohesion for the period from 2014 to 2020, under Priority Axis 4 - Promotion of energy efficiency and renewable energy sources. The funds will be allocated with the goal to activate the private capital and ESCO market. Important source of funding of the renovations of public buildings in the Republic of Croatia were the revenues from the sales of the greenhouse gas emission allowances by the auctions [7].

<u>MEN-6: Energy management in the public sector</u>

Energy management in the public sector include implementation of continuous and systematic measurement, planning and improvements of the energy use in public sector. It includes the use of national information system on energy management ISGE [8]. Energy Management Information System (ISGE), which was supported and established by the UNDP, GEF, the Fund and the Croatian Government, is used as a national tool for systematic energy and water management in public buildings. ISGE is under the competence of the Ministry of Construction and Physical Planning and Agency for Transactions and Mediation in Immovable Properties (APN).

The measure is regulated by the Energy Efficiency Act (OG 127/14), Directive 2012/27/EU on Energy Efficiency, Ordinance on Energy Management (OG 18/15) and Methodology on Energy Management (OG 18/15). In the period 2017-2019 the focus will be on the automation of the data collection of the consumption of energy and water, reporting and verification of energy savings and education of associates.

MEN-7: Measurement and informative calculation of energy consumption

Law on Energy Efficiency (OG 127/14) stipulates that energy distributors ensure that, to the extent that is technically possible, financially reasonable and proportionate in view of the potential energy savings, final customers of energy and hot water in homes acquire individual meters at competitive prices that accurately reflect the actual energy consumption of end customers. Energy supplier shall free of charge on request of the end customer at least once a year provide information on the calculation of electricity, heat or gas and previous consumption of the end customer.

Legible and understandable energy bills (electricity, heat and natural gas) and individual consumption metering are obligation of distribution system operators and suppliers. This will increase consumer awareness of the way in which they consume the energy. The bills should include comparisons of consumption for the current year and for the corresponding period of the previous year, as well as information on available energy efficiency measures.

MEN-8: Labelling the energy efficiency of household appliances

Scheme of labelling the energy efficiency of household appliances is legally prescribed in the Regulations on Energy Labelling of Household Appliances (OG 130/2007, 101/2011, 48/13, 127/14). It is prescribed that energy efficiency label have to be marked on all household appliances that use electricity and are placed on the Croatian market, whether they are manufactured in the Republic of Croatia or imported.

By energy labelling, customers are informed about the energy consumption of devices and selection is directed towards more efficient appliances. For the implementation of these measures, a lot has been done to raise public awareness and educate in order to increase the market share of household appliances with A, A+, A++ energy efficiency class and reduce the market share of household appliances under class C.

MEN-9: Eco-design of energy-using products

Ordinance on establishing Eco-design requirements for energy related products (OG 80/2013, 127/14, 50/15), transposed the 2009/125/EZ Directive of the European Parliament and of the Council of 21 the

October 2009 about establishing a framework for determining the Eco-design requirements for energy related products to the Croatian legislation.

This Ordinance established a framework for the setting of EU Eco-design of energy-related products with the aim of ensuring the free movement of these products on the internal market. The Ordinance provides for the determination of requirements to be met by energy-related products covered by implementing measures, to be placed on the market and / or in use. It contributes to sustainable development by increasing the energy efficiency and level of environmental protection, while at the same time increasing the security of energy supply.

This Ordinance also allows the implementation of provisions related to the Directive 2009/125/EZ (air conditioners and fans, fan motor-driven, self-circulation pumps without seals, household washing machines, electric motors, non-directional household lamps, lamps directed to the corresponding equipment LED - lamps, fluorescent lamps, external power supplies, cooling devices, simple control boxes, electric and electronic equipment in homes and offices - mode, hold and mute, televisions, household dryers, washing household dishes and pumps water). The Ordinance came into force on the date of the Republic of Croatia accession to EU.

MEN-10: Promotion of energy efficiency and implementation of measures through energy services model

The goal of the promotion of energy efficiency is to raise the awareness of the persons and companies on possibilities and benefits of improving the energy efficiency. The leading body is the National Energy Efficiency Authority (NKT), which moderates and promotes the national web portal for energy efficiency www.enu.hr [9].

Energy efficiency projects with implementation through energy services include modernization, reconstruction and renovation of existing plants and facilities with the aim of rational use of energy in a way to achieve the return on investment through savings in energy costs and maintenance. These projects include the development, implementation and financing to improve energy efficiency and reduce operation and maintenance. Areas of business are public and private sectors, i.e. buildings (schools and kindergartens, offices, hotels, universities, hospitals), public lighting, industry and power supply systems (cogeneration, district heating).

MEN-11: Program for the reduction of energy poverty

The reduction of the energy poverty in Croatia will be accomplished through three activities: development of the Program for the Reduction of the Energy Poverty; capacity building of the institutions for the reduction of the energy poverty; and implementation of measures for the energy and water savings in the households which meet energy poverty criteria.

The financing of the measures will be based on the revenues from the auctions of the emission allowances from the EU ETS, and the goal is to implement the measures in around 330 households annually.

MEN-12: Education in the area of energy efficiency

The goal of this measure is to set the education and certification system for the workers in the area of energy efficiency.

The Ordinance on education and certification system will be developed and education of coaches and program for the education done in accordance with the CROSKILLS project [10].

The important source of the funding will be through the EU SIF, Operational Program Efficient Human Resources.

MEN-13: National Program for the Energy Efficiency in Public Lighting

Public lighting consumes around 3% of final electricity consumption in Croatia. By this measure, National Program for the Energy Efficiency in Public Lighting will be developed. The goal is to provide savings of at least 30 GWh annually.

The focus of the program will be on establishing the advanced implementation models to together with the efficient allocation of the funds available from the EU SIF based on the Operational Program Competitiveness and Cohesion 2014-2020.

MEN-14: Green public procurement

The goal of this measure is to incorporate the criteria of environmental protection in public procurement. Based on the National Action Plan for Green Public Procurement for the Period 2015-2017 with a view to 2020 (Ministry for environmental protection and Energy, 2015), the parties obligated for the public procurement should include environmental protection criteria. The goal is that by 2020 at least 50% of public procurement has incorporated the criteria of environmental protection.

New Public Procurement Act (OG 120/16) prescribed the obligation for the economic evaluation of the offers, including evaluation of social and environmental criteria, which will be the strong stimulus for the green public procurement.

MEN-15: Energy audits in industry

With this measure, support to assess the potential energy savings in industrial plants through co-financing the implementation of energy audits should be provided. Scheme for Energy audits in industry includes:

- mandatory energy audits for large companies (companies that meet at least two of the following criteria: total assets of at least HRK 130,000,000.00, annual income of at least HRK 260,000,000.00, an average of at least 250 employees during the financial year). The obligation is regulated by the Law on Energy Efficiency (OG 127/14),
- voluntary scheme of energy audits for small and medium companies. Energy audits on a voluntary basis are supported by the financial assistance provided by the Environmental Protection and Energy Efficiency Fund.

MEN-16: Industrial Energy Efficiency Network (MIEE)

This is the voluntary cooperation instrument with the goal to promote the energy efficiency in industry sector, support the synergies of the processes where possible and facilitate the access to funds available through various options.

MEN-17: Increase of the use of renewable energy sources and energy efficiency in industry sector

The plan of this measure is to reallocate the funds available from the EU SIF, based on the Operational Program Competitiveness and Cohesion as well as funds available from the auctions of the emission allowances in EU ETS and direct them for the use of renewable energy sources and energy efficiency in industry sector.

The allocation of the funds has to be in line with the Regulations of the EU 651/2014 and 1407/2013 on the state aid.

MEN-18: Feed-in tariffs and premium system for the support of the use of renewable energy sources in electricity generation and for the efficient cogeneration

The main mechanism creditable for the past development of renewable energy sources are incentive prices (feed-in tariffs). The tariffs depend on the type of source, power plant size and amount of generated electricity.

In addition to the system of incentives for electricity, generation from cogeneration plants provides adoption of appropriate regulations to promote the heat generation from cogeneration (defining the status of eligible heat producer).

In the National Action Plan for Renewable Energy Sources (Ministry of Economy, 2013), the Republic of Croatia determined the objectives and policy for increasing the share of RES in final energy consumption by 2020 to 20%, 35% in electricity generation, 10% in transport and 20% in heating and cooling.

Act on Renewable Energy Sources and Efficient Cogeneration (OG 100/15) was adopted in 2015 and modified the existing system from the feed-in tariffs to premium. The bylaws still have to be adopted and no tender has been done in line with the new model.

MEN-19: Program for the Energy Efficiency in Heating and Cooling

The Program (Ministry of Economy, 2014) analysed the potential for the development of the district heating systems, mapped the energy consumption and production of heat, explored the potential for additional highly efficient cogeneration and evaluated the possible support mechanisms for the efficient cogeneration. The Program set out the guidelines for development of the heating and cooling sector and primary energy savings.

MEN-20: Promotion of the use of renewable energy sources and energy efficiency by HBOR-a (Croatian Bank for Reconstruction and Development)

For the purpose of financing the environmental protection projects, HBOR extends loans through the Loan programme for the Preparation of Renewable Energy Resources and Loan Programme for the Financing of Projects of Environmental protection, Energy Efficiency and Renewable Energy Sources.

The goal of the loan program of environmental projects, energy efficiency and renewable energy sources is the realization of investment projects focused on environmental protection, improving energy efficiency and promoting renewable energy. Loans are intended for investment in land, buildings, equipment and devices. Final user may be local and territorial (regional) governments, utility companies, companies, dealers and other legal entities.

MEN-21: Promotion of the use of renewable energy sources and energy efficiency by FZOEU (The Environmental Protection and Energy Efficiency Fund) resources

The Environmental Protection and Energy Efficiency Fund provides funding for the preparation, implementation and development of programs and projects in the field of environmental protection, energy efficiency and use of renewable energy sources and climate change mitigation.

Funds for financing are provided from the revenues raised by environmental polluters, which includes fees for nitrogen oxides, sulphur dioxide and carbon dioxide emissions, fees for burdening the environment with waste, environmental user fees and special fees for the environment for motor vehicles.

Resources of the Environmental Protection and Energy Efficiency Fund are allocated to projects, which improve energy efficiency, including cogeneration, district heating systems, energy audits and demonstration activities, public lighting projects, fuel replacement and waste heat use and projects in the field of building construction and sustainable construction.

Renewable energy projects for which the Environmental Protection and Energy Efficiency Fund grants resources include solar energy, wind energy, biomass, energy from small hydro and geothermal energy.

The Environmental Protection and Energy Efficiency Fund provides grants to local and regional governments, companies, craftsmen, non-profit organizations and individuals, through loans, interest rate subsidies, financial aids and donations.

For some tenders of the Fund, operators in the EU ETS are eligible, thus this measure has effects in the EU ETS and non-EU ETS sector.

MEN-22: CO_2 emission tax for the non-ETS stationary sources

The Regulation on Unit Charges, Corrective Coefficients and Detailed Criteria and Benchmarks for Determination of the Charge for Emissions into Environment of Carbon Dioxide (OG 73/07, 48/09) stipulates the obligation to pay charges on CO_2 emission for all stationary sources emitting more than 30 tonnes of CO_2 per year. Fee payers who invest in energy efficiency, renewable energy and other measures to reduce emissions of CO_2 and other greenhouse gas emissions are charged by lower fee.

The Environmental Protection and Energy Efficiency Fund is authorized for accounting and collecting charges. The Law on Amendments to the Law on Environmental Protection and Energy Efficiency Fund (OG 142/12) stipulates that from 1 January 2013, legal or natural persons who own or use a single source of CO_2 emissions, for which permits for greenhouse gas emissions have been obtained, do not have to pay fee. This means that from 2013 onwards measures apply only to sources that are not covered by the ETS.

The amount of compensation paid by the operators of installations excluded from the EU ETS in accordance with the Article 27 of Directive 2003/87/EC on establishing a scheme for greenhouse emission allowance trading within the Community is defined by the Decision on the amount of the unit charge on greenhouse gas emissions for operators of installations excluded from emissions trading system. The unit fee for 2013 was HRK 32.78 for emitting one tonne of CO_2 in 2013 (OG 105/14), HRK 45.40 in 2014 (OG 96/15), HRK 58.29 in 2015 and HRK 39.53 in 2016. The price for a present year is determined based on the average EUA price in the EU ETS in the previous year.

MEN-23: Revitalization and energy efficiency in existing thermal and hydro power plants

The activities of this measure are related to the Croatian utility company HEP. As listed in the 4th National Energy Efficiency Action Plan, in the coming years the plans for revitalization and implementation of energy efficiency measures in existing thermal and hydro power plants include: reconstruction of water management system, new steam boiler, optimization and automation of hydro stations, revitalization of hydro power plants, reduction of own use of heat, new measurement systems etc.

MEN-24: Reconstruction and renovation of the heating and steam network

Due to the ageing and damages of the heating and steam network, high losses of energy are occurring. The expected investments in the coming period will be provided from the utility companies and from the use of EU SIF, under the Operational Programme Competitiveness and Cohesion for the period 2014-2020.

MEN-25: Operation of power system and development of the transmission and distribution network

Croatian Transmission System Operator (HOPS) is responsible for the reduction of losses in transmission network, development of the transmission network and management of the power system. As listed in the 4th National Energy Efficiency Action Plan, HOPS will focus on optimization of network topology and reduction of losses and development of the network capacity.

HEP-Distribution System Operator (HEP-ODS) is responsible for the reduction of losses in distribution network and implementation of smart meters for the final consumers in Croatia.

The funds for the pilot project for the introduction of “smart grids” are available under the Operational Programme Competitiveness and Cohesion for the period 2014-2020.

4.2.2. Transport

MTR-1: Providing information to consumers on fuel economy and CO_2 emission of new passenger cars

Pursuant to the Ordinance on Availability of Information on Fuel Economy and CO_2 Emissions from Passenger Cars (OG 7/2015) each supplier of new passenger cars intended for sale shall provide consumers with information on the fuel consumption rate and specific CO_2 emission of passenger cars. The Ministry of Interior which is responsible for the road traffic safety, on the basis of the Ordinance once a year, not later than 31 March of the current year, makes a Guidelines on cost-effectiveness of fuel consumption and CO_2 emission from new passenger cars available for purchase on the market in the Republic of Croatia. The Guidelines contains required information for each model of new passenger cars available in the domestic market.

MTR-2: Training for drivers of road vehicles for eco-driving

The pilot projects were conducted and systematic training for drivers of road vehicles for eco-driving is implemented. This saves energy and increases the level of awareness of all citizens and drivers in the Republic of Croatia on advantages of this modern, intelligent and environmentally friendly driving style. Special elements are dedicated to education on eco driving for drivers of passenger cars, buses and trucks.

MTR-3: Obligation for the use of biofuels in transport

The basic regulation that regulates and promotes the usage of biofuel is Law on Biofuels for Transport (OG 65/09, 145/10, 26/11, 144/12, 14/14).

Based on this law, in 2010, the National Action Plan that promotes the production and use of biofuels in transport for the period 2011 - 2020 was prepared. The Plan establishes a policy to promote increased production and use of biofuels in transport in Croatia. The Plan contains a review and assessment of the situation on the fuel market for transport and air protection, comparative analysis, long-term goals, including the target-market of biofuels and measures to promote increased production and use of biofuels in transport. Measures prescribed by action plan included measures that promote the production of raw materials for the production of biofuels, measures that promote the production of biofuels with reference to the fee for promotion of production, measures that promote consumption of biofuels with reference to liquid petroleum distributors to place the biofuels on market, administrative measures and research and development activities. The National Action Plan for Renewable Energy Sources (Ministry of Economy, 2013) determined the goals and policies related to increasing the share of RES in final energy consumption by 2020 and in particular the estimated contribution of energy of biofuels in transport.

In 2014 the national system was modified to support only the use of biofuels in transport, not the production. Croatia has to modified the system again in 2017 to include the provisions of Directive 2015/1513 (ILUC Directive) for the biofuels in transport.

MTR-4: Special fee for environment on the motor vehicles

The current system of paying a special fee for the environment in motor vehicles is regulated by Law on Fund for Environmental Protection and Energy Efficiency (OG 107/03, 144/12), Regulation on unit charges, corrective coefficients and detailed criteria and standards to determine the special environmental fee for motor vehicles (OG 114/14, 147/14). Special fee is charged taking into consideration the type of engine and fuel, engine operating volume, type of vehicle, CO_2 emissions and vehicle's age.

MTR-5: Special tax on motor vehicles

This tax is prescribed by the Law on Special Tax on Motor Vehicles (OG 15/13, 108/13, 115/16). The tax is related to the vehicles intended for use on the roads in Croatia in the moment of their first registration in Croatia.

The tax depends on the price of the vehicles, fuel type and CO_2 emissions. The hybrid and electric vehicles are not subject to this tax.

MTR-6: Financial incentives for the purchase of plug-in hybrid and electric vehicles

Electric and hybrid vehicles are due to the cost of technological development currently still more expensive than conventional vehicles using internal combustion engines. Electric vehicles are significantly more efficient than conventional from the standpoint of primary energy consumption and are almost neutral from the standpoint of carbon dioxide emissions provided that are powered by electricity generated by using renewable sources.

In order to increase the share of electric and hybrid vehicles, subsidies for the purchase of electric and hybrid vehicles through a grant have been introduced. These payments are made from the income of the Environmental Protection and Energy Efficiency Fund achieved, inter alia, by collecting special environmental charge for motor vehicles. The Third National Action Plan for Energy Efficiency for the Period from 2014 to 2016 (Ministry of Economy, 2014) prescribed goals and a plan to support purchases of electric and hybrid vehicles.

MTR-7: Development of infrastructure for alternative fuels

Based on the Directive 2014/94/EU on the deployment of alternative fuels infrastructure, Croatia has adopted The National Policy Framework on Development of the Infrastructure and Market for Alternative Fuels in Transport (OG 34/17) and the Act on Development of the Infrastructure for Alternative Fuels (OG 120/16) with the goal to promote and ensure development of the infrastructure.
The measure includes development of the infrastructure for the use of liquefied natural gas (LNG) in maritime transport.

The measures will be financed based on various models: from utility companies, by the funds available from the auctions of allowances in EU ETS, from the EU SIF, based on the Operational Programme Competitiveness and cohesion for the period from 2014 to 2020, under Priority Axis 7 – Connectivity, with the coordination with the local governance etc.

MTR-8: Promotion of integrated and intelligent transport systems and alternatives fuels in urban areas

Traffic and need for mobility is one of the biggest pressures on the environment in urban areas. Increase in the number of passenger cars, the way they are used, intensity of traffic and unstructured expansion of urban areas largely reversed technological progress in relation to the energy efficiency of vehicles and emission intensity, including noise.

This measure includes promotion of optimization of transport of goods, integrated transport of citizens, intelligent transport management, promotion of car-sharing schemes, promotion of public bicycles and measures to support the development of infrastructure for alternative fuels in urban areas.

With this measure, a gradual development of sustainable transport systems in urban areas of Croatia is provided where Plans for sustainable transport development should be drawn up as basic documents. These plans would include the analysis of the current situation, defining the vision and objectives, impact analysis and the adoption of measures for all types of transportation, distribution of responsibilities, method of implementation and monitoring mechanism. These plans would be brought on the level of major cities, they should be prepared in accordance with the European Commission guidelines and funded through EU programs and funds.

In addition, incentives are expected and under the Operational Programme Competitiveness and cohesion for the period from 2014 to 2020 where under Priority Axis 7 - Connectivity and mobility, the development of public transport system with low levels of CO_2 is planned.

MTR-9: Monitoring, reporting and verification of greenhouse gas emissions in the lifetime of liquid fuels

In accordance with the Air Protection Act (OG 130/11, 47/14, 61/17), supplier that places the fuel on domestic market shall monitor greenhouse gas emissions per energy unit in the life of the fuel. Suppliers have to draw up a report that has to be verified and submitted to the Croatian Agency for the Environment and Nature.

Pursuant to the Act, the Croatian Government's Regulation on the quality of liquid petroleum fuels and the method of monitoring and reporting and methodology of calculation of greenhouse gas emissions in the lifetime of delivered fuels and energy (OG 57/17) lays down the limit values of components and/or quality characteristics of liquid petroleum fuels, method of determining and monitoring the quality of liquid petroleum fuels, conditions for the operation of sampling laboratories and laboratory analysis of the quality of liquid petroleum fuels, the way of demonstrating conformity of the product, the name and marking of the product, way and deadlines for the submission of reports on the quality of liquid petroleum fuels and emissions reports of greenhouse gases in the lifetime of fuels and energy to the Croatian Agency for Environment and Nature, method of monitoring and reporting, methodology for calculation of greenhouse gas emissions in lifetime of fuels and energy, methodology for determining the level of greenhouse gas emissions in lifetime of fuels per energy unit for the base 2010, methodology for calculating the contribution of electric road vehicles to reducing greenhouse gas emissions, the format of the report and the length of the storage and the manner of transmission of data to the competent bodies European Union.

4.2.3. Industrial processes

The Industrial Strategy of the Republic of Croatia 2014 – 2020 defines objectives of industrial development and key indicators of the Croatian industry in the period 2014 – 2020. According to the "realistic scenario", by the year 2020 achieving the level of physical volume of industrial production on the level of 2008 is expected, when it reached the highest level of economic activity in Croatia.

Measures belonging to the ETS sector are included in the section Other (cross-cutting) policies and measures under the measure *MCC-4 Emission Trading System* (the measures are below):

- reduction of clinker factor in cement production – increase in share of mineral additives in the cement up to 35%, depending on the composition of raw materials, availability of suitable additives on the market and market demands for certain types of cement (clinker content in cement is defined by standard HRN EN 197-1);
- increase of recycled glass in the glass production - returning container glass that lost applied value into the production process (depends on the efficiency of waste glass collection system in the Republic of Croatia and the possibility of import of waste glass);.

- reduction of N_2O emission in nitric acid production (catalytic decomposition) – N_2O emission reduction up to 88% can be achieved by installing the catalyst; measure is cost-effective because of relatively low marginal costs and high N_2O emission reduction potential.

In addition to production of cement, nitric acid and ammonia, the key source in the sector Industrial processes and product use is production of petrochemical and carbon black, non-energy products from fuels and solvent use and consumption of hydrofluorocarbons in refrigerating and air-conditioning equipment. Therefore, the following measures are considered:

MIP-1: Reducing emissions of volatile organic compounds in solvent use sector

Regulation on limit values for contents of volatile organic compounds in certain paints and varnishes used in construction and vehicles finishing products (OG 69/13) prescribes limit values for contents of these volatile organic compounds which may be placed on the market. Development and implementation of solvent management plan reduces emissions of volatile organic compounds and thereby carbon dioxide emissions.

Regulation on substances that deplete the ozone layer and fluorinated greenhouse gases (OG 90/14) prescribes the following measures:

MIP-2: Handling of substances that deplete the ozone layer and fluorinated greenhouse gases

Releasing controlled substances and fluorinated greenhouse gases into air while performing activities of collecting, leakage testing, maintenance or servicing of appliances and equipment is forbidden.

MIP-3: Technical and organizational measures for collection, reuse, recovery and destruction of controlled substances and fluorinated greenhouse gases

This set of measures defines how the used controlled substances and fluorinated greenhouse gases contained in products and equipment must be collected, reused, recovered or destroyed.

MIP-4: Capacity building and strengthening the knowledge of authorized repairers

Education of authorized repairers (servicers) on collection and handling of controlled substances and fluorinated greenhouse gases during equipment servicing.

MIP-5: Leakage detection of controlled substances and fluorinated greenhouse gases

Technical measures to prevent or eliminate leakage of controlled substances and fluorinated greenhouse gases in the atmosphere.

MIP-6: A fee to cover the costs of collection, reuse, recovery and destruction of controlled substances and fluorinated greenhouse gases

An entrepreneur, who imports/introduces controlled substances and/or fluorinated greenhouse gases for placing on the Croatian market or for their own needs, is required to pay a fee in the Environmental Protection and Energy Efficiency Fund. The fee is three HRK per kilogram imported/entered unused controlled substances and/or fluorinated greenhouse gases.

4.2.4. Agriculture

The positive impact of the implementation of measures on overall greenhouse gas emissions in the agriculture sector is reflected in the direct reduction of methane and nitrogen compounds emissions. Measures included in the formation of scenarios of gradual transition of agriculture in relation to the referent scenario:

MAG-1: Change in diet of cattle and pigs and animal feed quality

Specific sub-measures within this group of measures which relate to the further improvement of cattle keeping, animal waste management systems, level of production as well as their diet (digestibility): the change of ratios of certain types of forage in the diet and the use of fat supplements as an energy source for animals and improving the quality of voluminous forage and improving grazing systems. These measures refer to the potential reduction of methane (CH_4) and nitrogen compounds emissions from enteric fermentation and animal waste management.

MAG-2: Anaerobic decomposition of manure and biogas production

With the introduction of biogas plants emission reductions is achieved through elimination of methane emissions due to the disposal of used litter and receiving electricity from renewable sources. The measure is linked to the measures in Renewable sources in the production of electricity and heat and Construction of cogeneration plants from the Energy sector. Anaerobic breakdown help biogas plants to reduce the source of easily degradable carbon in the manure that is applied to agricultural land, but it also potentially reduces the process of nitrification and N_2O emissions.

MAG-3: Improving cattle facilities and systems of animal waste management

Covering manure storage places - creating a natural layer (cortex) with a natural (straw) or artificial material (porous). This measure reduces direct methane and ammonia emissions, although to a lesser degree they enhance the process of nitrification (porous material) and emissions of nitrous oxide.

MAG-4: Improvement of mineral fertilizer application methods

Application of new slow-release fertilizers suitable for growing corn and wheat (fertilizers coated with polymers especially). Research suggests the possibility of reduced need of fertilizer application per hectare with unchanged or increased revenues, including reduced emissions of nitrogen due to soil losses.

MAG-5: Hydromeliorative interventions and systems of protection against natural disasters

The reduction of nutrients leaching from arable horizon can be affected with the construction of drainage and irrigation systems; consequently, there is less need for nitrogen application.

MAG-6: Introduction of new cultivars, varieties and cultures

Encouraging development, education and implementation of technologies at a national and regional level, encouraging the transition and adaptation of the entire production chain to produce new crops or enabling and encouraging the implementation of cultivars and varieties that are more resistant to drought and disease and have a lower overall carbon footprint. This, among other benefits, is aimed at reducing the need for the introduction of nitrogen into the soil through fertilizers.

MAG-7: Rural Development Programme of the Republic of Croatia for the Period 2014-2020

One of the principal areas of institutional work of the European Union is the Common Agricultural Policy (CAP). Rural development, as the second CAP tier, is financed through the Agricultural Fund for Rural Development (EAFRD). Development of the Rural Development Programme of the Republic of Croatia is a prerequisite for the EAFRD eligibility in the next period. Goals set by the Europe 2020 Strategy are also evident within three CAP goals: agriculture competitiveness, sustainable resource management and balanced development of rural areas. The Rural Development Programme should achieve the goals set by CAP through measures given in six priorities:

- Promotion of knowledge and innovation transfers in agriculture, forestry and rural areas
- Improvements in sustainability and competitiveness in agriculture, forestry and rural areas
- Promotion of food provision chain, including processing and market placement of agricultural products, animal welfare and risk management
- Revitalization, protection and improvement of agriculture and forestry related ecosystems
- Promotion of resource efficiency and encouraging the shift to low-carbon farming, resilient to climate changes in the agriculture, food and forestry sectors
- Promotion of social involvement, combating poverty through economic development of rural areas.

4.2.5. LULUCF

MLF-1: Improving the reporting in LULUCF sector

The Annex I countries of the United Nations Framework Convention on Climate Change, including Croatia as well, are obligated in accordance with Annex I to Decision 15/CP.17 continuously review the quality of the relevant technical elements of GHG inventory. Because of this commitment and the stipulation of Decision 529/2013/EU which obliges countries to prepare also reports on emissions/removals from the activities Grassland management and Cropland management and submits their final annual estimates for accounting no later than 15 March 2022, the implementation of this measures is still considered relevant.

For the implementation of this measure, the Ministry of Environment and Energy has defined specific projects whose implementation is foreseen until 2020. Specified projects are foreseen to improve the calculation of emissions/sinks in some LULUCF sector storage (overhead and underground phytonutrients, bark, dead wood, soil and wood products), establishment of a unique information system for cover and land use for all categories of land in the LULUCF sector as improvements related to the making of projections in the LULUCF sector for better and easier future planning of activities in this sector. For each of the defined projects, the Ministry will determine the means and mechanisms of funding depending on the resources available in the individual financial instruments in the period up to 2020.

MLF-2: Preparation of cost-benefit analysis of afforestation on new areas and natural regeneration of forests as a measure of increasing the sinks in LULUCF sector

Changes in the sinks of greenhouse gases as a result of direct land use change caused by human activity and forestry activities are allowed to be calculated in the national balance of emissions and sinks of greenhouse gases and used to fulfil obligations under the Kyoto Protocol. The aforementioned is stipulated by Article 3 paragraph 3 of Kyoto Protocol for parties included by Annex I to the Kyoto Protocol.

By analysing the costs and benefits of afforestation on the new areas, possibility of increasing greenhouse gas sinks using reforestation activities on the barren productive forest floor will be investigated. Thus would justify introduction of possible incentive measures, such as the afforestation of fast-growing species and natural regeneration of forests, equivalent to measures for greenhouse gas emissions reduction. The implementation of this activity was determined in the Plan for Air Protection, Ozone Layer Protection and Climate Change Mitigation for the period 2013-2017 (OG 139/13), and its implementation originally planned for 2015 has been postponed and has been envisaged for 2017.

MLF-3: Implementation of Action plan for LULUCF sector

According to the Decision 529/2013/EU[16], as a member of the European Union, Croatia was obliged to prepare and submit information from the forestry sector to the Commission in accordance with Article 10 of Decision 529/2013/EU. The plan was drafted and submitted to the EC on 9 January 2015, and will form an integral part of the national strategy for low carbon development.

When developing this plan, the measures in the LULUCF sector of the Republic of Croatia were recognized and taken from appropriate strategies, programmes and legal acts such as: Plan for the air protection, protection the ozone layer and climate change mitigation in the Republic of Croatia for the period 2013-2017 (OG 139/13), Rural Development Programme of the Republic of Croatia for the Period 2014-2020, the Ordinance on multiple compliance (OG 32/15) and the Forest Management basis for areas of the Republic of Croatia for the period 2006-2015. The first report on the implementation of measures was sent to the Commission in line with the Article 10, paragraph 4.

4.2.6. Waste management

For the purpose of effective implementation of the measures included in the waste management sector, along with the already adopted sectoral legislation that is harmonized with EU legislation, it is necessary to adopt a more significant number of by-lows. It will primarily impact on the projections after 2020 to measures MWM-1, MWM-2 and MWM-3, described below.

MWM-1: Preventing the generation and reducing the amount of municipal waste

It is the first in the order of priority in the municipal waste management, pursuant to the Sustainable Waste Management Act (OG 94/13). This measure is achieved by cleaner production, education, economic instruments and enforcement of regulations, and by investing in modern technologies.

[16] 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.

According to the Act, quantitative targets and deadlines for reducing the total amount of waste disposed to non-compliant landfills are defined. By the end of 2017, the maximum waste disposed to non-compliant landfills amounts 800,000 tons. Disposal of waste to non-compliant landfills in Croatia is prohibited after 31 December 2017.

MWM-2 Increasing the amount of separately collected and recycled municipal waste

Beside the Sustainable Waste Management Act, the Waste Management Plan of the Republic of Croatia for the period 2017 – 2022 (OG 3/17) also defines the quantitative targets and deadlines for increasing the amount of separately collected and recycled waste. By 2020, it is necessary to secure the preparation for reuse and recycling of the following waste materials: paper, metal, plastic and glass from households and possibly from other sources if these waste streams are similar to the waste from households, with the minimum share of 50% by waste weight.

MWM-3: Methane flaring

The Ordinance on the Methods and Conditions for the Landfill of Waste, Categories and Operational Requirements for Landfills (OG 114/15) and Ordinance on the Waste Management (OG 23/14, 51/14, 121/15, 132/15) regulate technical requirements for landfill operation, which reduces possible adverse effects of landfills on the environment. On landfills where landfill gas occurs it is necessary to secure a gas collection system, and that gas must be treated and used. If collected landfill gases cannot be used for energy production, they should be burned in the area of the landfill and the emission of methane into the atmosphere should be prevented.

MWM-4: Reducing the amount of disposed biodegradable municipal waste

The aim of this measure is to reduce the amount of biodegradable fraction of waste disposed at landfills, thus reducing methane emissions resulting from anaerobic decomposition of waste.

Pursuant to the Sustainable Waste Management Act, quantitative targets related to the reduction of biodegradable municipal waste disposed to landfills are established. By the end of 2020, the share of biodegradable municipal waste disposed of in landfills must be reduced to 35% weight of biodegradable municipal waste produced in 1997.

MWM-5: Use of biogas for electricity and heat generation

The measure is associated with measure MEN-18: Feed-in tariffs and premium system for the support of the use of renewable energy sources in electricity generation and for the efficient cogeneration in the Energy sector. The main mechanism for encouraging the application of biogas for electricity generation and the construction of biogas cogeneration plants are incentive prices (feed-in tariffs) that depend on the type of source, power plant size and amount of generated electricity. Looking at the waste management sector, the potential reduction in greenhouse gas emissions of these measures is the potential to reduce methane emissions (resulting from the anaerobic decomposition of the biodegradable fraction of waste), which is used for electricity and heat generation.

In Croatia, in December 2017, 32 biogas plants were connected to the grid (total installed power of 36.73 MW) and two power plants on landfill gas and gas from wastewater treatment plants (total installed power of 5.500 MW), within the system of eligible power producers. Additionally, 19 biogas plants (total installed power of 17.79 MW) have signed power purchase agreements with the Croatian Energy Market Operator, but plants have not yet been put into operation [11].

4.2.7. Other (cross-cutting) policies and measures

MCC-1: Committee for cross-sectoral coordination of policies and measures for mitigation and adaptation to climate change

With the Decision of the Government in accordance with the Air Protection Act (OG 130/11, 47/14, 61/17) in 2014 was established Committee for inter-sectorial coordination of policies and measures for mitigation and adaptation to climate change (OG 114/14). This Committee was in charge for monitoring and evaluation of the implementation and planning of policies and mitigation and adaptation measures for climate change in the Republic of Croatia. To this Committee were appointed representatives of competent state administration bodies and other relevant institutions, agencies and non-governmental organizations. The composition of the Committee, the tasks and the manner of the work of the Committee were determined by the above mentioned Government decision. The Committee consists of a Coordination Group and a Technical Working Group.

MCC-2: System for the Measurement and Verification of Energy Savings

System for the Measurement and Verification of Energy Savings (SMIV) was established by the Ordinance on the System for the Measurement and Verification of Energy Savings (OG 71/15). It will monitor the energy savings and resultant reduction of greenhouse gas emissions.

SMIV is moderated by the National Energy Efficiency Authority (NKT). It is the important component of the future energy efficiency obligation schemes in Croatia.

MCC-3: Promotion of the use of innovative information and communication technologies (ICT) to reduce greenhouse gas emissions

Innovative information and communication technologies have an increasingly important role in reducing greenhouse gas emissions and increasing energy efficiency. Intensifying their use in public administration, services and manufacturing processes, will boost productivity and work efficiency and at the same time will reduce energy consumption and consequent greenhouse gas emissions. The measure is expected to intensify the use of innovative ICT and monitoring of actual energy savings and reductions of greenhouse gas emissions.

MCC-4: Emissions Trading System

ETS (Emissions Trading System) sector includes all activities listed in Annex I of the Regulation on trading with greenhouse gas emission allowances (OG 69/12, 154/14) and for the reduction of greenhouse gas emissions from these activities alone are responsible plant operators involved in the trading system. Reduction commitments through emission allowances allocated evenly have been distributed to all Member States with the goal to contribute to the reduction of the emissions by 21% until 2020 compared with the 2005 level. Thus it can be concluded that reduction of emissions of certain activities of the ETS is in fact regulated at EU level.

From 1 January 2013, the Republic of Croatia is fully integrated in the EU Emission Trading System (EU ETS). Operators in Croatia - the pursuant in the EU ETS have obtained Permits for greenhouse gas emissions and have established a regime for emissions monitoring and reporting to the competent authority.

Greenhouse gases covered by EU ETS are: carbon dioxide (CO_2) for all activities and additionally for certain activities, nitrous oxide (N_2O) and perfluorocarbon (PFC). Additional activity included in EU ETS is aviation. Aircraft operators in Croatia are included in the EU ETS from 2012 for flights to EU and from 2014 for flights within Croatia, and Croatia undertook to administer aviation operators included in the EU ETS from 2014.

All operators, except electricity producers for the third parties sales, have submitted their applications for issuance of free allowances. Free allowances can be distribute free of charge for the installations that are exposed to the risk of carbon leakage to third countries, on the bases of benchmark established in accordance with values of 10% of the most efficient installations in the same sector. Operators, which will not have a sufficient number of allowances to cover their greenhouse gases emissions, have the option to purchase emission units through auctions.

<u>MCC-5: Use of funds obtained from the sales of EU ETS emission allowances through auctions for the GHG emission reduction measures</u>

Of the total number of allowances designated for the allocation to operators and aircraft operators, in each year of the trading period, a part is distributed free of charge according to the above prescribed method. The remaining part is distributed to the Member States of the European Union and is subject to public auctions.

The Air Protection Act (OG 130/11, 47/14, 61/17) stipulates that the Republic of Croatia use 95% of the funds received for the climate related purposes and the funds are paid to the special account of the Environmental Protection and Energy Efficiency Fund and other 5% of the funds are paid in the state budget of the Republic of Croatia. Funds that are paid to a special account in the Environmental Protection and Energy Efficiency Fund should be used for:

- reduction of greenhouse gas emissions,
- adaptation to climate change,
- financing measures to mitigate climate change and adaptation in third countries,
- financing of renewable energy sources in order to meet the share of renewable energy sources of the Republic of Croatia in 2020,
- improvement of forest resources and reporting from the forestry sector,
- encouraging the transition to low-carbon and public transport,
- financing research and development aimed at mitigating climate change and adapting to climate change, including aeronautics and air transport,
- ecologically safe capture and geological storage of carbon dioxide, especially from fossil fuel power plants and certain industrial sectors and subsectors, including those in third countries,
- financing research and development in the field of energy efficiency and clean technologies,
- financing research and development in the field of reporting on greenhouse gas emissions,
- encouraging energy efficiency measures in the construction sector (in particular energy refurbishment of the buildings), industry, transport and services, and
- providing financial support for measures contributing to the suppression of energy poverty.

Funds to be paid into the state budget should be used to cover the costs of managing trading systems for emission units, for administrative tasks, for the functioning of the Registry, for auction managers, for the National GHG Monitoring System and other climate change issues.

The plan for the use of funds acquired through the sale of emission units by auction in the Republic of Croatia for the period 2014-2016 was adopted by the Government of the Republic of Croatia (NN 140/14, NN 12/17). The total revenue realized for the period 2014-2016 amounts to 733 984 921.23 HRK and was used for renewable energy, energy efficiency, transport, waste management development and research and professional support.

The auction plan for the period up to 2020 was adopted in February 2018 and is planned to be raised to 825,000,000.00 HRK. These funds will be spent on mitigation measures and adaptation to climate change.

MCC-6: Implementation of interdisciplinary research on the potential of geological storage of CO_2 in the Republic of Croatia

Technology for carbon capture and storage for large emission sources is not yet commercially available. The possibility of commercial application is expected in the period after 2020.

According to Directive 2009/31/EC on the geological storage of carbon dioxide, respectively Article 36 of Directive on industrial emissions 2010/75/EU, for power plants with capacity exceeding 300 MW which have obtained the construction permit after the entry into force of the Directive 2009/31/EK, it is necessary to assess whether the following requirements are satisfied:

- suitable storage locations are available,
- transport facilities are technically and economically feasible and
- upgrade of the plant for CO_2 capture is technically and economically feasible.

If these conditions are satisfied, the competent authority should provide adequate reserve area on the plant's location for equipment for capturing and compressing extracted CO_2.

Due to described commitments for new thermal power plants, with this measure the preparation of National Feasibility Study with the action plan of the preparatory activities for CCS projects is planned. This Study will include stages of capturing on the sources of emissions, transport, injection and storage.

MCC-7: Energy efficiency obligation scheme

Based on the provisions of the Directive 2012/27/EU, Act on Energy Efficiency (OG 127/14), 3rd and 4th National Energy Efficiency Action Plan, Croatia plan to establish the energy efficiency obligation scheme for the fuel suppliers. The obligated parties will have contribute to the energy savings in final energy consumption.

4.3. POLICIES AND MEASURES AND THEIR EFFECTS

Overview tables of policies and measures in each sector contain the code and title of the policy or measure, objective of implementation, identification of greenhouse gas affected by the policy or measure, type of policy instrument, status of implementation and implementing body.

The type of instrument was determined according to recommendations laid down in the Guidelines for the preparation of National Communications by parties included in Annex I to the Convention. The guidelines make a distinction between economic, fiscal, agreement, regulatory, information, research and other instruments.

The status of implementation that can be assigned to a policy or measure is: implemented, adopted or planned. Status "implemented" is assigned if national legislation is in force, voluntary agreements have been established, financial resources have been allocated or human resources have been mobilized. Status "adopted" is assigned to policies and measures for which an official government decision has been made and there is a clear commitment to proceed with implementation. For those policies and measures that are still under discussion and have a realistic chance of being adopted and implemented, status "planned" is chosen.

Energy

Table 4-1: Overview of policies and measures in Energy sector

NAME OF PAM	OBJECTIVE	GREENHOUSE GAS	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING BODY
MEN-1: National Plan for the Increase of the Number of Nearly-Zero Energy Buildings	Increase the number of nearly-zero energy buildings	CO_2	regulatory, economic, planning	implemented	Ministry of Construction and Physical Planning
MEN-2: Program for energy renovation of the apartment buildings	Support the renovation of 2% of multi-family dwellings annually	CO_2	economic	implemented	Ministry of Construction and Physical Planning, Environmental Protection and Energy Efficiency Fund
MEN-3: Program for the increase of energy efficiency and use of renewable energy sources in commercial non-residential buildings	Support the energy renovation and use of RES in commercial and services sector	CO_2	economic	adopted	Ministry of Environment and Energy, Ministry of Construction and Physical Planning, Environmental Protection and Energy Efficiency Fund
MEN-4: Program for the Energy Renovation of the Family Dwellings	Energy renovation of 2.000 houses annually	CO_2	economic	implemented	Ministry of Construction and Physical Planning, Ministry for Regional Development, Environmental Protection and Energy Efficiency Fund
MEN-5: Program for the energy renovation of public buildings	Renovate 9,46% of the surface of all the public sector buildings	CO_2	economic	implemented	Ministry of Construction and Physical Planning, Environmental Protection and Energy Efficiency Fund, Agency for Legal Affairs and Real Estate
MEN-6: Energy management in the public sector	Improve the energy performance of public sector	CO_2	regulatory	implemented	Agency for Legal Affairs and Real Estate, National Energy Efficiency Authority
MEN-7: Measurement and informative calculation of energy consumption	informing consumers on energy consumption and production	CO_2	regulatory, information	implemented	Ministry of Environment and Energy, energy distributors

NAME OF PAM	OBJECTIVE	GREENHOUSE GAS	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING BODY
MEN-8: Labelling the energy efficiency of household appliances	informing consumers on the energy efficiency of household appliances	CO_2	regulatory, information	implemented	Ministry of Environment and Energy
MEN-9: Eco-design of energy-using products	improve the energy efficiency of energy-using products	CO_2	regulatory, information	implemented	Ministry of Environment and Energy
MEN-10: Promotion of energy efficiency and implementation of measures through energy services model	promote the of energy efficiency and ESCO model projects	CO_2	information	implemented	National Energy Efficiency Authority, ESCO companies
MEN-11: Program for the reduction of energy poverty	Reduce the energy poverty	CO_2	economic, regulatory	planned	Ministry of Environment and Energy, Ministry for Demography, Family, Youth and Social Policy, Environmental Protection and Energy Efficiency Fund
MEN-12: Education in the area of energy efficiency	Educate the workers for energy efficiency	CO_2	education	implemented	Croatian Employment Service, Agency for Vocational Education and Adult Education
MEN-13: National Program for the Energy Efficiency in Public Lighting	New energy savings of 30 GWh in electricity annually	CO_2	economic	implemented	Ministry of Environment and Energy National Energy Efficiency Authority, Environmental Protection and Energy Efficiency Fund and EU Funds
MEN-14: Green public procurement	Include the environmental criteria in public procurement	CO_2, CH_4, N_2O	regulatory	implemented	Ministry of Environment and Energy, Ministry of the Economy, Entrepreneurship and Crafts, Public office for public procurement, National Energy Efficiency Authority
MEN-15: Energy audits in industry	Assessment of potential for energy savings	CO_2, CH_4, N_2O	regulatory, informative	implemented	Ministry of Environment and Energy, Ministry of the Economy, Entrepreneurship and Crafts, Environmental Protection and Energy Efficiency Fund

NAME OF PAM	OBJECTIVE	GREENHOUSE GAS	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING BODY
MEN-16: Industrial Energy Efficiency Network (MIEE)	Assessment of potential for energy savings, synergies and sources for funding	CO_2, CH_4, N_2O	voluntary	implemented	Croatian Chamber of Commerce, National Energy Efficiency Authority, Environmental Protection and Energy Efficiency Fund
MEN-17: Increase of the use of renewable energy sources and energy efficiency in industry sector	Increase of the use of renewable energy sources and energy efficiency in industry sector	CO_2, CH_4, N_2O	economic	implemented	Ministry of Environment and Energy, National Energy Efficiency Authority, Environmental Protection and Energy Efficiency Fund
MEN-18: Feed-in tariffs and premium system for the support of the the use of renewable energy sources in electricity generation and for the efficient cogeneration	increasing the share of renewable energy in electricity and heating; primary energy savings	CO_2	economic, regulatory	implemented	Ministry of Environment and Energy, Croatian Energy Operator (HROTE)
MEN-19: Program for the Energy Efficiency in Heating and Cooling	increasing the share of renewable energy in gross final energy consumption	CO_2	regulatory, economic, information	adopted	Ministry of Environment and Energy, Ministry of Construction and Physical Planning
MEN-20: Promotion of the use of renewable energy sources and energy efficiency by HBOR-a (Croatian Bank for Reconstruction and Development)	increasing the share of renewable energy in gross final energy consumption, primary energy savings	CO_2, CH_4, N_2O	economic	implemented	Croatian Bank for Reconstruction and Development (HBOR)
MEN-21: Promotion of the use of renewable energy sources and energy efficiency by FZOEU (Environmental Protection and Energy Efficiency Fund) resources	increasing the share of renewable energy in gross final energy consumption, primary energy savings	CO_2, CH_4, N_2O	economic, regulatory	implemented	Ministry of Environment and Energy, Environmental Protection and Energy Efficiency Fund
MEN-22: CO2 emission tax on the non-ETS stationary sources	reduce CO2 emissions from stationary sources with annual emissions greater than 30 tons of CO2, excluding EU ETS operators	CO_2	fiscal	implemented	Ministry of Environment and Energy, Ministry of Finances, Environmental Protection and Energy Efficiency Fund
MEN-23: Revitalization and energy efficiency in existing thermal and hydro power plants	primary energy savings	CO_2	voluntary, regulatory	implemented	HEP-Proizvodnja d.o.o.

NAME OF PAM	OBJECTIVE	GREENHOUSE GAS	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING BODY
MEN-24: Reconstruction and renovation of the heating and steam network	primary energy savings	CO_2	regulatory, economic	implemented	HEP-Toplinarstvo d.o.o.
MEN-25: Operation of power system and development of the transmission and distribution network	primary energy savings	CO_2	economic, regulatory	implemented	Croatian Transmission System Operator, HEP-Distribution System Operator

Transport

Table 4-2: Overview of policies and measures in Transport sector

NAME OF PAM	OBJECTIVE	GREENHOUSE GAS	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING BODY
MTR-1: Providing information to consumers on fuel economy and CO2 emission of new passenger cars	consumer information on fuel economy and CO2 emissions of new passenger cars	CO_2	information	implemented	Ministry of Environment and Energy
MTR-2: Training for drivers of road vehicles for eco-driving	reducing CO2 emissions from road vehicles	CO_2	educational	implemented	Ministry of Interior Affairs, Ministry of Environment and Energy, Environmental Protection and Energy Efficiency Fund, National Energy Efficiency Authority
MTR-3: Obligation for the use of biofuels in transport	increasing the share of biofuels in transport	CO_2	regulatory, economic, fiscal	adopted, partially implemented	Ministry of Environment and Energy
MTR-4: Special fee for environment on the motor vehicles	reducing CO2 emissions from road vehicles	CO_2	fiscal, economic	implemented	Ministry of Environment and Energy, Ministry of Finances, Environmental Protection and Energy Efficiency Fund
MTR-5: Special tax on motor vehicles	reducing CO2 emissions from road vehicles	CO_2	fiscal, economic	implemented	Ministry of Environment and Energy, Ministry of Finances
MTR-6: Financial incentives for the purchase of plug-in hybrid and electric vehicles	reducing CO2 emissions from road vehicles	CO_2	economic	implemented	Ministry of Environment and Energy, Environmental Protection and Energy Efficiency Fund

NAME OF PAM	OBJECTIVE	GREENHOUSE GAS	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING BODY
MTR-7: Development of infrastructure for alternative fuels	Legislative framework and reducing CO2 emissions from road vehicles	CO_2	regulatory, economic	adopted	Ministry of the Sea, Transport and Infrastructure, Ministry of Environment and Energy, Ministry of Construction and Physical Planning, Ministry of Finances, Ministry of Interior, Units of regional and local self-government, Environmental Protection and Energy Efficiency Fund
MTR-8: Promotion of integrated and intelligent transport systems and alternatives fuels in urban areas	reducing CO2 emissions from road vehicles	CO_2	research	partly adopted, partly implemented	Ministry of Environment and Energy, Units of regional and local self-government, Environmental Protection and Energy Efficiency Fund
MTR-9: Monitoring, reporting and verification of greenhouse gas emissions in the lifetime of liquid fuels	Greenhouse Gas Emissions Monitoring of liquid petroleum fuels	CO_2	regulatory	adopted	Ministry of Environment and Energy, Croatian Agency for the Environment and Nature

Industrial processes

Table 4-3: Overview of policies and measures in Industrial processes

NAME OF PAM	OBJECTIVE	GREENHOUSE GAS	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING BODY
MIP-1: Reducing emissions of volatile organic compounds in solvent use sector	reducing emissions of volatile organic compounds and thereby CO_2 emissions	CO_2	economic, regulatory	implemented	Ministry of Environment and Energy
MIP-2: Handling of substances that deplete the ozone layer and fluorinated greenhouse gases	ban of the release of controlled substances and fluorinated greenhouse gases into the atmosphere	SF_6, HFC, PFC	regulatory	implemented	Ministry of Environment and Energy

NAME OF PAM	OBJECTIVE	GREENHOUSE GAS	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING BODY
MIP-3: Technical and organizational measures for collection, reuse, recovery and destruction of controlled substances and fluorinated greenhouse gases	collection, reuse, recovery and destruction of controlled substances and fluorinated greenhouse gases	SF_6, HFC, PFC	regulatory	implemented	Centres for collection and recovery of controlled substances and fluorinated greenhouse gases
MIP-4: Capacity building and strengthening knowledge of authorized repairers	education of authorized repairers (servicers) on collection and handling of controlled substances and fluorinated greenhouse gases	SF_6, HFC, PFC	regulatory, educational	implemented	Ministry of Environment and Energy
MIP-5: Leakage detection of controlled substances and fluorinated greenhouse gases	prevention or elimination leakage of controlled substances and fluorinated greenhouse gases in the atmosphere	SF_6, HFC, PFC	regulatory	implemented	Ministry of Environment and Energy, operators
MIP-6: A fee to cover the costs of collection, reuse, recovery and destruction of controlled substances and fluorinated greenhouse gases	collect waste freons in an environmentally friendly way	SF_6, HFC, PFC	regulatory, economic	implemented	Ministry of Environment and Energy, Environmental Protection and Energy Efficiency Fund

Agriculture

Table 4-4: Overview of policies and measures in Agriculture

Name of PAM	Objective	Greenhouse gas	Type of instrument	Status	Implementing body
MAG-1: Change in the diet of cattle and pigs and animal feed quality	reduction of methane and nitrogen compounds emissions from enteric fermentation and animal waste management	CH_4, N_2O	economic	planned	Ministry of Agriculture

Name of PAM	Objective	Greenhouse gas	Type of instrument	Status	Implementing body
MAG-2: Anaerobic decomposition of manure and biogas production	reduction of easily degradable carbon in the manure that is applied to agricultural land, reducing the process of nitrification and N2O emissions	CH_4, N_2O	economic	planned	Ministry of Agriculture, Advisory services
MAG-3: Improving cattle facilities and system of animal waste management	reduction of direct methane and ammonia emissions, although to a lesser degree these enhance the process of nitrification (porous material) and emissions of nitrous oxide	CH_4	economic	planned	Ministry of Agriculture, Advisory services
MAG-4: Improvement of mineral fertilizers application methods	application of new slow-release fertilizers with the possibility of reduction of fertilizer application (emissions of nitrogen) per hectare with unchanged or increased revenues	N_2O	economic, information, research	planned	Ministry of Agriculture, Advisory services
MAG-5: Hydromeliorative interventions and systems of protection against natural disasters	reduction of nutrients leaching from arable – reduction of nitrogen application.	N_2O	economic	planned	Ministry of Agriculture, Advisory services
MAG-6: Introduction of new cultivars, varieties and cultures	reducing the need for the introduction of nitrogen into the soil through fertilizers	N_2O	information, research	planned	Ministry of Agriculture

Name of PAM	Objective	Greenhouse gas	Type of instrument	Status	Implementing body
MAG-7: Rural Development Programme of the Republic of Croatia for the Period 2014-2020	Agriculture competitiveness, sustainable resource management and balanced development of rural areas: promotion of knowledge and innovation, improvements in sustainability and competitiveness, promotion of resource efficiency and encouraging of the shift to low-carbon farming, resilient to climate changes in the agriculture, food and forestry sectors	CH_4, N_2O	regulatory, economic	adopted	Ministry of Agriculture, Agency for paying in Agriculture

LULUCF

Table 4-5: Overview of policies and measures in the LULUCF sector

Name of PAM	Objective	Greenhouse gas	Type of instrument	Status	Implementing body
MLF-1: Improving the reporting in LULUCF sector	improving the GHG estimation in LULUCF sector	CO_2	regulatory	Partially implemented Continuing until 2020	Ministry of Environment and Energy
MLF-2: Preparation of cost-benefit analysis of afforestation on new areas and natural regeneration of forests as a measure of increasing sinks in LULUCF sector	examining the justification of new measures to increase the outflow	CO_2	research	Planned	Ministry of Environment and Energy Ministry of Agriculture
MLF-3: Implementation of Action plan for LULUCF sector	fulfilment of the obligations of submitting data on LULUCF sector to the European Commission	CO_2	regulatory	Implementation in process until 2020	Ministry of Environment and Energy Ministry of Agriculture

Waste management

Table 4-6: Overview of policies and measures in Waste management

NAME OF PAM	OBJECTIVE	GREENHOUSE GAS	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING BODY
MWM-1: Preventing the generation and reducing the amount of municipal waste	reduce the amount of waste for disposal	CH_4	regulatory, economic, educational	implemented	Ministry of Environment and Energy Regional and local self-government units
MWM-2: Increasing the amount of separately collected and recycled municipal waste	reuse and recycling of waste, reduce the amount of waste for disposal	CH_4	regulatory, economic	implemented	Ministry of Environment and Energy Regional and local self-government units
MWM-3: Methane flaring	reduce methane emissions in the atmosphere	CH_4	regulatory, economic	implemented	Ministry of Environment and Energy Regional and local self-government units
MWM-4: Reducing the amount of disposed biodegradable municipal waste	reduce methane emissions in the atmosphere	CH_4	regulatory	adopted	Ministry of Environment and Energy Regional and local self-government units
MWM-5: Use of biogas for electricity and heat generation	reduce methane emissions in the atmosphere, primary energy savings in energy generation	CO_2, CH_4	regulatory, economic	implemented	Ministry of Environment and Energy Regional and local self-government units

Other (cross-sectorial) policy and measures

Table 4-7: Overview of cross-cutting policies and measures

Name of PAM	Objective	Greenhouse gas	Type of instrument	Status	Implementing body
MCC-1: Committee for cross-sectoral coordination of policies and measures for mitigation and adaptation to climate change	monitoring the implementation of policies and measures for mitigation and adaptation to climate change	all GHG	regulatory	implemented	Ministry of Environment and Energy, competent ministries
MCC-2: System for the Measurement and Verification of Energy Savings	Monitoring and verification of energy savings	CO2	information, regulatory	implemented	National Energy Efficiency Authority

Name of PAM	Objective	Greenhouse gas	Type of instrument	Status	Implementing body
MCC-3: Promotion of the use of innovative information and communication technologies (ICT) to reduce greenhouse gas emissions	increasing productivity and work efficiency while reducing energy consumption and consequent greenhouse gas emissions. Improve monitoring of GHG emissions	CO2	information	implemented	Ministry of Environment and Energy, Ministry of Economy, Ministry of Construction and Physical Planning, Croatian Agency for the Environment and Nature
MCC-4: Emissions Trading System	reduction the GHG emissions in operators under EU ETS	CO2, N2O	economic	implemented	European Commission, Ministry of Environment and Energy, Croatian Agency for the Environment and Nature
MCC-5: Use of funds obtained from the sales of EU ETS emission allowances through auctions for the GHG emission reduction measures	distribution of funds raised at the auction in projects to mitigate and adapt to climate change	all GHG	economic	implemented	Ministry of Environment and Energy, Government of the Republic of Croatia
MCC-6: Implementation of interdisciplinary research on the potential of geological storage of CO_2 in the Republic of Croatia	fulfilment of the condition for the implementation of CCS projects in the Republic of Croatia	CO2	research	planned	Ministry of Environment and Energy
MCC-7: Energy efficiency obligation scheme	energy savings in final consumption	CO2	economic	planned	Ministry of Environment and Energy

4.4. POLICIES AND MEASURES THAT ARE NI LONGER IN USE

The measure, which is no longer in the application relates to the payment of fees to the environmental emissions of carbon dioxide for natural and legal persons who within their activities owned or used a single source of carbon dioxide emissions, and who have been issued permits for greenhouse gas emissions in accordance with The Air Protection Act, that is who are liable to the European system of trading greenhouse gas emission allowances.

5. PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES

5.1. INTRODUCTION

This chapter presents the historical greenhouse gas emissions in the period from 1990 to 2014 and projections of greenhouse gas emissions for the period from 2015 to 2035. The emissions are presented as total emissions of greenhouse gases by sectors and by gases.

Since greenhouse gases have different irradiation properties and consequently different contribution to the greenhouse effect, emissions of each gas are multiplied by their Global Warming Potential (abb. GWP). In this case, the emission of greenhouse gases is presented as equivalent emission of carbon dioxide (CO_2 eq). In case of removing emissions of greenhouse gases, it refers to outflows (sinks) of greenhouse gas emissions and the amount is shown as negative value. The global warming potentials of individual gases that are used in the report are presented below.

GAS	GWP
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	298
HFC-23	14800
HFC-32	675
HFC-125	3500
HFC-134a	1430
HFC-143a	4470
HFC-152a	124
HFC-227ea	3220
HFC-236fa	9810
CF_4	7390
C_3F_8	8830
C_2F_6	12200
SF_6	22800

Source: 2006 IPCC Guidelines

Sectors are identified according to the Guidelines for the preparation of National Communications by Parties included in Annex I to the Convention (FCCC/CP/1999/7, Part II):

- energy, transport,
- industry,
- agriculture,
- waste management,
- LULUCF.

Particularly the emissions of certain greenhouse gases are presented:

- CO_2,
- CH_4,
- N_2O,
- HFCs and PFCs,
- SF_6.

According to the Guidelines for the preparation of National Communications by Parties included in Annex I to the Convention, projections are presented for three scenarios: ‘without measures’ scenario, ‘with existing measures’ scenario and ‘with additional measures’ scenario. Scenario ‘without measures’ assumes that implementation of adopted policies and measures as well as implementation of planned policies and measures will not happen. Scenario ‘with existing measures’ assumes a consistent application of policies and measures, which application is already in progress and application of adopted policies and measures, which application is likely, but still not begun. Scenario ’with additional measures’ is based on application of planned policies and measures.

Emission projections start from the inventory of greenhouse gas emissions (NIR 2017) which includes an inventory of emissions and sinks of greenhouse gases for the period 1990 – 2015. Reference year for projection is 2014.

5.2. PROJECTIONS OF GREENHOUSE GAS EMISSIONS

5.2.1. Projections of greenhouse gas emissions by sectors

Historical and projected trends in greenhouse gas emissions by sectors are presented in Figures 5-1 to 5-3. Emissions are presented for ‘without measures’ scenario, ‘with existing measures’ scenario and ‘with additional measures’ scenario for the period from 1990 to 2035.

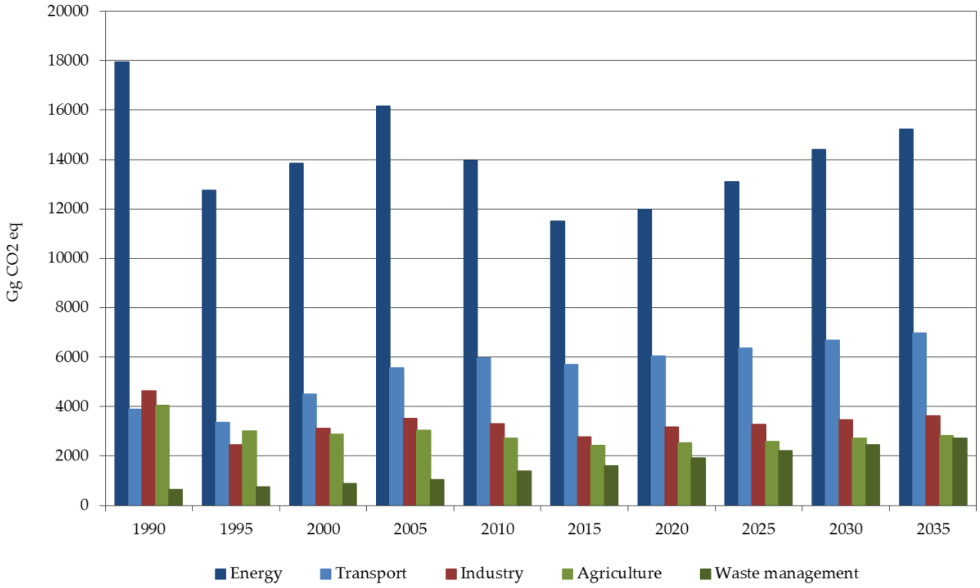

Figure 5-1: Historical and projected greenhouse emissions by sectors, 'without measures' scenario

Source: [3], [2]

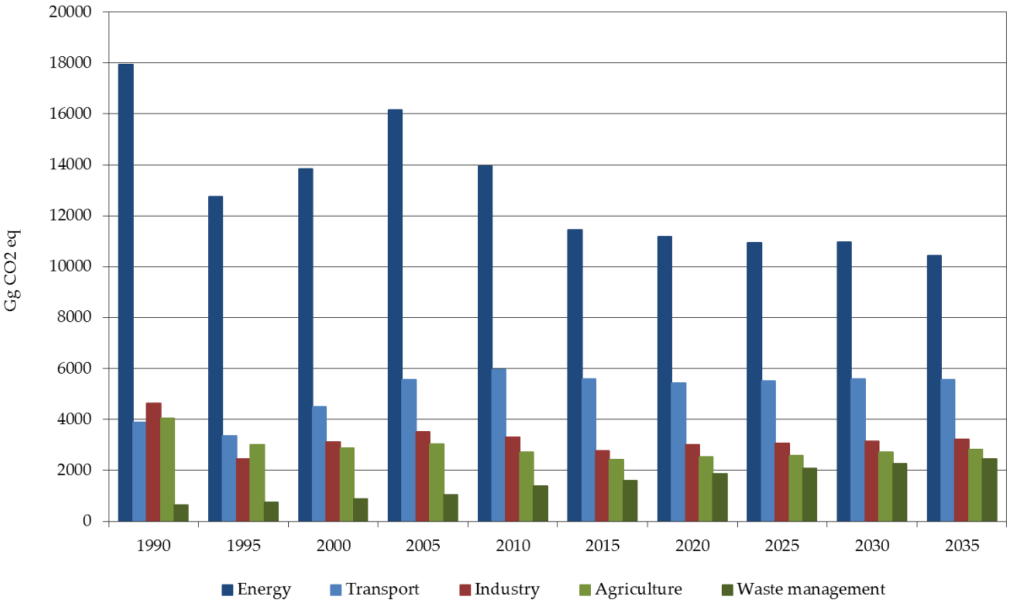

Figure 5-2: Historical and projected greenhouse emissions by sectors, 'with existing measures' scenario

Source: [12], [2]

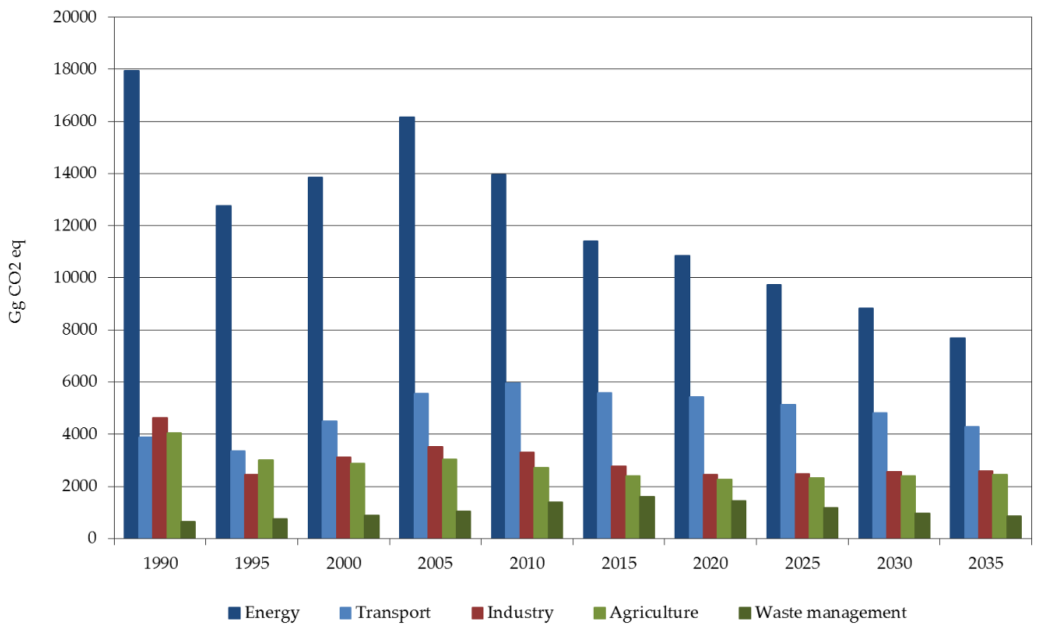

Figure 5-3: Historical and projected greenhouse emissions by sectors, 'with additional measures' scenario

Source: [3], [2]

The energy sector covers all activities that involve fuel combustion from stationary sources and fugitive emission from fuels. The emission from energy sector in 2014 amounted to 10,817 kt CO_2 and it is the main source of anthropogenic emission of greenhouse gases, it accounts approximately 46.9 % of the total greenhouse gases emission in 2014. In scenario ‘without measures', i.e. without implementation of energy efficiency measures and renewable energy policy and with the increase in a number of fossil fuel power plants to reduce the import of electricity by 2030, projections show steady growth until 2035. In the ‘with existing measures’ scenario, projections show stagnation of emissions until 2020 as the growth of demand is mainly satisfied by the development of the renewable energy sources and energy efficiency. In the period from 2020 to 2035, this scenario shows a slight decrease due to expected development of the renewable energy sources even without the additional measures, only due to market competitiveness and impact of the EU ETS. Most measures to reduce emissions in the energy sector are defined by 2020, so it has not yet been determined which will be implemented after 2020. In scenario 'with additional measures', all measures planned in the energy sector were taken into account and projections show a steady trend of emission reduction.

The transport sector includes emissions from fuel combustion in road transportation, civil aviation, railways and navigation. The emission from transport sector in 2014 amounted to 5,642 kt CO_2-eq, which makes about 24.5 % of total Croatia’s greenhouse gases emission. In scenario ‘without measures', projections show a continuous trend of growth of emissions by 2035, primarily due to strong ties with expected increase in GDP and transport activity. In the ‘with existing measures’ scenario in the period from 2015 to 2035, projections indicate stagnation of emissions. Factors that encourage the growth of emissions are expected increase in economic activities and living standards, while the emission reductions are primarily affected by the measures to increase energy efficiency and use of renewable sources in transport. Most of the existing measures have defined duration by 2020 so in this scenario not many measures are simulated after 2020. In scenario 'with additional measures', projections show a continuous trend of reducing emissions by 2035, primarily due to expected measures to increase rail transport and development of electric vehicles, which will be the key condition for the strong reduction of emissions in transport sector in long term.

The industry sector includes the process emission from industrial processes and product use, while emission from fuel combustion in industry is included in the Energy sector. The emission from industry sector in 2014 amounted to 2 688 kt CO_2-eq, which makes about 11.7 % of total Croatia's greenhouse gases emission in 2014. The projections of emissions indicate an increase in 'without measures' and 'with existing measures' scenarios due to expected increase in production to the maximum utilization of existing productive capacity in the period until 2035. The differences between 'without measures' and 'with existing measures' scenarios relate to the degree of the implementation of process measures in 'with existing measures' scenario prescribed by the sectoral legislation. The projections of emissions indicate a decrease in 'with additional measures' scenario due to the implementation of cost-effective measures to reduce emissions.

The agriculture sector covers about 10.5 % of total greenhouse gas emissions in 2014 (emission is 2 427 kt CO_2-eq). The projections indicate an increase in emissions after 2015, implying a growth of emissions from the agricultural sector based on the assumed increase in livestock population and crop production (assumption based on expert judgement of University of Zagreb, Faculty of Agriculture experts) and normalization of agricultural production (trend analysis).

The waste management sector participates in the total emission of greenhouse gases with about 6.4 % in 2014 (emission is 1 474 kt CO_2-eq). The projections of emissions indicate an increase in 'without measures' and 'with existing measures' scenarios due to expected increase of waste quantities in the period until 2035 as a result of higher living standards, despite the effects of measures undertaken to avoid/reduce and recycle waste. The differences between 'without measures' and 'with existing measures' scenarios relate to the degree of the implementation of measures in 'with existing measures' scenario prescribed by the sectorial legislation. The projections of emissions indicate a decrease in 'with additional measures' scenario due to the implementation of cost-effective measures to reduce emissions. The potential of CO_2 emission reduction, which can be achieved by implementing the measures included in the scenarios 'with existing measures' and 'with additional measures' is balanced in the Energy sector.

In the year 2014, removals by sink in the LULUCF sector were -6 591.28 kt CO_2-eq. Projections of removals up to 2035 amount -2 338.29 kt CO_2-eq sinks per year. These projections are made by sectorial sub-categories 'Forest land', 'Cropland', 'Grasslands', 'Wetlands', 'Settlements', 'Other land' and 'Harvested wood products' for the scenario with existing measures and their aggregated trend is shown in Figure 5- 4.

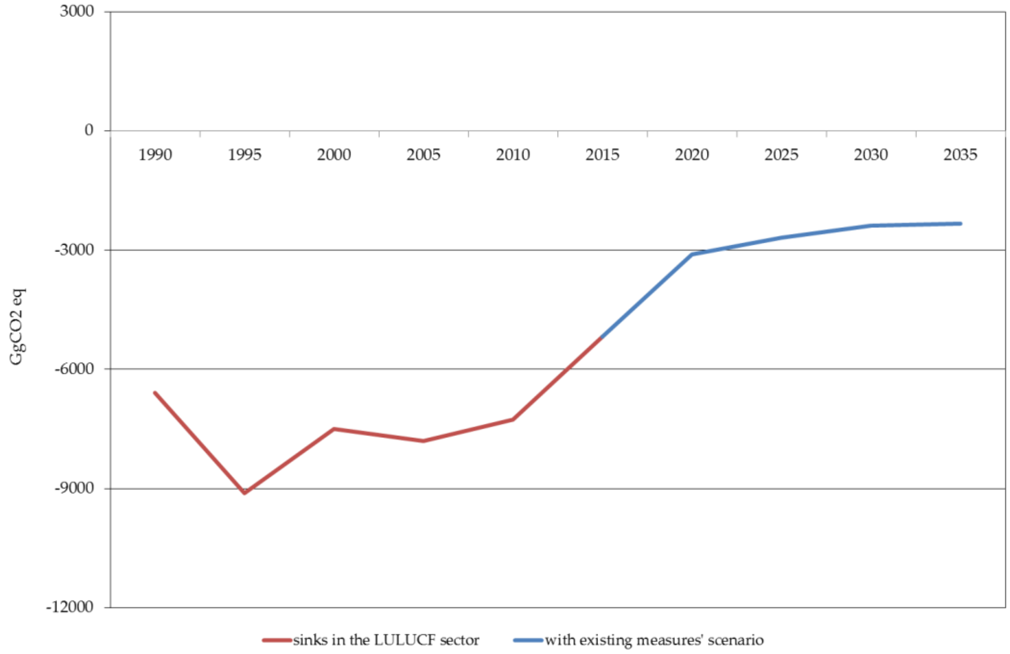

Figure 5-4: Historical and projected greenhouse removals in the LULUCF, 'with existing measures' scenario

Source: [3], [2]

5.2.2. Projections of greenhouse gas emissions by gases

Trends in emissions, by greenhouse gases (CO_2, CH_4, N_2O, HFCs and PFCs, SF_6), for all three scenarios, in the period from 1990 until 2035 are shown in Figure 5-5.

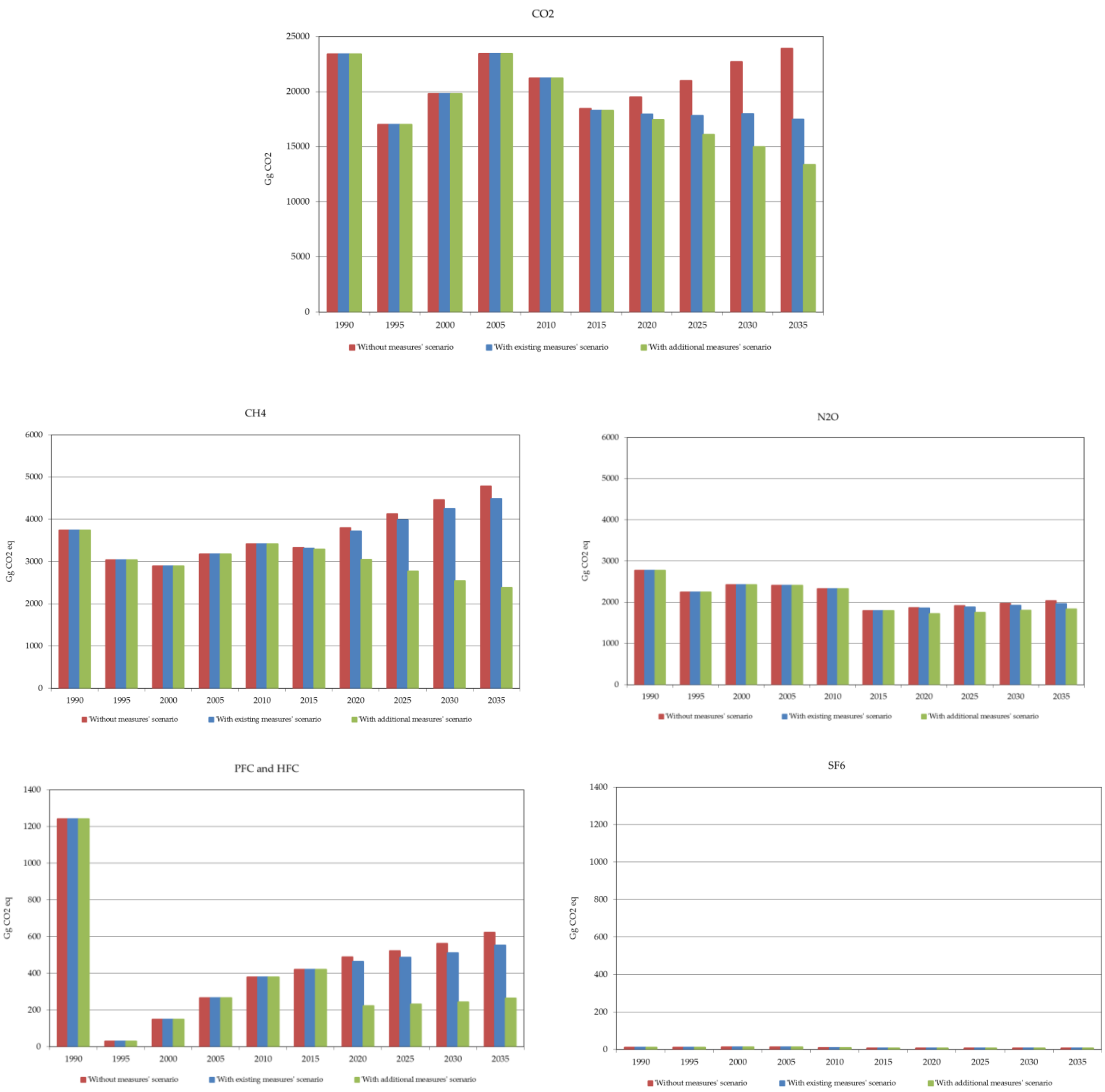

Figure 5-5: Projections of greenhouse gas emissions by gases

Source [3], [2]

Historical emissions and projections of greenhouse gas emissions CO_2, CH_4, N_2O, HFCs and PFCs, SF_6, for all three scenarios, in the period from 1990 until 2035 are shown in Table 5-1.

Table 5-1: Historical emissions and projections of greenhouse gas emissions by gases, kt CO_2-eq

CO2	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
'Without measures' scenario	23,390.08	16,992.80	19,789.12	23,451.85	21,203.74	18,455.92	19,478.81	20,981.70	22,700.20	23,896.19
'With existing measures' scenario	23,390.08	16,992.80	19,789.12	23,451.85	21,203.74	18,295.74	17,937.49	17,826.15	17,990.49	17,481.24
'With additional measures' scenario	23,390.08	16,992.80	19,789.12	23,451.85	21,203.74	18,271.93	17,431.88	16,093.41	14,989.61	13,363.06
CH4	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
'Without measures' scenario	3,744.19	3,033.66	2,887.85	3,173.79	3,415.08	3,327.91	3,794.42	4,132.36	4,463.65	4,785.08
'With existing measures' scenario	3,744.19	3,033.66	2,887.85	3,173.79	3,415.08	3,313.14	3,713.89	3,985.90	4,248.31	4,487.82
'With additional measures' scenario	3,744.19	3,033.66	2,887.85	3,173.79	3,415.08	3,285.09	3,045.69	2,768.80	2,546.74	2,385.09
N2O	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
'Without measures' scenario	2,768.74	2,243.31	2,418.77	2,407.93	2,322.33	1,794.47	1,868.01	1,909.88	1,973.65	2,031.41
'With existing measures' scenario	2,768.74	2,243.31	2,418.77	2,407.93	2,322.33	1,794.47	1,854.15	1,878.63	1,920.88	1,957.93
'With additional measures' scenario	2,768.74	2,243.31	2,418.77	2,407.93	2,322.33	1,794.51	1,722.46	1,753.45	1,797.26	1,834.89
PFC and HFC	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
'Without measures' scenario	1,240.24	29.32	147.90	265.80	378.91	419.58	487.10	522.51	562.26	621.97
'With existing measures' scenario	1,240.24	29.32	147.90	265.80	378.91	419.58	463.90	486.06	511.15	552.86
'With additional measures' scenario	1,240.24	29.32	147.90	265.80	378.91	419.58	221.68	231.50	242.88	263.24
SF6	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
'Without measures' scenario	10.45	11.12	11.62	13.03	8.95	6.38	6.59	6.71	6.86	7.08
'With existing measures' scenario	10.45	11.12	11.62	13.03	8.95	6.38	6.59	6.71	6.86	7.08
'With additional measures' scenario	10.45	11.12	11.62	13.03	8.95	6.38	6.59	6.71	6.86	7.08
TOTAL	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
'Without measures' scenario	31,154	22,310	25,255	29,312	27,329	24,006	25,636	27,553	29,707	31,341
'With existing measures' scenario	31,154	22,310	25,255	29,312	27,329	23,830	23,977	24,182	24,677	24,488
'With additional measures' scenario	31,154	22,310	25,255	29,312	27,329	23,777	22,430	20,855	19,583	17,854

The energy sector has the most significant anthropogenic sources of CO_2 emissions, with maximum value from 21 218 kt CO_2 (for the ‘without measures’ scenario) to 11 182 kt CO_2 (for the 'with additional measures' scenario) in 2035.

The most important source of N_2O emissions is agriculture sector, which projections in 2035 have the maximum of 2 819 kt CO_2-eq for the ‘without measures’ scenario, or 2 459 kt CO_2-eq for the ‘with additional measures' scenario.

The sources of HFCs and PFCs and SF_6 emissions are in the industry sector. Although their emissions in absolute terms are not large, due to the large global warming potential (GWP), their contribution is significant. Projections in 2035 have the maximum value of 825 kt CO_2-eq for the ‘without measures’ scenario, 687 kt CO_2-eq for the ‘with existing measures’ scenario and 333 ktCO_2-eq for the ‘with additional measures' scenario.

5.2.3. Total projections of greenhouse gas emissions

Total projections of greenhouse gas emissions (without LULUCF) for all three scenarios, for the period until 2035 are shown in Figure 5-6 and Table 5-2.

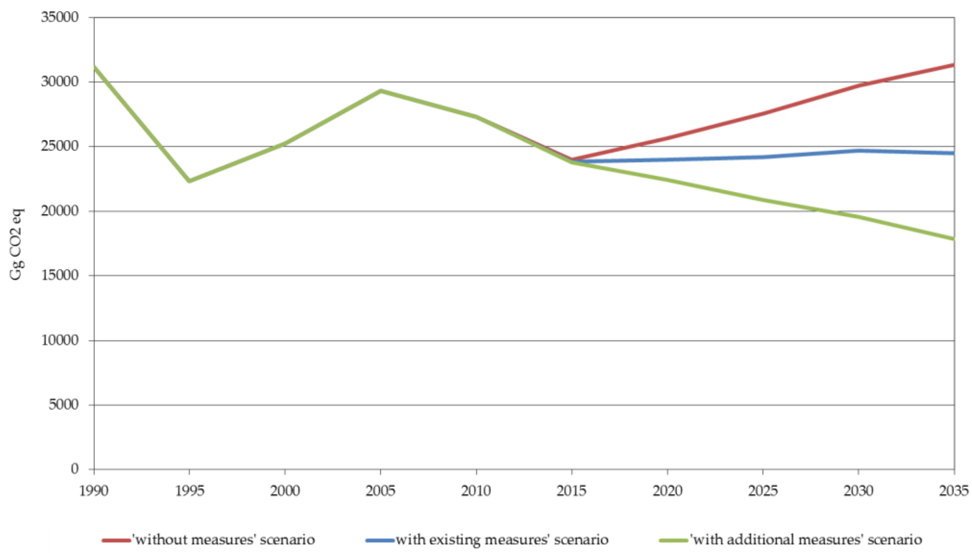

Figure 5-6: Total projections of greenhouse gas emissions (without LULUCF) for period until 2035

Source: [3], [2]

Table 5-2: Historical emissions and projections of greenhouse gas emissions by sectors, $GgCO_2$ eq

'Without measures' scenario	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Energy	17.951	12.754	13.851	16.169	13.952	11.496	11.975	13.098	14.395	15.215
Transport	3.881	3.368	4.499	5.561	5.952	5.703	6.050	6.373	6.692	6.973
Industry	4.629	2.441	3.128	3.508	3.315	2.781	3.157	3.287	3.457	3.626
Waste management	654	740	889	1.045	1.392	1.612	1.931	2.205	2.450	2.708
Agriculture	4.039	3.008	2.888	3.030	2.718	2.414	2.523	2.591	2.713	2.820
TOTAL	**31.154**	**22.310**	**25.255**	**29.312**	**27.329**	**24.006**	**25.636**	**27.553**	**29.707**	**31.341**

'With existing measures' scenario	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Energy	17.951	12.754	13.851	16.169	13.952	11.433	11.169	10.944	10.967	10.434
Transport	3.881	3.368	4.499	5.561	5.952	5.603	5.422	5.514	5.595	5.561
Industry	4.629	2.441	3.128	3.508	3.315	2.781	3.009	3.060	3.147	3.229
Waste management	654	740	889	1.045	1.392	1.599	1.854	2.072	2.256	2.444
Agriculture	4.039	3.008	2.888	3.030	2.718	2.414	2.523	2.591	2.713	2.820
TOTAL	**31.154**	**22.310**	**25.255**	**29.312**	**27.329**	**23.830**	**23.977**	**24.182**	**24.677**	**24.488**

'With additional measures' scenario	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Energy	17.951	12.754	13.851	16.169	13.952	11.412	10.847	9.741	8.840	7.677
Transport	3.881	3.368	4.499	5.561	5.952	5.599	5.421	5.128	4.827	4.286
Industry	4.629	2.441	3.128	3.508	3.315	2.781	2.447	2.484	2.547	2.586
Waste management	654	740	889	1.045	1.392	1.597	1.449	1.185	974	845
Agriculture	4.039	3.008	2.888	3.030	2.718	2.387	2.266	2.318	2.395	2.459
TOTAL	**31.154**	**22.310**	**25.255**	**29.312**	**27.329**	**23.777**	**22.430**	**20.855**	**19.583**	**17.854**

Projections show that compared to 1990, in 2035 the emission remains approximately the same as in 1990 in the 'without measures' scenario. In the ‘with existing measures’ scenario, in 2035 the emission is reduced by 21.4 % compared to 1990, while in the 'with additional measures' scenario emission is reduced by 42.7 % compared to 1990.

In the ‘with existing measures’ scenario, projections show stagnation of emissions until 2020. In the period from 2020 to 2035, this scenario shows a slight increase of emission.

In the 'with additional measures' scenario, projections show a steady downward trend of emissions.

In ‘with existing measures’ scenario, in relation to the 'without measures' in 2035, the greenhouse gas emissions will be reduced by 21.9 %, while in the scenario 'with additional measures' by 43 %.

In scenario 'with additional measures' in relation to the scenario ‘with existing measures’ in 2035, greenhouse gas emissions will be reduced by 27.1 %.

5.2.4. Total effects of policies and measures

Total effects of applied policies and measures to reduce greenhouse emissions are shown in Table 5-3.

Table 5-3: Total effects of policies and measures, kt CO_2-eq

	2015	2020	2025	2030	2035
'Without measures' scenario	24,006	25,636	27,553	29,707	31,341
‘With existing measures’ scenario	23,830	23,977	24,182	24,677	24,488
TOTAL	176	1,659	3,371	5,029	6,853

By comparing the 'without measures' scenario with scenario that includes the application of relevant policy and measures which implementation is already in progress, or application of policy and measures that have already been adopted (‘with existing measures’ scenario), total effects of applied policies and measures have been determined. Emission is reduced by 176 kt CO_2-eq in 2015 to 6,853 kt CO_2-eq in 2035 (Figure 5-7).

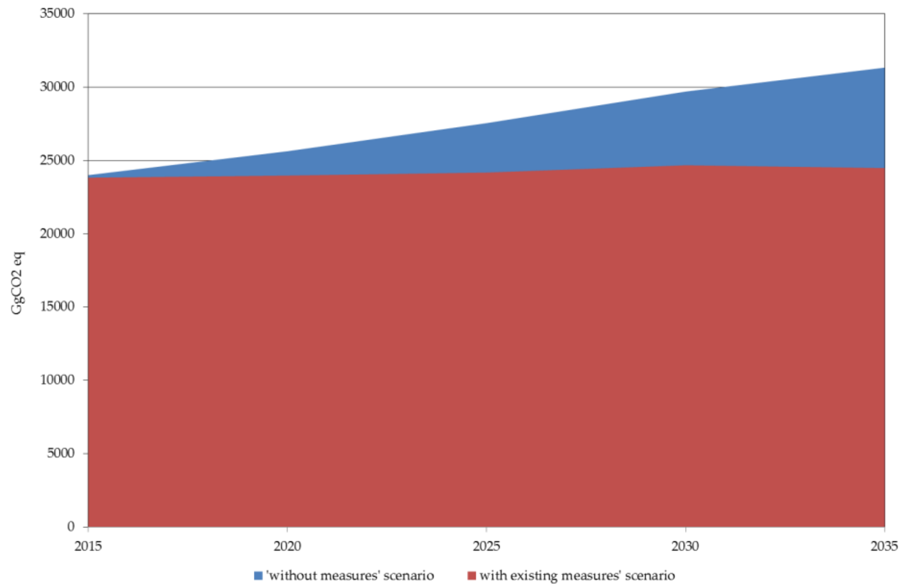

Figure 5-7: Total effects of policies and measures

5.2.5. Emissions of the ETS i ESD sectors

Historical emissions and projections of greenhouse gas emissions in ETS and ESD sectors for three scenarios are shown in Table 2-4.

Table 5-4: Historical emissions and projections of greenhouse gas emissions in ETS and ESD sectors, kt CO_2-eq

	2010	2015	2020	2025	2030	2035
'Without measures' scenario	27,329	24,006	25,636	27,553	29,707	31,341
ETS	8,710	8,772	9,452	10,546	11,881	12,693
ESD	18,587	15,201	16,142	16,963	17,774	18,594
'With existing measures' scenario	27,329	23,830	23,977	24,182	24,677	24,488
ETS	8,710	8,731	8,707	8,515	8,630	8,155
ESD	18,587	15,066	15,228	15,622	15,996	16,277
'With additional measures' scenario	27,329	23,777	22,430	20,855	19,583	17,854
ETS	8,710	8,712	8,098	7,342	6,848	6,024
ESD	18,587	15,033	14,290	13,469	12,686	11,780

Source: [3], [2]

Emissions within the ETS in 2010 encompassed 32 % of total emissions, amounting to 8 710 kt CO_2-eq. Projections indicate that in 2015 the ETS cover approximately 36.6 % of total emissions, while in 2035, according to the 'with additional measures' scenario, 33.7 % of emissions will be included, 33.3 % of emissions will be included according to the 'with existing measures' scenario and 40.5 % of total emissions will be included in the 'without measures' scenario.

In the 'without measures' scenario, compared to 2010, emission projections show an increase in emissions of 0.7 % in 2015 up to 45.7 % in 2035. The reason of this increase is primarily due to no improvements in energy efficiency and production of electricity from fossil fuel plants as a result of the assumption of reduced dependency on electricity imports and assumption that all new electricity demands in this scenario will be covered by fossil fuel power plants. In the 'with existing measures' scenario, projections show stagnation of emissions until 2020. In the period from 2020 to 2035, this scenario shows a slight decrease of emission (by 6.4 % in 2035 compared to 2010). In the 'with additional measures' scenario, projections show a steady downward trend, primarily due to planned actions to promote usage of renewable energy sources and energy efficiency. Compared to 2010, emission projections show a decrease in emissions of 30.8 % in 2035.

In 2010, emissions within ESD sector amounted to 18 587 kt CO_2-eq, which represents 68 % of total emissions. In the 'without measures' scenario, increase in emissions is expected in the whole observed period from 2015 to 2035, and it is expected that in 2035 the emission will be at the 2010 level. In the 'with existing measures' scenario, projections show a slight increase of emission in period from 2015 to 2035 (by 8 % in 2035 compared to 2015). Compared to 2010, emission projections show a decrease in emissions of 12.4 % in 2035. Compared to 2005, emission projections show a decrease in emissions of 12.6 % in 2035. In the 'with additional measures' scenario, further reduction of emissions is expected, by 36.6 % in 2035 compared to 2010.

5.2.6. Impact of the use of clean development mechanism, joint implementation and emission trading as an additional measure for the GHG emission reduction

The current impact of the implementation of the Kyoto Protocol mechanisms cannot be determined since the Republic of Croatia has so far not used these mechanisms. Domestic measures were the only measures applied to reduce emissions and increase greenhouse gas emissions. The Decree on the Implementation of Flexible Mechanisms (Official Gazette 142/08), which regulates the implementation of flexible mechanisms, is still in force. Installations in the Republic of Croatia have also been included in the European Union's greenhouse gas emissions trading scheme (EU ETS) since 2013, which means that the emission trading mechanism is in use at the level of power and industrial plants. So far no plans have been made for the implementation of project mechanisms, i.e. for investments in the mechanism of clean development and the mechanism of joint projects for which the Republic of Croatia would acquire CER and ERU units.

Annex II to CTF Table 2 describes the possibilities of using international flexible mechanisms within the EU ETS.

5.3. METHODOLOGY

Projections were made in accordance with the Guidelines for preparation of national reports by Parties included in Annex I to the Convention.

The potential for mitigation of national greenhouse gas emissions is analysed and assessed at the sectoral level. This assessment takes into account the previous trends and the current state as well as the future projections of parameters that determine the potential for mitigating emissions. The model and methodology used in preparing the projections are described by sector, in this chapter.

A list of assumptions and input data is provided in tabular form. The list contains general parameters and parameters related to the sectors and sub-sectors (energy, transport, buildings, industry, agriculture, waste management and LULUCF), in accordance with Annex XII of Implementing Regulation (EU) 749/2015.

The ‘with existing measures’ and 'with additional measures' scenarios included policies and measures for reduction of emissions from sources and increase greenhouse gases sinks. In order to determine the contribution of each individual policy and measure for emissions reduction, the reduction potential was determined. In cases where the emission reduction potential of individual policies and measures cannot be expressed separately, reports are aggregated with other potential policies and measures.

5.3.1. Descriptions of models and methodologies for projections

Energy and transport

In preparing the projections, a software package LEAP (Long-range Energy Alternatives Planning System) [13] was used, in which was created a model of the energy sector in Croatia. For the needs of detailed modelling of the development and optimization of the power sector, more advanced model were used, whose outputs were the inputs for the energy model in LEAP. Output data are structured in accordance with the structure of inventory of the United Nations Framework Convention on Climate Change. It is the engineering simulation model in which are the scenarios simulated and certain processes and decisions optimized in regard to the assumptions and limitations. The model is detailed to the level of individual production units, present and future.

Projections were made until 2035, with a single step every year. The model is of 'bottom-up' type, because it starts from the sectorial data and individual emission sources in the power sector and calculates CO_2, CH_4 and N_2O emissions.

Assumptions and input parameters used in the preparation of projections are shown below.

Table 5-5: Assumptions for projections – energy and transport

<table>
<tr><td colspan="2">ENERGY AND TRANSPORT</td></tr>
<tr><td colspan="2">As described in the Chapter 3, projections of GHG emissions for this report are taken from the draft of the Low-Carbon Development Strategy of Croatia until 2030 with a view to 2050. Below is a more detailed description of the methodology used.</td></tr>
<tr><td rowspan="2">1. Final energy demand</td><td>Final energy demand is projected in different sectors - industry, transport, services, households and agriculture, fisheries and forestry. The bases for projections of activities are macroeconomic parameters and guidelines provided by the EC to Member States to harmonize the key parameters. For the projections of energy intensities, a development of technology and changing of lifestyles was taken into account. The scenarios ‘with existing measures’ and 'with additional measures' modelled the impacts of each measure.
The analyses were performed by sub-sectors:
– industry - by industry and type of fuel used,
– transport – by type of transport (road, air, marine and rail) and types of means of transport (cars, buses, motorcycles, light and heavy vans) and by type of technology and fuel used
– services – by branches (tourism, trade, education, health), climatic zone (coastal or continental Croatia), purpose (heating, water heating, cooking, cooling, electrical appliances and lighting), type of fuel used, heating demand is modelled on the level of useful and final energy
– households – by climatic zone (coastal or continental Croatia), purpose (heating, water heating, cooking, cooling, electrical appliances and lighting) and by type of fuel, heating demand is modelled on the level of useful and final energy
– agriculture, fisheries and forestry - by type of fuel</td></tr>
<tr><td>Demographic trends - assumes a scenario of average fertility and average migration, in accordance with the guidelines of the EC.</td></tr>
<tr><td colspan="2">1.1. 'Without measures' scenario</td></tr>
<tr><td>1.1.1. Energy demand in industry</td><td>Assumptions:
– development of industrial production will not be based on energy-intensive industries, as market mechanisms will direct the balanced development to the less energy-intensive industry where Croatia is not in need of resources,
– trends in gross value added in industry are based on harmonized parameters for projection given by the EC [21],
– for this scenario, it is assumed that the energy intensity per unit of gross value added and fuel mix in industry will be as in 2014,
– Emissions in the industry sub-sector is growing along with economic growth, but growth is moderate as in other sub-sectors considering a decreasing dependence of energy consumption on GDP growth and assumption that there will be no construction of major new energy-intensive industries.</td></tr>
<tr><td>1.1.2. Energy demand in transport</td><td>Assumptions:
– it is assumed that there will be the increase in number of cars from the 328 cars per 1000 citizens as in 2012 to 520 cars per 1000 citizens in 2050. The average number of cars per 1000 citizens in EU in 2012 was 501 [ODYSSEE]
– efficiency of cars assumed as in 2014, no development of alternative fuels;
– existing road infrastructure was mainly built;
– the transport of passengers will have fastest growth in air traffic;</td></tr>
</table>

ENERGY AND TRANSPORT	
	– stagnation in development of rail infrastructure.
1.1.3. Energy demand in general consumption	Assumptions: Households: – according to the existing data, in Croatia in 2012 was 142.2 million m^2 of residential buildings and houses (Long-term strategy for the promotion of the investments of buildings, OG 74/14). It is assumed that the living area will grow slowly with the recovery of economic activity, despite the fall of number of people, by 8,5% until 2030 and by 10,6% until 2050. Most of the new surfaces will refer to a block of flats in urban areas, – no improved efficiency and renovation of building are assumed for this scenario, – consumption of electricity to power household appliances and devices for cooling (air conditioning) will grow, – specific energy consumption for cooking in households will stagnate. Services: – no change in the structure, used forms of energy – increase of electricity consumption, decrease in the usage of petroleum products and their replacement with natural gas, – on the islands and parts of Croatia not covered with a natural gas grid, the share of liquefied petroleum gas will be increased – In the services and households sub-sector, projections in the 'without measures' scenario show an increase in the final energy consumption because of the GVA growth of the service sector as well as increase in income of households. Agriculture, forestry and fisheries: – there will be no changes in energy intensity.
1.2. 'with existing measures' scenario	
	In the period until 2020, energy efficiency improvements are in line with the existing measures listed in the National Action Plan for Energy Efficiency for the Period 2017-2019 (listed in the Report on Policy and Measures), while for the post-2020 period, there are no yet implemented measures, so only assessed market improvements are integrated: – market driven improvements of energy efficiency and fuel switches in industrial sector; – renovation of 0,5% surface are of the buildings annually to the standard as listed in the Technical regulation on rational use of energy in buildings (OG 97/14) ; – all new buildings built according to the same Regulation; – it is assumed that all emissions from the new vehicles will be in line with the Regulation EU no. 333/2014 for the personal vehicles, i.e. average emissions of new vehicles will be below 95 g CO_2/km and Regulation EU no. 510/2011 to reduce the average emissions of light duty vehicles below 174 g CO_2/km after 2017 and below 147 gCO_2/km after 2020; – it assumed that there will be stagnation in the use of rail and inland waterways transport; – it is assumed that 6% of the vehicles will be electric vehicles in 2050 (based on the EU Reference scenario 2016).
1.3. 'With additional measures' scenario	

<table>
<tr><th colspan="2">ENERGY AND TRANSPORT</th></tr>
<tr><td></td><td>Continued support to energy efficiency after 2020, with the following key assumptions:
- renovation of 2% of the buildings annually to the nearly-zero energy standard (include the use of renewable sources);
- support for the development of the share of electric vehicles to 25% of the personal vehicles in 2050;
- intermodal shift with the goal to shift 7% of the transport of passengers and goods to rails until 2030 and 20% until 2050;
- improvements of energy efficiency in industry together with fuel switch towards the use of renewable energy and electricity.</td></tr>
<tr><td>2. Energy transformations and resources</td><td>The power system was analysed by the simulation of market development with the software for the hourly optimization of operation and development of the power system. The price of the emission allowances in the EU ETS was assumed as in the EU Reference scenario 2016.
The simulation of the operation of the refineries was done to satisfy the domestic demand as possible with the existing capacities, which mean without building new refineries in ‘without measures’ scenario, and reducing production in ‘with existing measures’ and ‘with additional measures’ scenarios.</td></tr>
<tr><td colspan="2">2.1. 'Without measures' scenario</td></tr>
<tr><td></td><td>Assumptions:
– all electricity needs will be met from domestic sources (except nuclear power plant Krško) after 2030, which significantly increases the generation in Croatian power plants since import amounted to 25 - 35%.
– no new capacity of renewable resources,
– all new electricity demands and replacement of old capacity are settled by production from fossil power plants; about 50% gas-fired power plants and about 50% coal-fired power plants,
– Nuclear power plant Krško continues delivering 50% of energy to Croatia and operates up to 2043.
– fuel production in refineries driven by the domestic demand;
– improvements of environmental performance and lifetime of power plants in line with the Directive 2010/75/EU on industrial emissions.</td></tr>
<tr><td colspan="2">2.2. ‘with existing measures’ scenario</td></tr>
<tr><td></td><td>Assumptions:
- Until 2020, installed capacities of renewable energy sources power plants are as defined by the National Action Plan for Renewable Energy Sources by 2020 and Tariff system for renewable energy and efficient cogeneration (OG 133/2013, 151/2013, 20/2014, 107/2014 i 100/2015);
- for the post-2020 period the simulation of the market development with the software for the hourly optimization of operation and development of the power system was done. The price of the emission allowances in the EU ETS was assumed as in the EU Reference scenario 2016. The analysis showed that renewable energy sources will be competent to certain extent without the need of the public support for the solar PV system and wind.
- no new coal power plants;
- no net imports of electricity after 2030.</td></tr>
<tr><td colspan="2">2.3. 'With additional measures' scenario</td></tr>
</table>

ENERGY AND TRANSPORT	
	Assumptions include continuous development of renewable energy policy even after 2020: - the simulation of the market development with the software for the hourly optimization of operation and development of the power system was done. The price of the emission allowances in the EU ETS was assumed as in the EU Reference scenario 2016. - Due to lower demand for energy compared to the 'with existing measures' due to the energy efficiency improvements, the costs to achieve higher shares of renewable energy are lower. - no new coal power plants; - no net imports of electricity after 2030.

Industry

In preparing the projections, a model derived in tabular Calculation interface was used. The model is structured in accordance with the table structure of the inventory of United Nations Framework Convention on Climate Change. It is the engineering simulation model. The model is detailed to the level of individual production units, the present and future ones.

Projections are made until 2035, in steps of five years. The model is of 'bottom-up' type, because it starts from the sectoral data and individual emission sources and calculates CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 emissions.

Assumptions and input parameters used in the preparation of projections are presented below.

Table 5-6: Assumptions for projections – industry

INDUSTRY	
	The projections were carried out based on the expected development of certain industries, which includes the production goals by 2035. Emission projections start from the situation and projections of macroeconomic parameters in 2015 [14] - the projected dynamics of the annual growth rate of gross domestic product and gross value added and the decline of population, as well the results of sectoral analysis and studies (cement, ammonia and nitric acid production). The 'without measures' scenario is illustrative scenario; it is developed for the needs of this report. It assumes no implementation of existing or additional measures. Assumptions for 'with existing measures' scenario: – no installation of additional capacity; – production will reach the maximum value by 2035. The Industrial Strategy of the Republic of Croatia 2014 – 2020 defines objectives of industrial development and key indicators of the Croatian industry in the period 2014 – 2020. According to the "realistic scenario", by the year 2020 achieving the level of physical volume of industrial production on the level of 2008 is expected, when it reached the highest level of economic activity in Croatia. Process emissions from economic activities, as defined by IPCC methodology, included in the sector Industrial processes and product use were estimated on the basis of detailed sectoral projections of production of cement,

INDUSTRY	
	ammonia and nitric acid and the projected macroeconomic indicators of gross value added by other industrial branches, annual increase rate in GDP and decline of population. The scenario includes the implementation of measures defined in the strategic and sectoral planning documents included in the business policy of cement and nitric acid manufacturers, conditioned by market demands, laws and regulations and the requirements of the application of best available techniques in the production process. Assumptions for 'with additional measures' scenario: – the application of cost- effective measures to reduce greenhouse gas emissions in the production of cement, glass and nitric acid and the reduction of emissions of volatile organic compounds, controlled substances and fluorinated greenhouse gases. According to *good practice*, the projections were made for activity data and emission factors: – activity data – applying grade of 1, 2 and 3 methods (projections of macroeconomic parameters, effects of policies and measures, sectoral analysis and studies); emission factors – applying grade of 1 and 2 methods (projections based on average values for the previous five-year period, effects of policies and measures, sectoral analysis and studies).

Agriculture

In preparing the projections, a model derived in tabular Calculation interface was used. The model is structured in accordance with the table structure of the inventory of United Nations Framework Convention on Climate Change. It is the engineering simulation model. The model is detailed to the level of individual sources, the present and future ones.

Projections are made by 2020, indicative until 2035, in steps of five years. The model is of 'bottom-up' type, because it starts from the sectorial data and individual emission sources and calculated emissions of CH_4 and N_2O.

Assumptions and input parameters used in the preparation of projections are presented below.

Table 5-7: Assumptions for projections - agriculture

AGRICULTURE	
	The projections were carried out based on the expected future state of key parameters. In order to determine the key parameters for projections (number and types of livestock, crop production), the extrapolation of historical input data was used and expert assessment that includes historical data and sectoral strategic and development documents. Assumptions: – uncertainties due to the lack of adequate and reliable statistics and economic indicators.

Waste management

In preparing the projections, a model derived in tabular Calculation interface was used. The model is structured in accordance with the table structure of the inventory of United Nations Framework Convention on Climate Change. It is the engineering simulation model. The model is detailed to the level of individual sources, the present and future ones.
Projections are made until 2035, in steps of five years. The model is of 'bottom-up' type, because it starts from the sectoral data and individual emission sources and calculated emissions of CO_2, CH_4 and N_2O.

Assumptions and input parameters used in the preparation of projections are presented below.

Table 5-8: Assumptions for projections – waste management

WASTE MANAGEMENT	
	The projections were carried out on the basis of expected development and future state of parameters relating to the amount of produced solid waste, share of municipal bio waste, amount of waste disposed at landfills, and the share of landfilled biodegradable waste. The scenarios assume a continuous increase of municipal solid waste as a result of higher living standards, which will slow down due to the application of measures defined in the strategic documents. The objectives are defined by sectoral strategic documents – Sustainable Waste Management Act and Waste Management Plan of the Republic of Croatia for the period 2017 – 2022. Emission projections start from the situation and projections of macroeconomic parameters [14] - the projected dynamics of the annual growth rate of gross domestic product and gross value added and the decline of population, which includes the goals by 2035. The 'without measures' scenario is illustrative scenario; it is developed for the needs of this report. It assumes no implementation of existing or additional measures. Assumptions for 'with existing measures' scenario: – includes projections of greenhouse gas emissions from solid waste disposal, biological treatment (composting) of solid waste, incineration of waste and wastewater treatment and discharge; – assumes a continuous increase of waste quantities in the period until 2035 as a result of higher living standards, despite the effects of measures undertaken to avoid/reduce and recycle waste. Greenhouse gas emissions which, according to the IPCC methodology, are included in the waste management sector were estimated on the basis of sectoral analysis and projected macroeconomic indicators on the annual increase in gross domestic product, gross value added and decline of population. The scenario includes the implementation of measures defined in the strategic and planning sectoral documents. Assumptions for 'with additional measures' scenarios: – includes projections for solid waste disposal on land and biological treatment (composting) of solid waste; – continuous growth of the quantity of municipal solid waste will be slowed down due to application of the measures defined in the strategic documents; – quantitative targets for the amount and composition of municipal waste and other parameters in the model for estimating CH_4 emissions from

WASTE MANAGEMENT	
	landfills, which are not defined by the strategic documents, are estimated by expert judgment. According to *good practice*, the projections were made for activity data and parameters included in the models for GHG emission calculation: applying grade of 1, 2 and 3 methods (projections of macroeconomic parameters, effects of policies and measures, sectoral analysis and studies, expert judgement).

LULUCF

In the 'with existing measures' scenario, for all sectoral components, the Projections Guide (A: General Guidelines and B: Sectoral Guide, [15]) was used. The most of sub-categories of this sector in the Report of the National Inventory of Croatia for 2017 have been recognized as the key ones, whether the trend or level. These are:

- 4(III) Direct N2O emissions from N mineralization/immobilization
- 4(V) Biomass Burning
- 4.A.1 Forest Land Remaining Forest Land
- 4.A.2 Land Converted to Forest Land
- 4.B.1 Cropland Remaining Cropland
- 4.B.2 Land Converted to Cropland
- 4.C.2 Land Converted to Grassland
- 4.D.2 Land Converted to Wetlands
- 4.E.2 Land Converted to Settlements
- 4.G Harvested Wood Products.

If possible, for the aforementioned sub-categories it is recommended to use Grade 2 or 3 when making projections. However, because of insufficient capacities in the system for making projections in the LULUCF sector at the national level, Grade 1 was applied. Emissions and removals are calculated by multiplying the projected activity data on and implied emission factors based on historic for the period from 2005 to -2014 for each carbon pool. Alternative 1 was used, whereat the activity data (in this case the size of the sub-categories of land) and emission factors for the period from 2015 to 2035, in this case the size of the sub-categories of land, were estimated using the linear extrapolation (or average values – e.g. for Wildfires) within the past ten years, from 2005 to 2014. For estimation of the projections for the biomass pool under subcategory Forest land remaining Forest land data on wood increment and wood removals from Forest management area plan for the period 2016-2025 [29] were taken into account. We need to clarify that this document is still in draft version. Also, for Harvested wood products pool, reference historical period for projection estimate was 1994-2012, because of large fluctuation in input data. In cases where the extrapolation had unrealistic extreme values (for example, negative values on areas in “Land converted to wetlands”), the arithmetic means of information on specific activity or implied emission factor for the past years were used. Expert assessment to predict the annual volume of afforestation ("Land converted to forest land'). All pools estimated in NIR 2017 have been taken into account when compiling projections of GHG emissions/removals. Some pools (e.g. dead wood) have been omitted because of insufficient data (same as in NIR 2017 also). Croatia is planning significant improvements in estimation of projections of GHG emissions/removals in the future period. Main steps of planned projects and activities should be oriented in modelling of projections estimation for key source subcategories and pools mentioned above. Results should decrease uncertainty in estimation and further use of Grade 2.

Assumptions and input parameters used in the preparation of projections for this year's Report are presented in Table 4-5.

Table 5-9: Assumptions for projections – LULUCF

LULUCF	
	The projections were carried out based on the expected future state of the parameters that determine a potential for emissions mitigation. Key parameters for screening were determined based on the parameters in the relevant Guideline for projections (land area of each subcategory, emission factors assumed by sinks) and expert judgment for surface renovated and forest land. Assumptions: – Total area of 'forest land' and 'settlements' will be increased – Land conversion to forest land will remain at the annual level (1.8 kha / year) – Areas of 'wetlands' will not increase – Areas of burned areas will not increase.

5.3.2. Parameters for projections

Table 5-10: Parameters on projections – general economic parameters

Parameter		2014	2015	2020	2025	2030	2035
GDP – annual growth rate	%	-0.4	1,6	1.8	1.2	1.3	1.9
Population	million people	4 238	4 229	4 194	4 140	4 081	4.018
Coal prices	Euro/GJ	2.5	2.2	2.2	2.6	3.2	3.4
Oil prices (1% S)	Euro/GJ	8.1	7.8	11.6	13.2	14.5	15.1
Gas prices	Euro/GJ	6.5	6.7	7.5	8.1	8.8	9.4

Source: [16], [14], [17]

Table 5-11: Parameters on projections – energy sector: total energy consumption, total electricity generation, 'with existing measures' scenario

Parameter		2014	2015	2020	2025	2030	2035
Total energy consumption							
Coal	PJ	31.6	31.7	24.3	23.1	22.0	16.5
Oil	PJ	125.8	130.7	125.9	122.3	118.5	116.2
Gas	PJ	84.6	91.8	104.7	109.2	118.7	119.7
Renewable	PJ	146.0	137.8	171.2	198.1	218.9	239.4
Total electricity generation							
Coal	TWh	2.0	2.2	1,5	1.4	1.3	0.7
Oil	TWh	IE	IE	IE	IE	IE	IE
Gas	TWh	1.5	1.8	2.4	2.6	1.6	3.4
Renewable	TWh	10.1	7.2	9.5	12.2	14.3	16.4
Electricity imports	TWh	4.0	6.8	6.4	4.6	2.9	2.6

Source: [2]

Table 5-12: Parameters on projections – energy sector: final energy consumption

Parameter		2014	2015	2020	2025	2030	2035
Final energy consumption							
Industry	PJ	40.6	10.9	44.9	46.4	48.0	50.4
Transport	PJ	84.5	84.5	87.3	89.8	92.9	93.3
Households	PJ	92.0	112.5	11.9	112.0	111.9	111.6
Agriculture, forestry and fisheries	PJ	9.7	9.4	9.5	9.2	8.9	8.7
Services	PJ	29.5	31.3	33.1	35.1	37.0	38.9
Other	PJ	4.2	4.2	4.7	4.7	4.8	5.0

Source: [2]

Table 5-13: Parameters on projections – weather parameters

Parameter	
Heating degree days	2,228
Cooling degree days	NE

Source: [18]

Table 5-14: Parameters on projections – industry

Parameter		1990	2010	2015	2020	2025	2030	2035
Production index for industry*								
Cement industry	%	2,643 kt	5	-4	33	36	40	41

Glass industry		275 kt	-16	2	14	21	29	41
Nitric acid industry	%	332 kt	1	-13	-13	-13	-10	-10
CO_2 emissions**								
Solvent use	%	93.99 kt CO_2-eq	49	62	58	56	54	50
HFC emissions***								
Consumption of HFCs in refrigeration and air conditioning equipment.	%	(1995) 29.32 kt CO_2-eq	1 292	1 431	1 582	1 658	1 743	1 885

*,**,*** the percentage change in relation to 1990

Source: Manufacturers of cement, glass and nitric acid, [3], [14], [12]

Table 5-15: Parameters on projections – transport

Parameter		**2014**	**2015**	**2020**	**2025**	**2030**	**2035**
Number of passenger kilometres, all modes	10^9 pkm	40.56	40.98	43.09	45.32	47.58	49.05
Transport of goods	10^9 tkm	11.59	11.64	11.90	12.16	12.42	12.69
Energy consumption in road transport	PJ	74.17	75.59	76.84	78.73	80.61	80.45

Source: [18], [2]

Table 5-16: Parameters on projections – agriculture

Parameter		**2014**	**2015**	**2020**	**2025**	**2030**	**2035**
Dairy cattle	1000 heads	179	165	168	175	180	185
Non-dairy cattle	1000 heads	264	240	270	285	320	340
Sheep	1000 heads	605	590	620	650	675	700
Goats	1000 heads	65	65	68	70	72	75
Horses	1000 heads	20	20	22	23	24	25
Mules/asses	1000 heads	4	2,0	2,2	2,5	3,0	3,5
Swine	1000 heads	551	480	504	528	600	672
Poultry	1000 heads	5327	6048	6231	6414	6597	6719
Wheat	t	648 917	758 638	879 847	1 002 001	1 042 030	1 178 645
Maize	t	2 046 966	1 709 152	2 187 640	2 205 554	2 239 040	2 256 114
Potatoes	t	160 847	171 179	203 239	160 630	132 738	104 879
Sugar beets	t	1 392 000	756 509	1 428 948	1 408 317	1 471 355	1 497 069
Tobacco	t	9 164	10 132	11 766	12 041	12 794	13 712
Sunflowers	t	99 489	94 075	92 333	109 745	114 592	129 556
Rape seed	t	71 228	56 783	70 866	70 933	90 782	99 821
Tomatoes	t	19 374	36 273	44 884	41 278	50 494	53 804
Barley	t	175 592	193 451	228 296	243 098	250 955	278 746
Oats	t	56 555	71 743	61 295	76 089	74 009	82 453
Cabbages and other brassicas	t	24 703	38 413	61 109	57 412	63 091	63 099
Garlic	t	4 272	4 634	4 912	4 534	5 288	5 757
Onions	t	24 160	26 204	33 438	33 475	40 069	44 763
Rye	t	2 800	3 356	0	0	0	0
Sorghum	t	1 205	1 205	1 554	1 891	2 357	2 761
Watermelons	t	25 598	15 771	32 599	31 346	33 683	35 274
Soybeans	t	131 424	196 431	153 926	174 867	185 521	190 140
Beans, dry	t	1 329	1 156	0	0	0	0

Cabbages and other brassicas	t	1 413	1 346	2 210	3 050	3 903	4 708
Lentils	t	83	83	13	0	0	0
Peas, dry	t	579	194	356	98	0	0
Vetches	t	1 500	1 500	1 923	1 585	1 512	1 462
Clover	t	70 873	82 992	147 241	143 473	148 600	157 171
Alfalfa	t	128 702	112 876	226 824	247 731	283 849	317 840
Applying nitrogen	t	80 707	99 000	99 000	99 000	99 000	99 000

Source: [16], [14], [15], [3]

Table 5-17: Parameters on projections – waste management

Parameter		1990	2010	2015	2020	2025	2030	2035
Waste generation per head of population	t/ per cap	0.209	0.380	0.393	0.436	0.463	0.494	0.542
Organic fraction of municipal solid waste (‘with existing measures’ scenario)	%	67	68	65	65	65	65	65
Organic fraction of municipal solid waste (‘with additional measures’ scenario)	%	67	65	65	24	18	12	9
Municipal solid waste disposed to landfills (‘with existing measures’ scenario)	kt	590	1 599	1 323	1 463	1 533	1 612	1 743
Municipal solid waste disposed to landfills (‘with additional measures’ scenario)	kt	590	1 599	1 323	797	298	148	107

Source: [3], [19], [20], [21], [14], [22]

6. VULNERABILITY ASSESSEMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

In the period from May 2016 to November 2017, the project "Strengthening the capacity of the Ministry of Environment and Energy for adaptation to climate change and preparation of the Draft Climate Change Adaptation Strategy" was implemented, funded by the EU Transitional Technical Assistance Tool for needs of the Ministry of environment and energy.

The result of this project is educated experts and civil servants and the public with raised awareness in the area of climate change adaptation, as well as the Draft Climate Change Adaptation Strategy in the Republic of Croatia for the period to 2040 with a view to 2070 (White Book) and Action Plan for the first five years of implementation (2019–2023). The White Book was prepared on the basis of a public debates, comments received from sectoral experts and suggestions on the working version of the Strategy (Green Paper). During the project implementation, 18 workshops were held and direct communication of project experts with involved institutions and other stakeholders was also established. As part of the project, apart from the White and Green Books and the draft Action Plan, a number of analytical backgrounds were developed, such as climate modeling, capacity building study, review of current research and climate change vulnerability assessment.

The general goals of the Strategy (White Book) are:

- to raise awareness of the importance of climate change and the inevitable launch of the adaptation process in all social segments
- to bring together all relevant institutional, political, economic and social stakeholders to create strong enough support for the implementation of joint actions on the implementation of adaptation measures, which necessitates a proactive approach.
- to integrate the adaptation process, including the implementation of measures, into existing and new policies, programs, plans and other activities implemented at all levels of governance
- to stimulate or enhance scientific research to better understand the complexity of climate change impacts and reduce the degree of uncertainty related to the effects of climate change
- to reduce the vulnerability of social and natural systems to the adverse impacts of climate change, i.e. to strengthen their resilience and the ability to recover from these impacts

Official adoption of the Draft Climate Change Adaptation Strategy in the Republic of Croatia for the period to 2040 with a view to 2070 (White book) and Draft Action Plan for the first five years of implementation (2019–2023) is expected in early 2019.

More detailed information and documentation about this project can be found on the website link: http://prilagodba-klimi.hr/.

6.1. EXPECTED IMPACTS OF CLIMATE CHANGE

6.1.1. Global climate change

The Earth's climate fluctuates over seasons, decades and centuries in response to both natural and human variables. Natural climate variability on different time scales is caused by cycles and trends in the Earth's orbit [23], incoming solar radiation, the atmosphere's chemical composition, ocean circulation, the biosphere, cryosphere and much more [24].

<u>Year 2017 was the warmest year on the record without El Nino warm anomaly</u>

According to NOAA (National Oceanic and Atmospheric Administration) and NASA (National Aeronautics and Space Administration), state agencies from United States of America (USA), 2017 finished as the third-warmest year globally since preindustrial time i.e. with anomaly of +1.2 °C (+2.1 °F) above the preindustrial average for the period 1881 –1910. This is the warmest year on record without an El Niño surface temperature warm anomaly in the Pacific Ocean, as neutral conditions existed in the Pacific until La Niña developed in the fall, what was not case in 2016 and 2015, the two the warmest years ever recorded by systematic observations. Ten the warmest years, since beginning systematic observations, are presented in Figure 6-1 from which 9, except 1998, belong to 21st century..

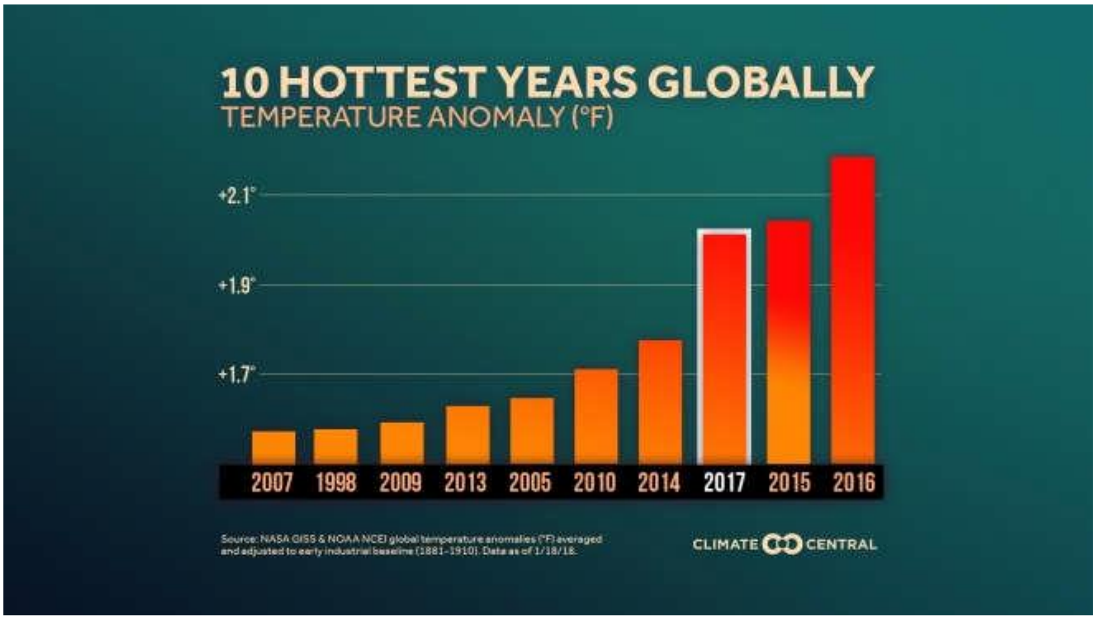

Figure 6-1: Ten the warmest years during period of systematic observations of air and ocean temperature on the Earth

Source: [25]

In other words, according to [26], the globally averaged temperature in 2017 was 0.46°C above the 1981-2010 multiannual average (14.3°C). This 30-year baseline is used by some national meteorological and hydrological services to assess the averages and variability of key climate parameters, such as temperature, precipitation and wind, which are important for climate sensitive sectors such as water management, energy, agriculture and health (Figure 6-2). Meteorological and Hydrological Service (DHMZ) of the Republic of Croatia uses a traditional standard period 1961–1990 which is still in use by Intergovernmental Panel on Climate Change (IPCC).

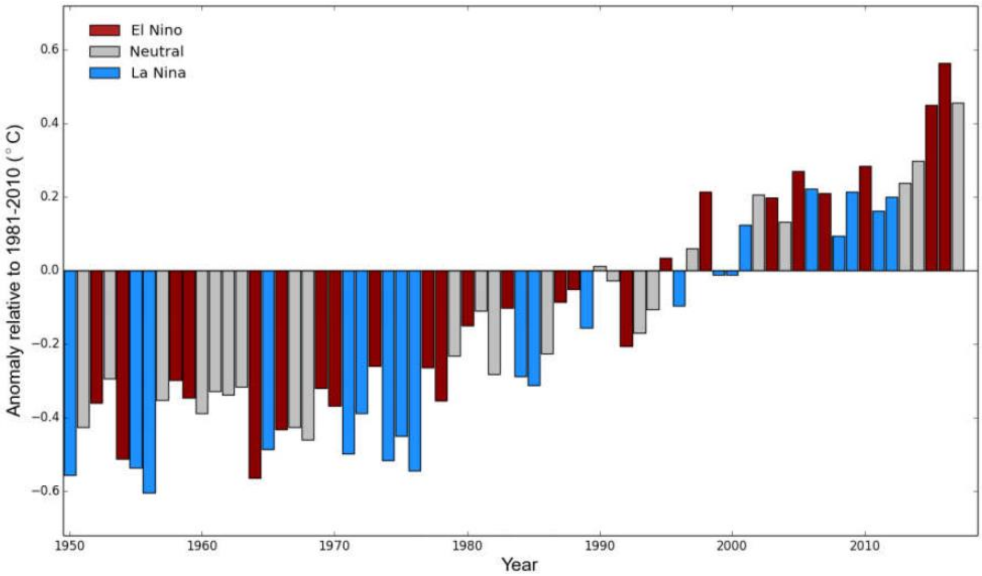

Figure 6-2: Global average temperature anomalies in reference to the period 1981–2010

Source: [26]

The highest positive average annual temperature anomalies appeared near the Arctic region (Figure 6-3), what is in agreement with climate scenarios.

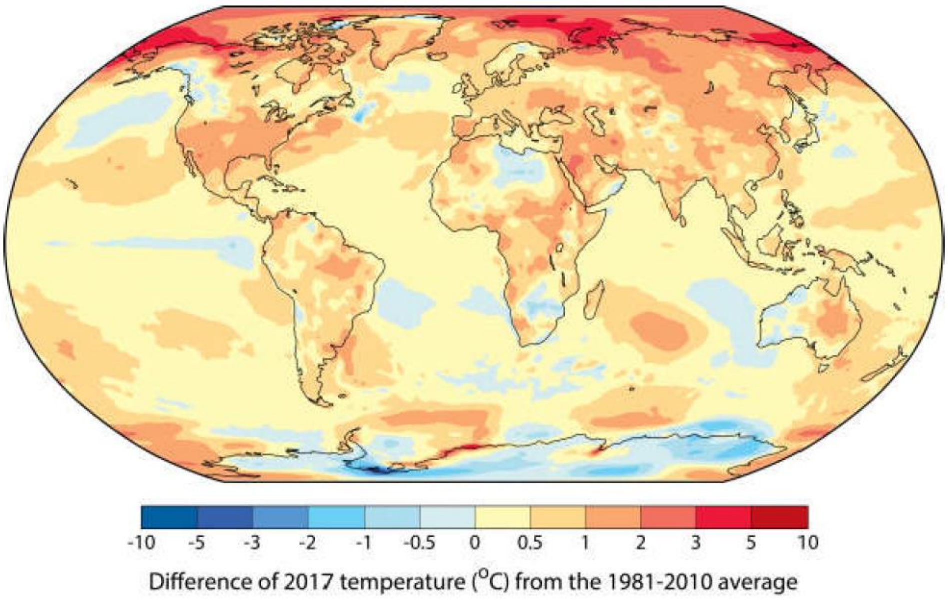

Figure 6-3: Distribution of average annual temperature anomalies for 2017 in reference to the period 1981–2010

Source: [26]

A summary of climate characteristics on a global scale for 2917 is presented in Figure 6-4. The last three years i.e. 2015, 2016 and 2017 are the warmest 3 years since beginning systematic climate observations with global average temperature higher 1.1–1.2 °C above pre-industrial average (1881–2010). The year 2017 was the warmest without El Nino influence and a year with high impact of extreme weather.

Figure 6-4: Summary of climate characteristics on a global scale for 2017

Source: [26]

Long-term trend of global warming is caused by greenhouse gaseous emissions in the Earth atmosphere. The December 2017 average concentration of carbon dioxide at the NOAA Mauna Loa site in Hawaii was 406.82 parts per million (ppm), an increase of 2.40 ppm from December 2016, and up from 314.67 ppm (29 %) from December 1958, when records began there.

The warmest decade

A study of World Meteorological Organization [24] indicates that a pronounced increase in the global air temperature occurred over the four decades i.e. during period 1971–2010 (Figure 6-2 and 6-5). The global temperature increased at an average estimated rate of 0.17 °C per decade during that period while during the whole period 1880–2010 was only 0.062 °C per decade. Furthermore, the increase of 0.21 °C in average decadal temperature from 1991–2000 to 2001–2010 is larger than the increase from 1981–1990 to 1991–2000 (0.14 °C) and larger than between any other two successive decades since the beginning of instrumental records. Nine of the 2001–2010 decade's years were among the 10 warmest on considered record. The warmest year ever recorded was 2010 in considered period.

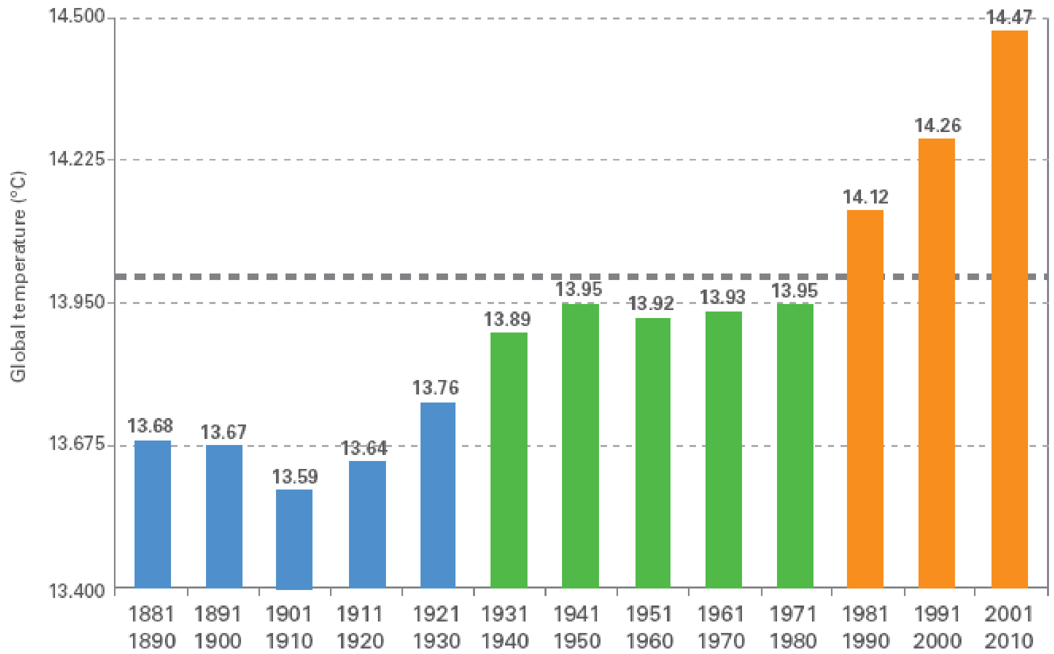

Figure 6-5: Decadal global combined surface air temperature over land and sea-surface temperature (°C). The horizontal grey line indicates the long-term average value for the period 1961–1990 (14 °C).

Source: [24]

<u>"Warm" and „cold" extremes</u>

While the average annual air temperature is an important climate indicator, the temperatures that people experience can differ greatly from day to day and over the course of a year because of natural climate variability. At the same time, human influence has probably increased the maximum temperatures of the most extreme hot nights and days and the minimum temperatures of cold nights and cold days. It is also more likely than not that human-induced climate change has increased the risk of heat waves [24].

According to the WMO survey, a total of 56 countries (44 %) reported their highest absolute daily maximum temperature record over the period 1961–2010 being observed in 2001– 2010 compared to 24 per cent in 1991–2000, with the remaining 32 % spread over the earlier three decades. Conversely, 11 % (14 out of 127) of the countries reported their absolute daily minimum temperature record being observed in 2001–2010, compared to 32 % in 1961–1970 and around 20 % in each of the intermediate decades (Figure 6-6). The highest number of 24-hour precipitation extremes have been recorded in two last decades (lower part of Figure 6-6).

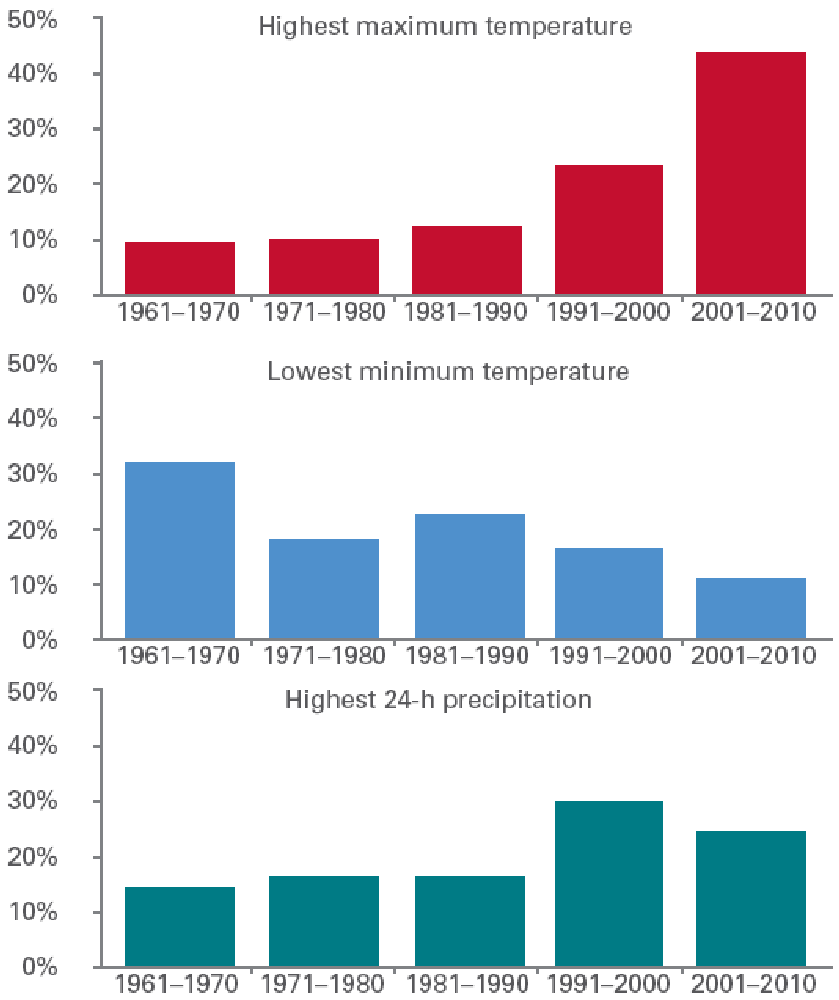

Figure 6-6: Absolute country records of the daily maximum and minimum air temperature and 24-hour precipitation in the last five decades

Source: [24]

Minimum extent of the Arctic sea cover

According to National Snow & Ice Data Centre – NSIDC) from the USA Arctic sea ice cover ranched its annual minimum on 13 September 2017 (Figure 6-7). That cover was 4.64 millions of square kilometres less than 1981–2010 average and at the same time 500 thousand square kilometres higher than that on the same date in 2012. Minimum Arctic ice cover in 2017 appeared 2 days earlier than 15 September which is date of annual minimum of multiannual average of Arctic ice cover. The earliest annual minimum of Arctic ice cover appeared on 5 September in 1980 and 1987, and the last on 23 September 1997.

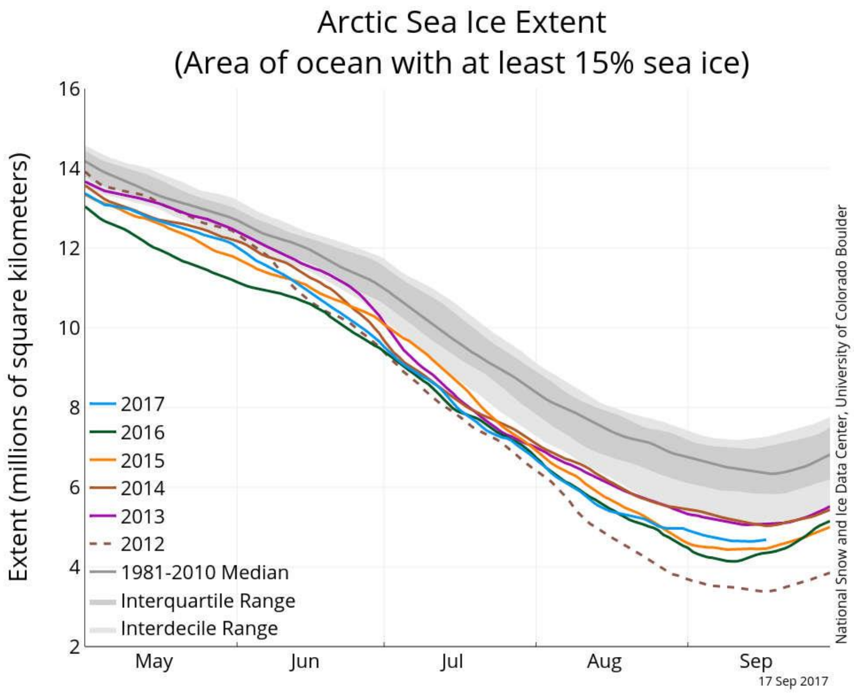

Figure 6-7: Arctic sea-ice extent for 2017, compared with previous 5 years and the 1979–2000 average (WMO, 2018).

6.1.2. Observed climate change in Croatia

<u>Introduction</u>

The Republic of Croatia has been exposed to the negative effects of climate change for a long time, resulting in significant economic losses. According to the European Environment Agency (EEA) report, the Republic of Croatia belongs to a group of three countries, together with the Czech Republic and Hungary, with the highest share of the damages from extreme weather and climate events in relation to the Gross Domestic Product (GDP). It is estimated that these losses, in the period from 1980 to 2013, amounted to around EUR 2.25 billion or around EUR 68 million per year on average. These losses have increased significantly during 2014 and 2015 (to EUR 2.83 billion in 2015). Some economic sectors were significantly affected in that period. According to some estimates, between 2000 and 2007 extreme weather conditions caused a damage of EUR 173 million to the agricultural sector, while the drought in 2003 caused damage of between EUR 63 and 96 million in the energy sector. It is also estimated that in August 2003 the mortality rate was 4 % higher due to heat stroke. Republic of Croatia, due to its size and economic power, can only make a small contribution to mitigate climate change, but it is nevertheless exposed to a significant impact of the adverse effects of climate change.

<u>Metodology</u>

The description of observed climate changes in the Republic of Croatia was taken from the Sixth National Report of the Republic of Croatia to the United Nations Framework Convention on Climate Change in 2014, considering that both reporting entries are in the same decade climatological period.
Climate change in Croatia over the period 1961-2010 has been determined by trends in annual and seasonal mean air temperature, mean minimum and mean maximum temperature; and in indices of

temperature extremes; then in precipitation amounts and precipitation indices, as well as in dry and wet spells.

The analyses are based on data from 41 mean, minimum and maximum daily temperature series and 137 daily precipitation series. The indices of temperature and precipitation extremes are calculated according to the definitions given by ETCCDI (Expert Team on Climate Change Detection and Indices) (Peterson et al. 2001; WMO 2004), Commission for Climatology (WMO/CCL) and World Climate Research Programme, Climate Variability and Predictability (WCRP/CLIVAR). The non-parametric Mann-Kendall rank test (Gilbert, 1987) was applied to assess statistical significance of trends at the 95% confidence level. The field significance test is based on the Monte Carlo simulation (Zhang et al. 2004).

Air temperature

Temperature trends were calculated for the temperature deviations from the associated 1961- 1990 means, and expressed in °C per decade, while trends in indices of temperature extremes are expressed by number of days per decade. Trends in air temperature (mean, mean minimum and mean maximum temperature) show warming all over Croatia (Figure 6-11). Annual temperature trends are positive and significant, and the changes are higher on the mainland than at the coast and the Dalmatian hinterland. The maximum temperature values were exposed to the greatest changes (Figure 6-8) with the highest frequency of trends in the class of 0.3 - 0.4 °C per decade, while trends in the mean and the mean minimum air temperatures mostly range between 0.2 °C and 0.3°C per decade. The overall positive trend in the annual air temperatures comes are mainly caused by the significant positive summer trends, while the trends for the winter and spring gave almost equal contribution to the increasing trends of mean maximum temperature. Autumn temperatures are subjected to small changes and they are mostly positive, though mainly insignificant.

Observed warming can be seen in all indices of temperature extremes, with positive trends of warm temperature indices (warm days and nights as well as warm spell duration index) and with the negative trends of cold temperature indices (cold days and nights and cold spell duration index) (Fig. 6-2).

All trends of indices of warm temperature extremes are statistically significant which is confirmed with the field significance trend (Figure 6-9 left). The most prominent increases are found in the number of warm days (Tx90) and warm nights (Tn90), and slightly lower trends are found in summer days (SU, absolute thresholds) and warm spell duration (WSDI). At most stations, the increase of the number of SU ranges between 2 and 8 days per decade (Table 6-2). Increase in the number of warm days (Tx90) most often accounted 6-10 days and warm nights (Tn90) even 8-12 days per decade. The duration of warm spells at most stations has increased for 4-6 days.

Warming is also evident in the observed negative trend in the indices of cold temperature extremes, but they are less expressed than the trends of warm indices (Figure 6-5 right). Cold days and cold nights (Tx10 and Tn10) have the most significant trends, and their number at most stations is reduced for up to 4 days per decade, while the trends in the number of cold days (FD, absolute thresholds) are smaller and are mostly reduced for up to 2 days per decade (Table 6.-1). The smallest changes are observed in the cold spell duration index (CSDI) which show a decrease by 2 days per decade at the majority of stations (more than 90 % of stations). Nevertheless, the trend is not statistically significant.

Table 6-1: List of the indices of temperaturne extremes and their definition. The abbreviations and definitions are according to standardisation of WMO-CCL/CLIVAR working group for climate change

Indices of cold temperature extremes		
FD	Frost days (absolute threshold	Number of days with minimum temperature below 0 °C
Tn10%	Cold nights (percentile threshold)	Number of days with minimum temperature (TN) below the 10th percentile from the 1961-1990 baseline period.
Tx10%	Cold days (percentile threshold)	Number of days with maximum temperature (TX) below the 10th percentile from the 1961-1990 baseline period
CSDI	Cold spell duration index	Number of days in periods with at least 6 consecutive days with minimum temperature below TN10%
Indices of warm temperature extremes		
Tn90%	Warm nights	Number of days with minimum temperature (TN) above the 90th percentile from the 1961-1990 baseline period percentile from the 1961-1990 baseline period
Tx90%	(percentile threshold)	Number of days with maximum temperature (TX) above the 90th percentile from the 1961-1990 baseline period percentile from the 1961-1990 baseline period
WSDI	Warm days	Number of days in periods with at least 6 consecutive days with minimum temperature above TX90%
SU	(percentile threshold)	Number of days with maximum temperature 25 °C

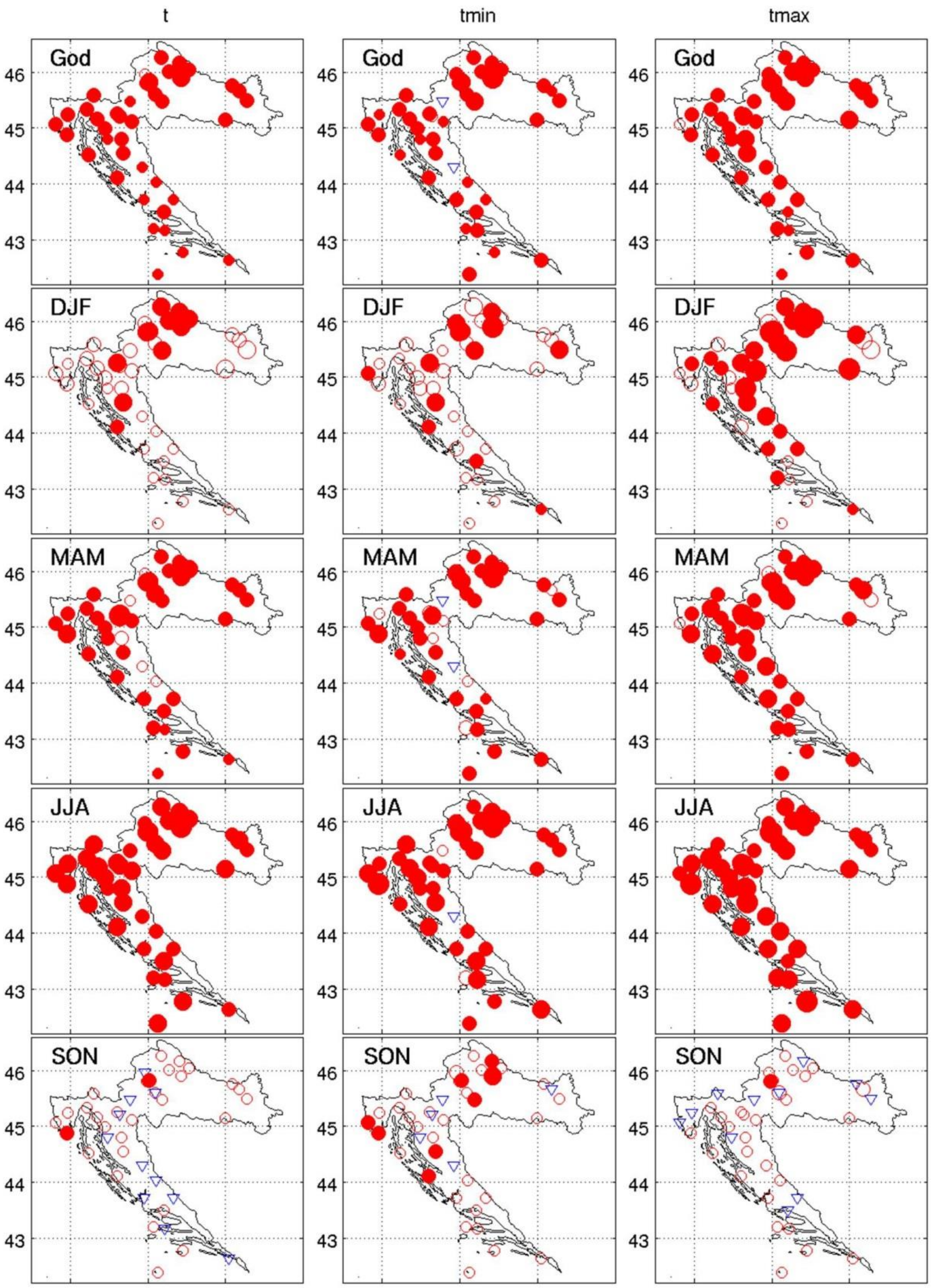

Figure 6-8: Decadal trends (°C/10yrs) in annual and seasonal (DJF-winter, MAM-spring, JJA-summer, SON-autumn) mean (t), mean minimum (tmin) and mean maximum temperature (tmax) values in the 1961-2010 period.

Circles denote positive trends, triangles the negative one, whereas filling means statistically significant trend. Four sizes of symbols are proportional tothe absolute value of change (in °C) per decade relative to the respective average from the period 1961-1990: <0.2, 0.2-0.4, 0.4-0.6 and >0.6, respectively

Table 6-2: Relative frequency of trend values (number of days in 10 years) in warm (SU, Tx90, Tx10, WSDI) and cold (FD, Tx10, Tn10, CSDI) temperature indices at 41 meteorological stations in Croatia

Trend	**SU**	**Tx90**	**Tn90**	**WSDI**	**FD**	**Tx10**	**Tn10**	**CSDI**
≤-6,0	0.0	0.0	0.0	0.0	2.4	0.0	2.4	0.0
-5,9-4,0	0.0	0.0	0.0	0.0	7.3	7.3	17.1	0.0
-3,9-2,0	0.0	0.0	0.0	0.0	36.6	**63.4**	**39.0**	2.4
-1,9-0,0	0.0	0.0	0.0	0.0	**43.9**	29.3	31.7	**92.7**
0,1-2,0	4,9	0,0	2,4	0,0	7,3	0,0	7,3	4.9
2,1-4,0	29.3	0.0	2.4	29.3	2.4	0.0	2.4	0.0
4,1-6,0	**36.6**	2.4	12,2	**46.3**	0.0	0.0	0.0	0.0
6,1-8,0	29.3	**29.3**	12.2	14.6	0.0	0.0	0.0	0.0
8,1-10,0	0.0	26.8	22.0	9.8	0.0	0.0	0.0	0.0
10,1-12,0	0.0	17.1	**24.4**	0.0	0.0	0.0	0.0	0.0
12,1-14,0	0.0	19.5	14.6	0.0	0.0	0.0	0.0	0.0
14,1-16,0	0.0	4.9	4.9	0.0	0.0	0.0	0.0	0.0
16,1-18,0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0
18,1-20,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
>20,0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0

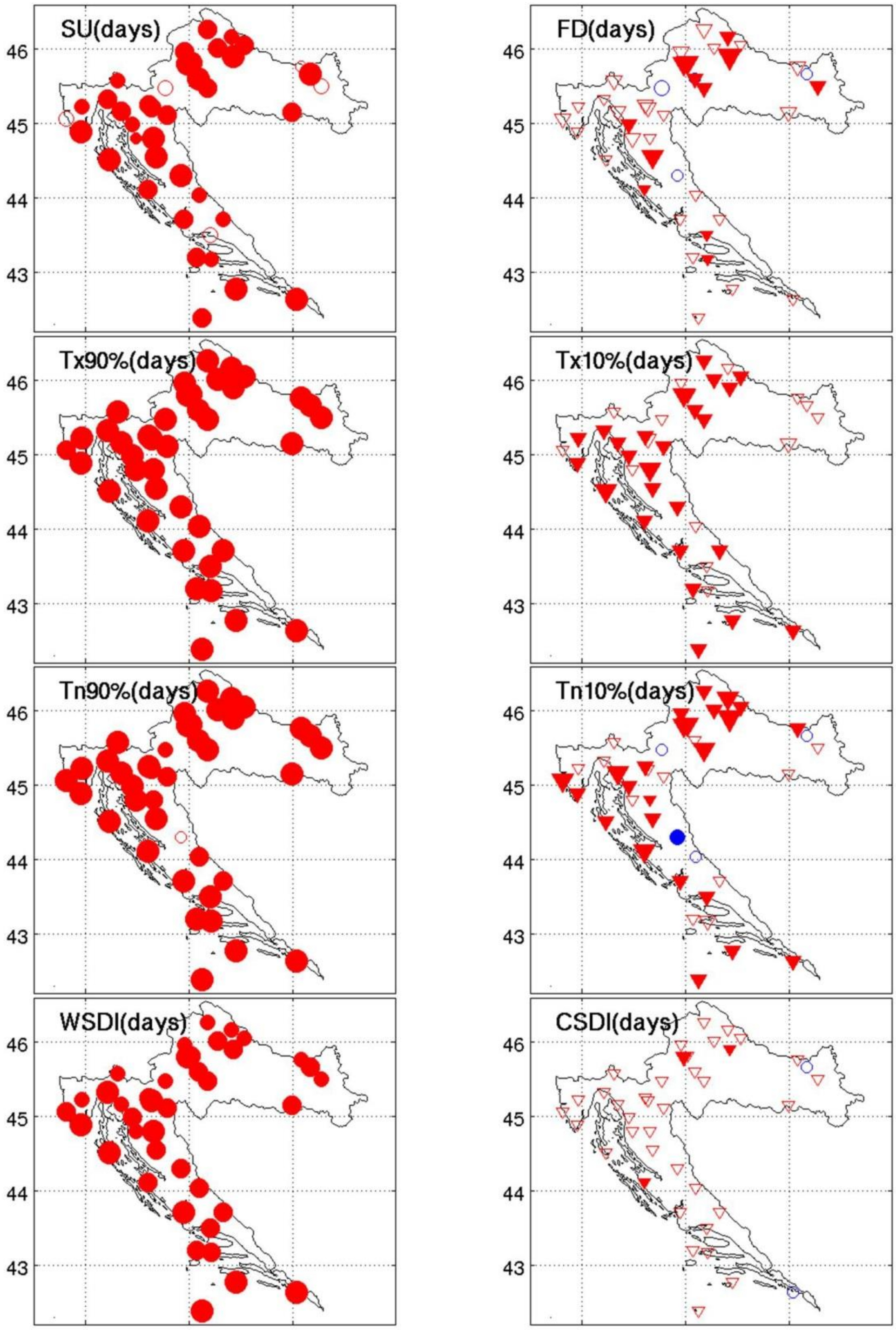

Figure 6-9: Decadal trends (days/10yrs) in annual extreme temperature indices in the 1961- 2010 period.
Circles denote positive trends, triangles the negative one, whereas filling means statistically significant trend. Four sizes of symbols are proportional to the absolute value of change (in days) per decade relative to the respective average from the period 1961–1990: <2, 2-4, 4-6 and >6, respectively.

Precipitation

Trends in annual and seasonal precipitation amounts give a general overview of the temporal change in precipitation over the country. During the recent 50-year period (1961 - 2010) the annual precipitation amounts (R) experienced prevailing insignificant trends that are increasing in the eastern lowland and decreasing elsewhere (Figure 6-10). The statistically significant decreases (filled symbols) are found for the stations in the mountainous region of Gorski kotar and in the Istria peninsula (northern Adriatic) as well as in the southern coastal region. Expressed per decade as percentages of the respective average values, these decreases range between -7 % and -2 %. Annual negative trends are mainly caused by decreasing trends in summer amounts (R- JJA), which are found to be statistically significant at most stations in the mountainous region and at some stations along the Adriatic and its hinterland (Figure 6-10 (b)). The statistical significance of the annual negative trend in Istria and Gorski kotar is also influenced by spring negative tendencies (from -8 % to -5 %; Fiure 6-10 (c)). Positive (circles) annual trends in eastern lowland are primarily caused by the significant increasing trends in autumn (Figure 6-10 (d)) and to a less extent in spring and summer. The geographical distribution of trends for seasons also shows interesting features. Summer precipitation shows a clear prominence of negative trend estimates all over the country and there is a number of stations for which this decrease is statistically significant, with the relative change between -11% and -6% per decade. In autumn, the trends are weak and mixed in sign, except in the eastern lowland where some locations show significant increasing trend in precipitation (8 % to 11 %). In spring results suggest no signal in the southern and eastern part of the country, while a negative tendency seems to affect the rest of the country, significantly only in Istria and Gorski kotar (-5 % to -7 %). During winter season (Figure 6-10 (e)), precipitation trends are not significant and they range between -11 % and 8 %. They are mostly negative at the southern and eastern parts as well as at Istria peninsula. The trends of mixed signs are found in the rest of the country.

Regional distribution of trends in precipitation indices, that define magnitude and frequency of precipitation extremes, shows complex structure, as it is also found for some Mediterranean regions.

Spatial distribution of trends in frequency of dry and wet precipitation extremes as indicated by number of dry days (DD), moderate wet days (R75) and very wet days (R95) are presented in Figure 6-7(f, g, h). The trends in DD are predominantly weak, but statistically significant positive trends (1 % to 2 %) appear at some stations in the mountainous region of Gorski kotar, Istria peninsula and in the southern coastal region. The trend pattern of R75 is spatially very similar to the annual precipitation one. The regional distribution of R95 trends shows no signal over the majority of the country. Statistically significant changes are present at few stations; positive over the northern lowlands and negative in the highlands of Gorski kotar as well as at the very southern coast.

Trends in the intensity of precipitation for wet days (Figure 6-10. (i)), as measured by the simple daily intensity index (SDII), reflect changes of trend magnitudes in two variables, annual amounts and annual number of wet days. For example, for two stations in different regions (indicated by two arrows in Figure 6-10. (i)), the same change in frequency of Rd (in these cases significant decrease, see Figure 6-10 (f)) but different changes in R, resulted in the similar significant increase in SDII at both stations. It implies that SDII is not suitable for explaining the causes of changes in R. Because of this fact, this index and its trends should be used with caution in application studies.

Table 6-3: List of the precipitation indices and their definitions

No.	Indices	Unit	Definition
1	DD	days	Dry days (absolute extreme) (Number of days with daily precipitation amount Rd<1.0 mm)
2	SDII	mm/day	Simple daily intensity index (absolute extreme) (annual precipitation amount / annual number of wet days (Rd≥1.0 mm)
3	R75	days	Moderate wet days (percentile threshold) (Number of days with precipitation Rd>R75%, where R75% is the 75th percentile of the distribution of daily precipitation amounts at days with 1 mm or more precipitation in the 1961-1990 baseline period
4	R95	days	Very wet days (percentile threshold) (Number of days with precipitation Rd>R95%, where R95% is the 95th percentile of the distribution of daily precipitation amounts at days with 1 mm or more precipitation in the 1961-1990 baseline period
5	R25T	%	Precipitation fraction due to days with Rd<R25% (percentile threshold) (Fraction of annual total precipitation ∑Rd/Rt, where ∑Rd indicates the sum of daily precipitation less than the 25th percentile of precipitation at days with R25% in the 1961-1990 baseline period. a Rt is the total annual precipitation amount.
6	R25-75T	%	Precipitation fraction due to days with R25%≤Rd≤R75% (percentile threshold) (Fraction of annual total precipitation ∑Rd/Rt, where ∑Rd indicates the sum of daily precipitation equal to or exceeding the 25th percentile of precipitation at days with R25% and equal to or less than the 75th percentile of precipitation at days with R75% in the 1961-1990 baseline period. Rt is the total annual precipitation amount.
7	R75-95T	%	Precipitation fraction due to days with R75%<Rd≤R95% (percentile threshold) (Fraction of annual total precipitation ∑Rd/Rt, where ∑Rd indicates the sum of daily precipitation exceeding the 75th percentile of precipitation at days with R75% and equal to or less than the 95th percentile of precipitation at days with R95% in the 1961-1990 baseline period. Rt is the total annual precipitation amount.
8	R95T	%	Precipitation fraction due to very wet days (percentile threshold) (Fraction of annual total precipitation ∑Rd/Rt, where ∑Rd indicates the sum of daily precipitation exceeding the 95th percentile of precipitation at very wet days R95% in the 1961-1990 baseline period
9	Rx1d	mm	Highest 1-day precipitation amount (absolute extreme) (Maximum precipitation sums for 1-day intervals)
10	Rx5d	mm	Highest 5-day precipitation amount (absolute extreme) (Maximum precipitation sums for 5-day intervals)

Fraction of annual total precipitation due to different classes of daily precipitation was analysed over the full-scale of daily precipitation categories. Four classes with percentile thresholds define the following indices: R95T, R75-95T, R25-75T and R25T (Table 6-3). The trend patterns of these indices are presented in Fig. 6-7 (k-n). Two opposite categories, that of very high precipitation extremes (R95T) and that of light precipitation extremes (R25T), show prevailing weak trends that are quite mixed in sign over the country. Only some locations seem to be affected by significant trends. Significant positive trend in R25T is found in the western Croatia (including NW region, Gorski kotar and Istria) and along the southern Adriatic coast. In the eastern lowland of Croatia, a positive trend in annual precipitation amount is associated with a significant positive trend in R95T. Contribution to annual amounts of daily precipitation from the central part of the distribution (R25-75T) shows weak changes of mixed sign (-7 % to 7 %). The similar is true for trends in the fraction of annual precipitation due to moderate wet days (R75-95T). Though, there is a significant positive trend found at few stations in the mountainous regions, as well as at the northern and middle Adriatic, despite the reduction in frequency of such days. Over the southern coastal region, the R75-95T shows negative trends that can be related to the negative tendency in R75.

The first information about temporal changes in annual extremes as defined by maximum 1-day precipitation (Rx1d) and multi-daily precipitation episode as defined by maximum 5-day precipitation (Rx5d) is presented by relative changes in their linear trends in Fig. 6-10. (f-g). Trend direction of both indices is generally in agreement along the respective regions. Trend is weak in magnitude and predominantly positive in the eastern lowland and along the coast; while it is mostly negative in NW area and in the mountainous regions (significant for Rx1d).

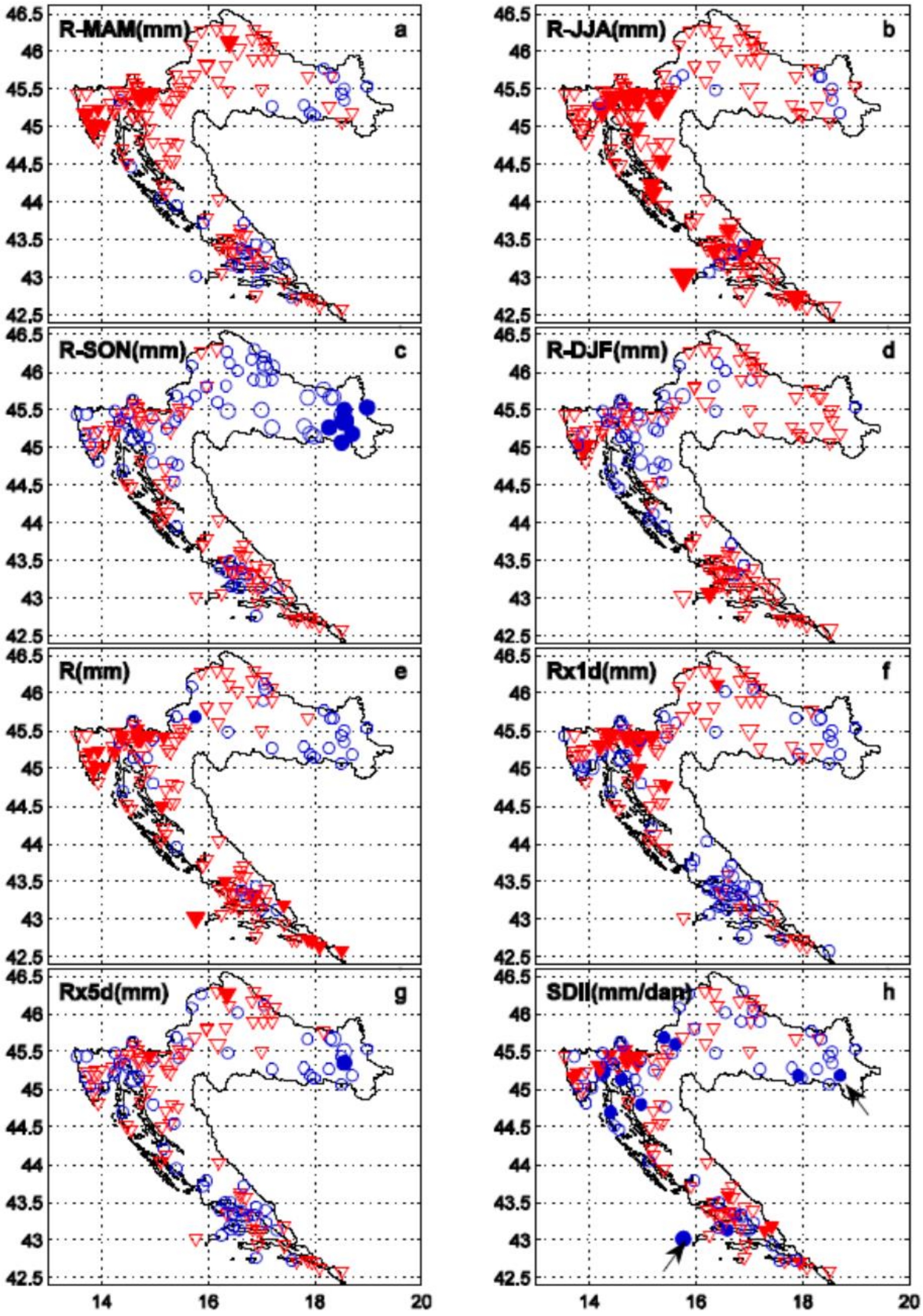

Figure 6-10: Decadal trends (%/10yrs) in seasonal and annual precipitation (R-MAM, R-JJA, R-SON. R-DJF, R) and precipitation indices (Rx1d, Rx5d, SDII, R75, R95, R25T, R25-50T, R50- 75T, R75-95T, R95T and DD) in the 1961-2010 period.

Circles denote positive trends, triangles the negative one, whereas filling means statistically significant trend. Four sizes of symbols are proportional to the absolute value of change per decade relative to the respective average from the period 1961-1990: <5%, 5-10%, 10-15% and >15%, respectively

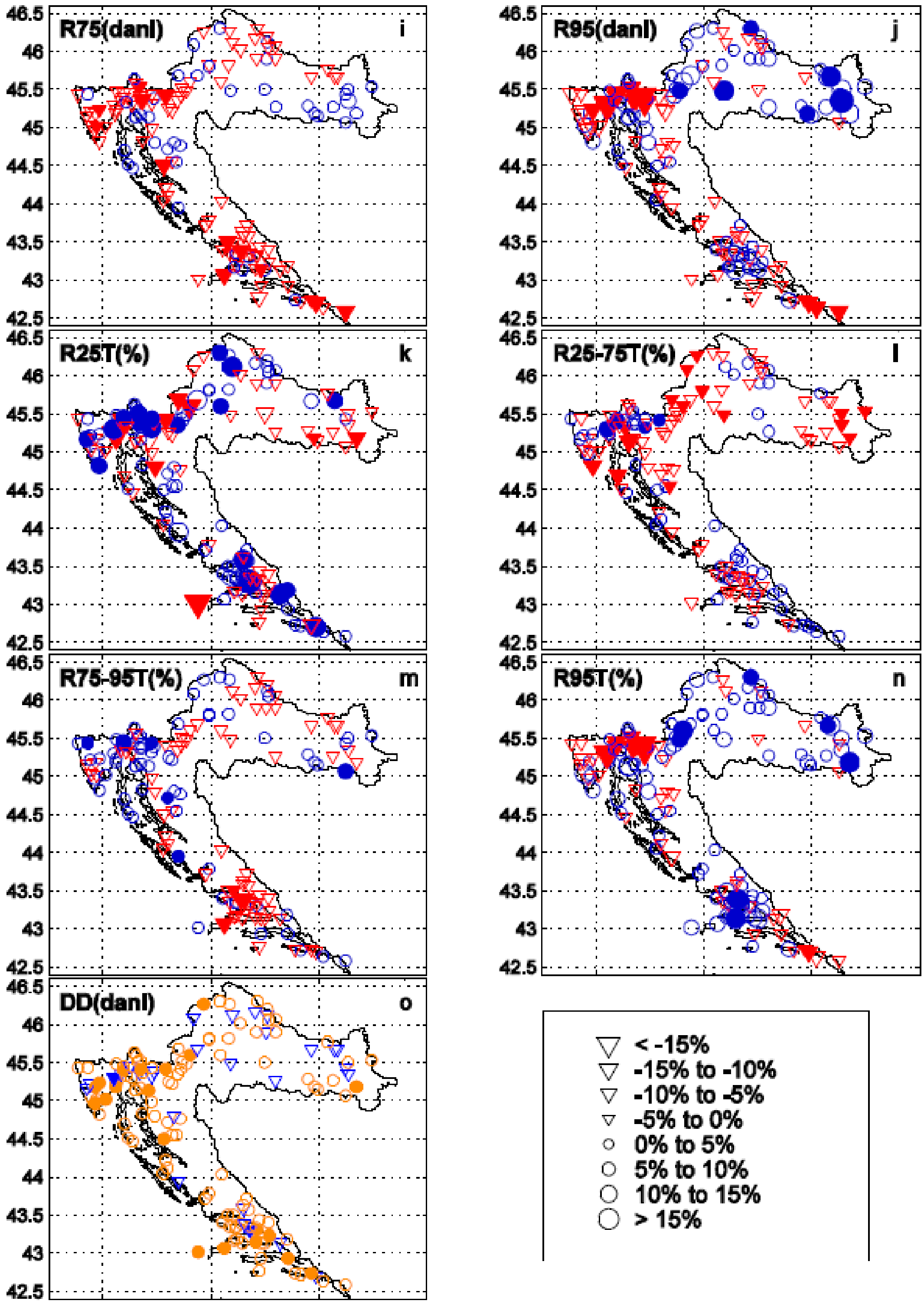

Figure 6-11: cont.

Dry and wet spells

In this section the annual and seasonal time trends in maximum lengths of dry and wet spells in Croatia are presented. They are defined as consecutive dry/wet days (CDD, CWD) having daily precipitation less/higher than the given threshold: 1 mm and 10 mm. These categories will be abbreviated in the rest of the text with CDD1, CDD10, CWD1 and CWD10 respectively for dry and wet spells. Daily data set comprises the 50-years time period 1961-2010. Spells beginning in one season but extending to the next one are accounted for in the season in which they started. The obtained trends are quantified as changes per decade, expressed as percentages of the associated 1961-1990 means (%/dec).

The most prominent feature of time trend is found for dry spells during autumn (SON) for which a spatially consistent statistically significant negative trend is found (Figure 6-12). Decrease ranges from -14%/dec to -1%/dec of associated mean length in CDD1; and from -11 % to 5 % of CDD10. For the rest of the seasons trends in dry spells of both categories are less consistent in magnitude and direction. Nevertheless, an increase in their lengths is particularly expressed in spring (MAM) at northern Adriatic and its hinterlands (from 7%/dec to 12%/dec); while in summer (JJA) this feature is extended to the southern Croatian coast reaching the increase up to 24% of the climatological mean value for the CDD1. There is also an evidence of increase in CDD1 duration in the eastern Slavonia (4%/dec to 7%/dec) during summer. Winter season (DJF) does not reveal significant changes in dry spell durations. The seasonal trend patterns of CDD1 result with a heterogeneous distribution of the associated annual trend. Though, annual maximum dry spell durations of CDD10 are prone to increase along Adriatic coast and highlands, and to decrease in the continental inland. It may be associated by the significant increase in very wet days (R95) that is found in the inland of Croatia thus breaking duration of dry spells (see chapter 6.2.2).

Regarding the wet spell durations there is not found a consistent spatial trend feature as for CDD (Fig. 6-13). There is yet a tendency to CWD1 increase during summer (up to 8%/dec) and autumn (up to 6%/dec) in the eastern lowland and NW region. In the same seasons the CWD1 in northern Adriatic are prone to decrease (up to -12%/dec). In winter season the trend results are mainly mixed in signs and only in the Nw inland there is an evidence of the significant CWD1 increase (up to 15%/dec).

Trends in CWD10 show statistically significant positive trend in the eastern lowland during autumn (11%/dec). Together with the observed significant decrease in CDD10 these results reveal the overall tendencies to the wetter conditions in that region. During summer there is a negative tendeny of CWD10 duration along northern and middle Adriatic and the highlands (- 8%/dec to -11%/dec), but positive on the southernmost region (up to 15%/dec). Generally, there is a high spatial heterogeneity found in trend signs of CWD10.

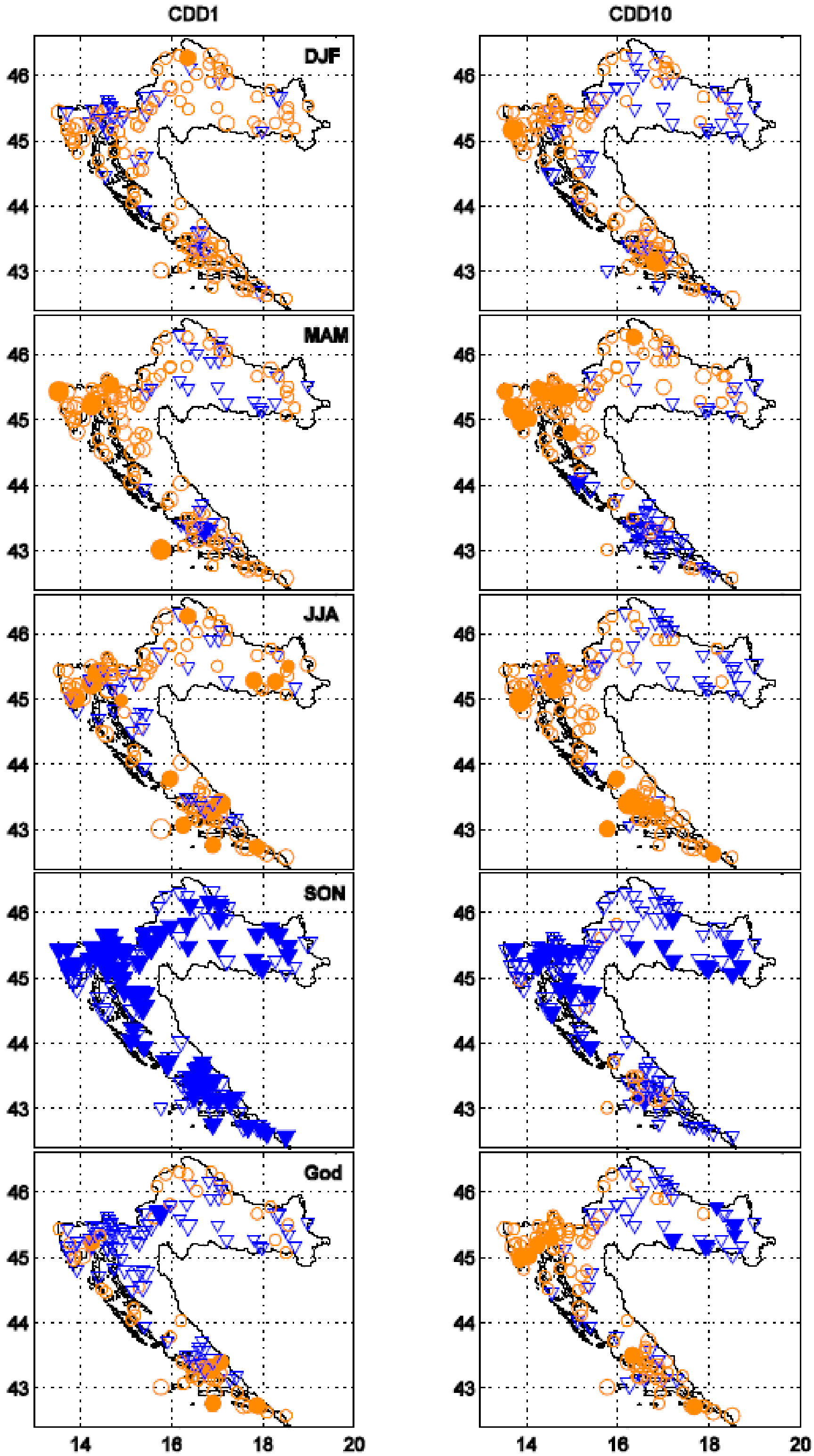

Figure 6-12: Trend results for maximum dry spell durations for 1 mm and 10 mm thresholds (CDD1, CDD10), for four seasons (upper four rows) and for whole year (bottom row).
Circles denote positive trends, triangles the negative one, whereas solid symbols depict statistically significant trend. Blue colour indicates wetter conditions and orange drier. Three sizes of symbols are proportional to the absolute value of change per decade relative to the associated 1961–1990 mean durations: 1-5 %, 5-10 % 10-30 % and >30 %, respectively.

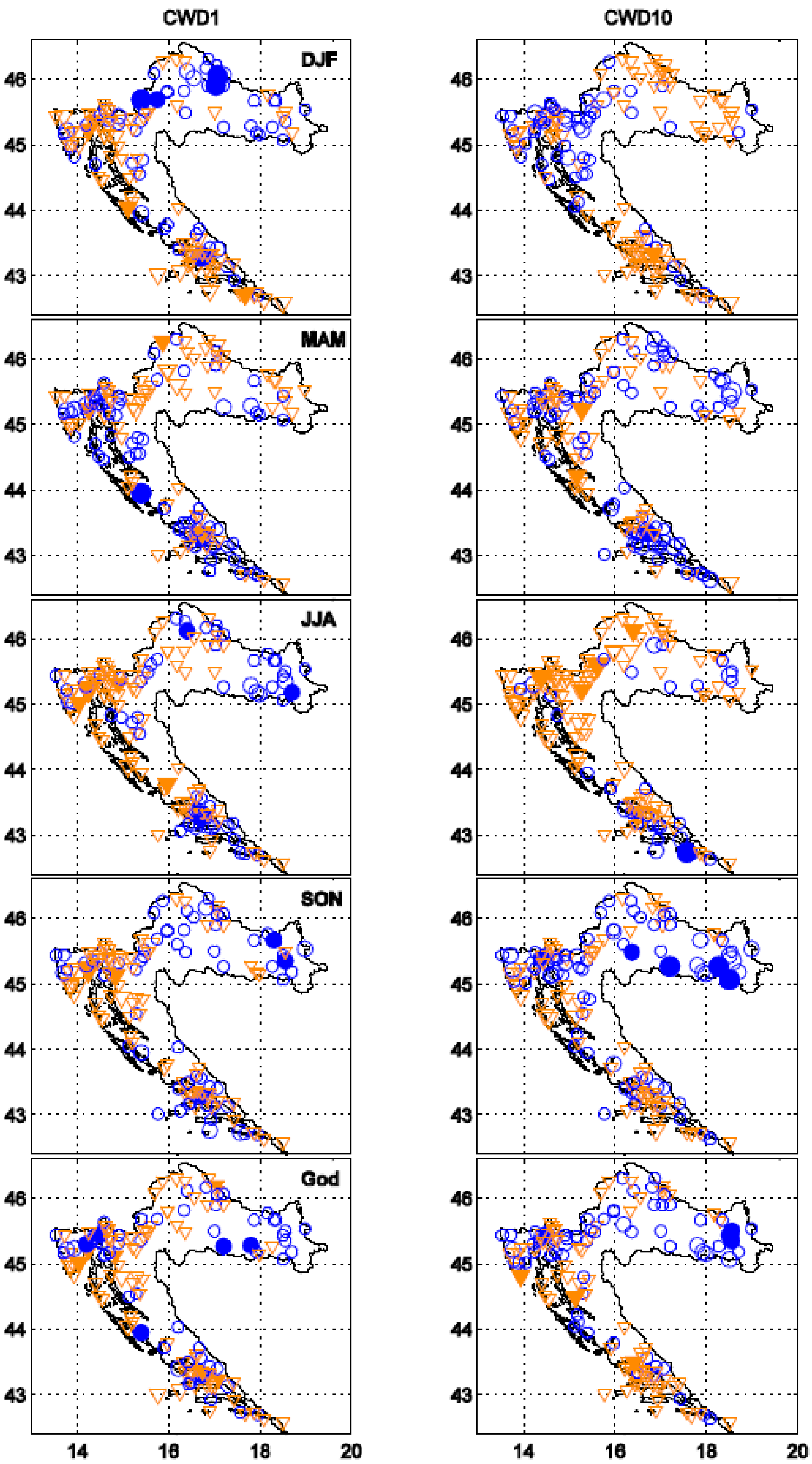

Figure 6-13: Trend results for maximum wet spell durations for 1 mm and 10 mm thresholds (CWD1, CWD10), for four seasons (upper four rows) and for whole year (bottom row).
Circles denote positive trends, triangles the negative one, whereas solid symbols depict statistically significant trend. Blue colour indicates wetter conditions and orange drier. Three sizes of symbols are proportional to the absolute value of change per decade relative to the associated 1961-1990 mean durations: 1-5 %, 5-10 % 10-30 % and >30 %, respectively.

Water balance components

Six water balance components can be considered: precipitation amount, potential and real evapotranspiration, loss from and recharge moisture into the soil, run-off and soil moisture amounts within a surface of one-metre-deep layer of the soil. As described in Pandžić et al. (2008), 10-day water balance components have been calculated according to modified Palmer's (1965) procedure, where modified Eagleman's (1967) procedure has been applied for calculation of 10-day potential evaporation. All water balance components are represented in the same units i.e. in millimetres (mm) what is a equivalent to a litre per square metre.

From the Figure 6-14 it is visible that there are increasing trends for annual potential evapotranspiration with patterns very similar to those of air. This can be explained by a strong relationship between air temperature and potential evapotranspiration. According to trend lines an increase of annual potential evapotranspiration up to 30 % can be expected until middle of 21st century. It means, even in the case that precipitation amounts will stay at the same level as nowadays an increase of potential evapotranspiration can reduce other water balance components for a significant amount. Real evapotranspiration amount trends as well as trend of recharge into the soil are weaker than that for potential evapotranspiration. An extrapolation of the of potential evapotranspiration results for Zagreb-Grič on other meteorological stations, including those on coastal region, can be made thanks to a rather high correlation between time series of potential evapotranspiration for the wider territory of Croatia (Pandžić et al., 2008).

It is obvious from the Figure 6-15 that there is very strong negative trend for the run-off calculated by Palmer's procedure for Zagreb-Grič meteorological station. According to trend line estimation until the mid-21st century, run-off calculated by Palmer's procedure, will disappear. The results are alarming although “prognostic” power of the trend line is poor and we hope this will not happened. A high correlation exists between calculated run-off for Zagreb-Grič and those for other meteorological stations in the area what has been shown by Pandžić at al. (2008). Thus, somehow results for meteorological stations with shorter time series of run-off can be extrapolated in the past according to the results for Zagreb-Grič meteorological station. It was also shown that some areas in Croatia are more sensitive to global warming than other, which depends on the ratio between potential evapotranspiration and precipitation. In general, in the areas where the precipitation amount is much higher than potential evapotranspiration, an increase in potential evapotranspiration will not considerably affect other water balance components including run-off. More sensitive will be the areas where precipitation amounts are similar to those of potential evapotranspiration.

Annual distribution of precipitation amounts is also very important for other water balance components. As potential evapotranspiration is more sensitive on air temperature changes during warmer than colder part of a year, the areas with maximum precipitation amounts during warmer

part of a year will be more sensitive on global warming than those with maximum precipitation during colder part of the year.

Soil moisture trend indicates a reduction of soil moisture in next half century (Figure 6-16). Regional sensitivity on soil moisture variability and trends depends also on soil type i.e. its field capacity which is in general in coastal region rather small on average.

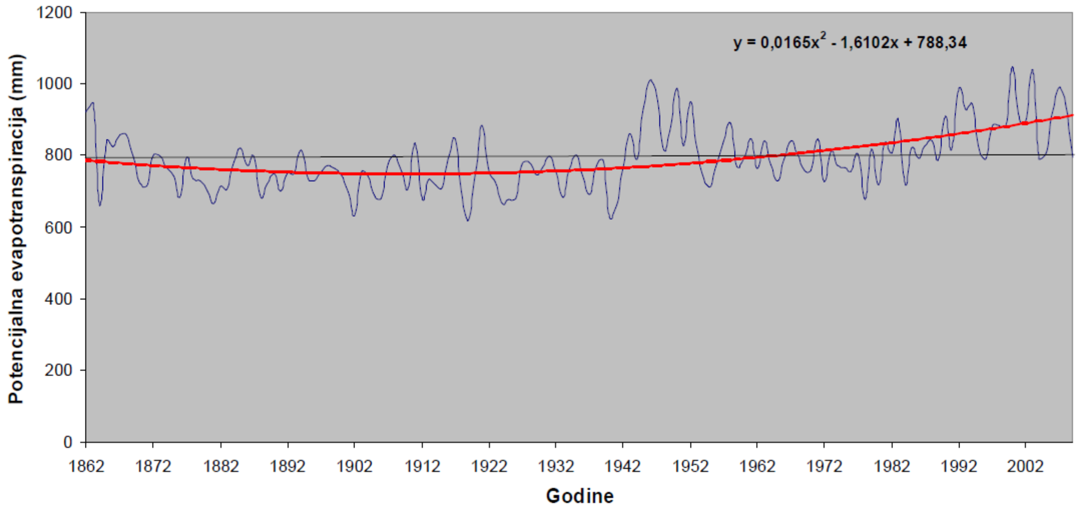

Figure 6-14: Annual potential evaporation (in millimetres) for Zagreb-Grič meteorological station for the period 1862-2008.
Thin line represents an average for the period 1961-1990 (Pandžić and Trninić, 2010)

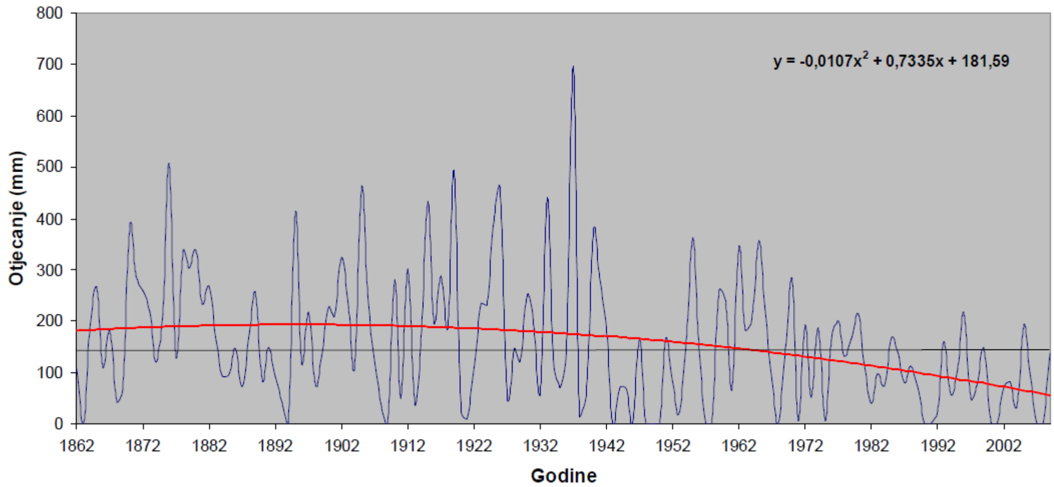

Figure 6-15: Calculated annual run-off (in millimetres) for Zagreb-Grič meteorological station for the period 1862-2008.
Thin line represents an average for the period 1961-1990 (Pandžić and Trninić, 2010)

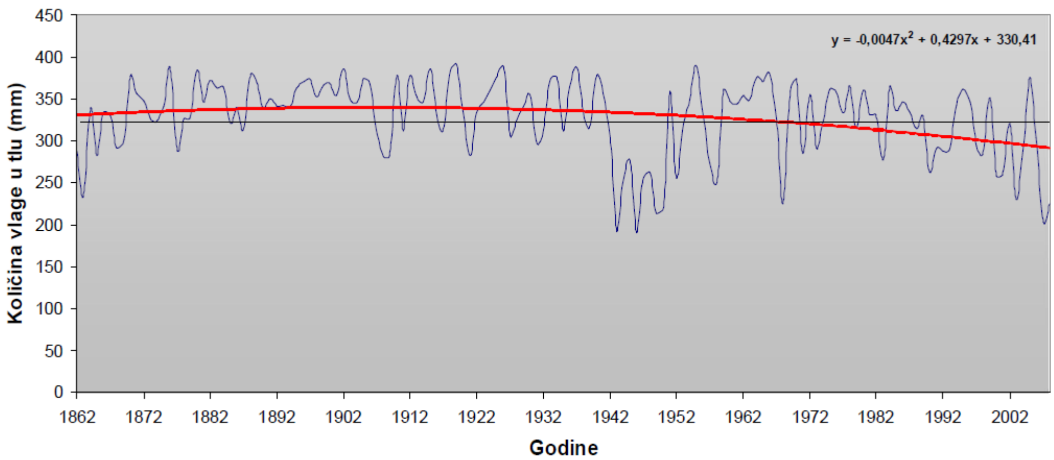

Figure 6-16: Calculated average annual soil moisture (in millimetres) for Zagreb-Grič meteorological station for the period 1862-2008.
Thin line represents an average for the period 1961-1990 (Pandžić and Trninić, 2010)

Decadal climate summary for Croatia

For WMO study in 2013 is used a data set of 11 meteorological stations (Osijek, Varaždin, Zagreb-Grič, Ogulin, Gospić, Knin, Rijeka, Zadar, Split-Marjan, Dubrovnik and Hvar). Distribution of meteorological stations is rather homogeneous over territory of Croatia. Five decadal periods are analyzed, beginning with the decade 1960 – 1970 until the last 2001 – 2010. Absolute daily maximum and minimum air temperatures and daily precipitation amounts have been considered. From the Table 6-4 is visible that Knin is the warmest town in Croatia and Gospic the coldest. Thus, in the period considered absolute minimum temperature of -28.9 °C was observed in Gospić, while maximum air temperature of 41.4 °C was observed in Knin. It should be mentioned that at meteorological stations that are not considered here slightly higher maximum, above 42°C, and lower minimum, less than -30 °C, have been observed. The lowest minimum temperature is registrated in decade 1961 – 1970 while the highest maximum temperature is registrated during decade 1991 – 2000. The highest daily precipitation of 352.2 mm has been observed in Zadar in 1986.

Spaceous decadal averages of air temeparture have been calculaed as arithmetic means of decadal air temeparatures for 15 meteorological. The results are shown in table 6-5. It is visible that the lowest average decadal spaceous air temperature is for decade 1971 – 1980 only for 0.1 lower than that for decade 1961 – 1970 when the air temperature was the same as 1961- 1990 average. For the period 1981 - 1990 a slight increase of temperatue appeared, while during the next two decates an increase have been considerable, i.e. 0.6 °C and 1.0 °C respectively, in respect to referent period 1961 – 1990, which is in accordance with globale decadal averages.

Table 6-6 shows the ranking of annual spatial averages for the period 2001-2010. The hottest year 2007 was for 1.5 °C warmer than the mean of the standard period 1961-1990., the coldest year 2005 was 0.1 °C colder. During the decade 2001 – 2010, spatial mean air temperature in nine years was higher than the corresponding referent averages.

Table 6-4: Daily extremes per decade for Croatia for the period 1961-2010

Period	**Parametar**	**value**	**date**	**Station name**	**Coordinates**	
					Lat	**Lon**
1961-1970	Highest Maximum Temperature (°C)	38.6	11 Jul 1968	Osijek	45° 28` 24``	18° 48` 23``
	Lowest Minimum Temperature (°C)	-28.9	15 Jan 1963	Gospić	44° 33` 2``	15° 22` 23``
	Maximum 24-hr rainfall (mm)	189.2	15 Sep 1967	Rijeka	45° 20` 13``	14° 26` 34``
1971-1980	Highest Maximum Temperature (°C)	38.4	5 Aug 1980	Knin	44° 2` 27``	16° 12` 25``
	Lowest Minimum Temperature (°C)	-24.8	21 Feb 1978	Osijek	45° 28` 24``	18° 48` 23``
	Maximum 24-hr rainfall (mm)	210.3	1 Sep 1976	Rijeka	45° 20` 13``	14° 26` 34``
1981-1990	Highest Maximum Temperature (°C)	39.6	3 Aug 1981	Knin	44° 2` 27``	16° 12` 25``
	Lowest Minimum Temperature (°C)	-27.3	12 Jan 1985	Gospić	44° 33` 2``	15° 22` 23``
	Maximum 24-hr rainfall	352.2	11 Sep 1986	Zadar	44° 7` 48``	15° 12` 21``

	(mm)					
1991-2000	Highest Maximum Temperature (°C)	41.4	22 Aug 2000	Knin	44° 2` 27``	16° 12` 25``
	Lowest Minimum Temperature (°C)	-26.4	26 Jan 2000	Gospić	44° 33` 2``	15° 22` 23``
	Maximum 24-hr rainfall (mm)	200	19 Oct 1998	Rijeka	45° 20` 13``	14° 26` 34``
2001-2010	Highest Maximum Temperature (°C)	40.9	19 Jul 2007	Knin	44° 2` 27``	16° 12` 25``
	Lowest Minimum Temperature (°C)	-27.6	13 Jan 2003	Gospić	44° 33` 2``	15° 22` 23``
	Maximum 24-hr rainfall (mm)	161.4	23 Nov 2010	Dubrovnik	42°3 8` 41``	18° 5` 6``

Table 6-5: Decadal air temperature for Croatia for Croatia for the period 1901–2010

DECADE	Mean temperature (°C)	Anomaly with respect to 1961-1990 (°C)
1901-1910	NA	NA
1911-1920	NA	NA
1921-1930	NA	NA
1931-1940	NA	NA
1941-1950	NA	NA
1951-1960	NA	NA
1961-1970	12,7	0
1971-1980	12,6	-0,1
1981-1990	12,8	0,1
1991-2000	13,3	0,6
2001-2010	13,7	1,0

Table 6-6: Temperature ranking 2001-2010

Ranking 2001–2010	Year	Temperature (°C)	Anomaly (°C)
Warmest	2007	14,23	1,53
2	2008	14,2	1,5
3	2009	14,1	1,4
4	2002	14,0	1,3
5	2003	13,9	1,2
6	2001	13,7	1,0
7	2006	13,5	0,8
8	2004	13,23	0,53
9	2010	13,22	0,52
Coldest	2005	12,6	-0,1

6.1.3. Climate change scenarios

Introduction

In this subsection, the results of climate modeling for the most common climatological variables are presented. The results were based on the "An overview of current research and activities related to the impact of climate change and adaptation to climate change in the Republic of Croatia", "Draft Climate Change Adaptation Strategy in the Republic of Croatia for the period to 2040 with a view to 2070 (White book) and the "Report on Assessed Impacts and Vulnerability to Climate Change for Individual Sectors" prepared in the framework of the project "Strengthening the capacity of the Ministry of Environment and Energy for adaptation to climate change and preparation of the Draft Climate Change Adaptation Strategy"[17].

For the purposes of the Climate Change Adaptation Strategy of the Republic of Croatia to 2040 with the view to 2070 results of climate models projection for two periods were used, taking into account two scenarios for the development of greenhouse gas concentrations in the future: RCP4.5 and RCP8.5, as defined by the Intergovernmental Panel on Climate change – IPCC). Scenario RCP4.5 is considered a more moderate scenario, while RCP8.5 is treated as more extreme. Climate projections are made for two time periods: the first to end in 2040 and the second to end in 2070.

Methodology

In addition to the "historical" climate simulation for the period 1971–2000, the RegCM regional climate model calculated change (projections) for the future climate in two periods: 2011–2040 and 2041–2070, assuming the IPCC scenarios RCP4.5 and RCP8.5 of the greenhouse gases concentration development. The RCP4.5 scenario is characterized by the medium level of greenhouse gas concentrations with relatively ambitious expectations of their future reduction, which would peak in around 2040. The RCP8.5 scenario is characterized by a continuous increase of greenhouse gas concentrations, which would be, by the year 2100, up to three times higher than today.

RegCM's numerical integrations used the marginal and initial conditions of four different Global Climate Models (GCMs) that were used in experiments in the fifth phase of the Coupled Model Intercomparison Project (CMIP5) for preparation of the Fifth Climate Change Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5) in 2013. These are the GCM models: the model of the French meteorological service CNRM–CM5, the model of the Dutch EC-Earth consortium, the MPI-ESM model of the German Max-Planck meteorology institute and the HadGEM2 model of the British meteorological service.

For those climate parameters whose spatial variability does not change significantly (e.g. temperature – daily mean, maximum, minimum, then pressure, evapotranspiration, insolation, etc.), the 50 km horizontal resolution used in this regional climate model can be sufficient to describe well the state of the reference climate and the expected future change to the predetermined climate scenario. For those climatological parameters that have higher spatial variability (precipitation, snow cover, wind, etc.) or depend on the different characteristics of small spatial scales (orography, land-sea contrast), a higher (finer) horizontal resolution would be preferable. However, due to the complex orography and

[17] More information on this projecr available: http://prilagodba-klimi.hr/dokumenti/

particularly large differences and contrasts in the coastal belt of the Republic of Croatia, adequate numerical modelling of climate and climate change is very demanding.

Air temperature

Observed change

During the period from 1961 to 2010, the trends of mean, mean minimum, and mean maximum air temperatures show warming throughout Croatia. Trends in annual air temperature are positive and statistically significant, and changes are greater in the continental part of the country than on the coast and in the Dalmatian hinterland. The maximum air temperature was exposed to the biggest change (increase). The highest contribution to the overall positive air temperature trend was due to the summer trends, and the trends for winter and spring equally contributed to the increase in mean maximum temperatures. The slightest changes were in regard to the autumn air temperature. Observed warming is also reflected in all temperature extremes indices.

Future change for the RCP4.5 scenario

In the period from 2011 to 2040, mean annual air temperature values are expected to increase almost uniformly (1.0 to 1.2 °C) throughout Croatia. In the period 2041 – 2070, the expected trend of rising temperatures would continue and would amount to between 1.9 and 2 °C. Somewhat warmer could only be at the far west of the country, along the western coast of Istria.

In the period between 2011 and 2040, a clear signal of increase in average ground air temperature throughout Croatia is expected in all seasons. In winter and summer, the highest projected temperature increase would be from 1.1 to 1.3 °C in the coastal regions. In the spring, the increase could be 0.7 °C in the Adriatic to slightly more than 1.0 °C in the north of Croatia, and in the autumn the expected increase in temperature could be between 0.9 °C in the eastern regions to about 1.2 °C in the Adriatic, exceptionally up to 1.4 °C, in western Istria.

In the period from 2041 to 2070, the highest increase in mean air temperature, up to 2.2 °C, is expected in the Adriatic in summer and autumn. In winter and spring, the largest projected temperature increase is somewhat smaller - up to about 2.1 °C or 1.9 °C in continental areas. In winter and spring, the spatial distribution of temperature increase is reverse of those in summer and autumn: the increase is the smallest in the Adriatic and higher towards inland. In spring, the average temperature increase is of 1.4 to 1.6 °C on the Adriatic, with gradual increase of 1.9 °C to the north.

The projected change in maximum air temperature by 2040 are similar to those for mean (daily) temperature and are expected to increase in all seasons. Generally, the increase would be higher than 1.0 °C (0.7 °C in spring in the Adriatic), but less than 1.5 °C. In the period 2041 – 2070, a further increase in maximum temperature is expected. It could be higher than in the previous period, and in relation to the reference climate it could reach 2.3 °C in summer and autumn on the islands.

The minimum temperature is expected to increase in the future climate as well. Until 2040 the highest expected increase in minimum temperature is in winter: up to 1.2 °C in northern Croatia and on the coast and up to 1.4 °C in Gorski Kotar, i.e. in the area that is usually the coldest. The slightest expected increase, less than 1.0 °C, would happen in spring. And in the period 2041-2070 the highest increase in the minimum temperature is expected in winter - from 2.1 to 2.4 °C in the continental part and from 1.8 to 2 °C in the coastal regions. In other seasons, the increase in the minimum temperature would be somewhat smaller than in winter.

Future change to the RCP8.5 scenario

According to this scenario, in the period from 2011 – 2040, the seasonal increase in temperature would be on average higher only by about 0.3 °C compared to RCP4.5. This coincidence of results in two different scenarios is also found in the projections of temperature increase from global climate models, according to which the increase in temperatures in all IPCC scenarios in most of the first half of the 21st century is very similar. However, in the period 2041 – 2070, the projected increase in temperature for the RCP8.5 scenario is significantly higher than that for the RCP4.5 and is between 2.6 and 2.9 °C in summer and from 2.2 to 2.5 °C in other seasons.

For the maximum temperature up to 2040, the expected seasonal increase in relation to the reference period is highest in summer (up to 1.7 °C in the coastal areas and on the islands), and the lowest in spring (0.9 – 1.1 °C). In winter and autumn, the expected increase in maximum temperature is between 1.1 and 1.3 °C. In the mid-21st century (2041 – 2070), the highest expected increase in mean maximum temperature is up to 3.0 °C in summer on the Adriatic islands and between 2.2 and 2.6 °C in other seasons.

For the minimum temperature the largest projected increase in the period 2011 – 2040 is over 1.5 °C in north–western Croatia, northern part of Gorski Kotar and in the eastern part of Lika in winter and in the coastal regions in summer. In spring and autumn, the expected increase is somewhat less, from 1.1 to 1.2 °C. By 2070 the minimum temperature would increase from 2.2 to 2.8 °C in winter and from 2.6 to 2.8 °C in summer. In spring and autumn, the increase would be slightly less – between 2.2 and 2.4 °C.

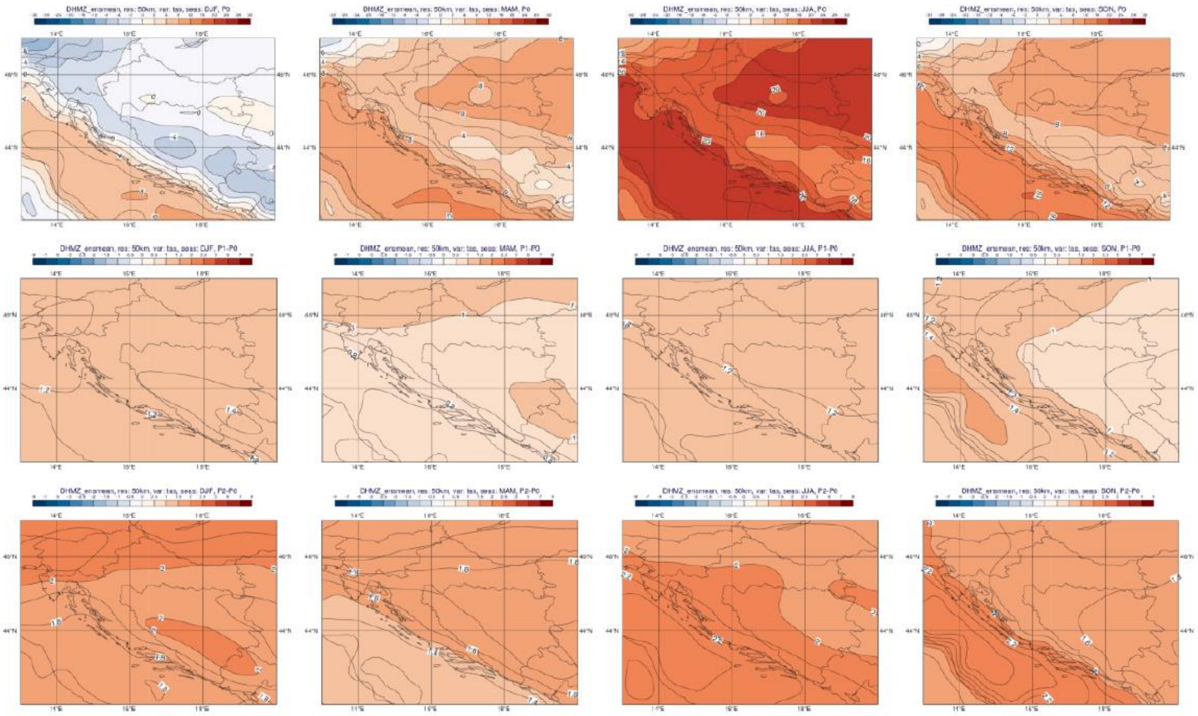

Figure 6-17: Air temperature (°C) ensembles-mean from the four integration by RegCM model. Left to right: winter, spring, summer and autumn.
Top: referent period 1971 – 2000; middle: change in the period 2011 – 2040.; bottom: change in period 2041 – 2070.

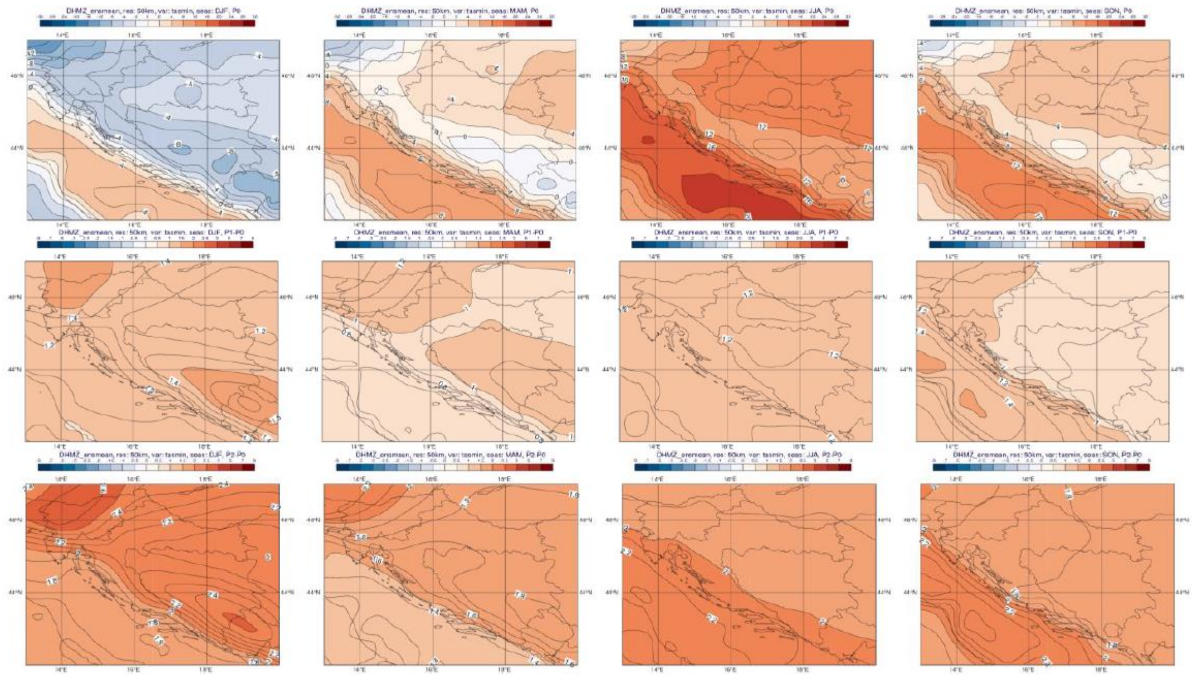

Figure 6-18: Minimum air temperature (°C) ensembles-mean from the four integration by RegCM model.
Left to right: winter, spring, summer and autumn. Top: referent period 1971 – 2000.; middle: change in the period 2011 – 2040; bottom: change in period 2041 – 2070

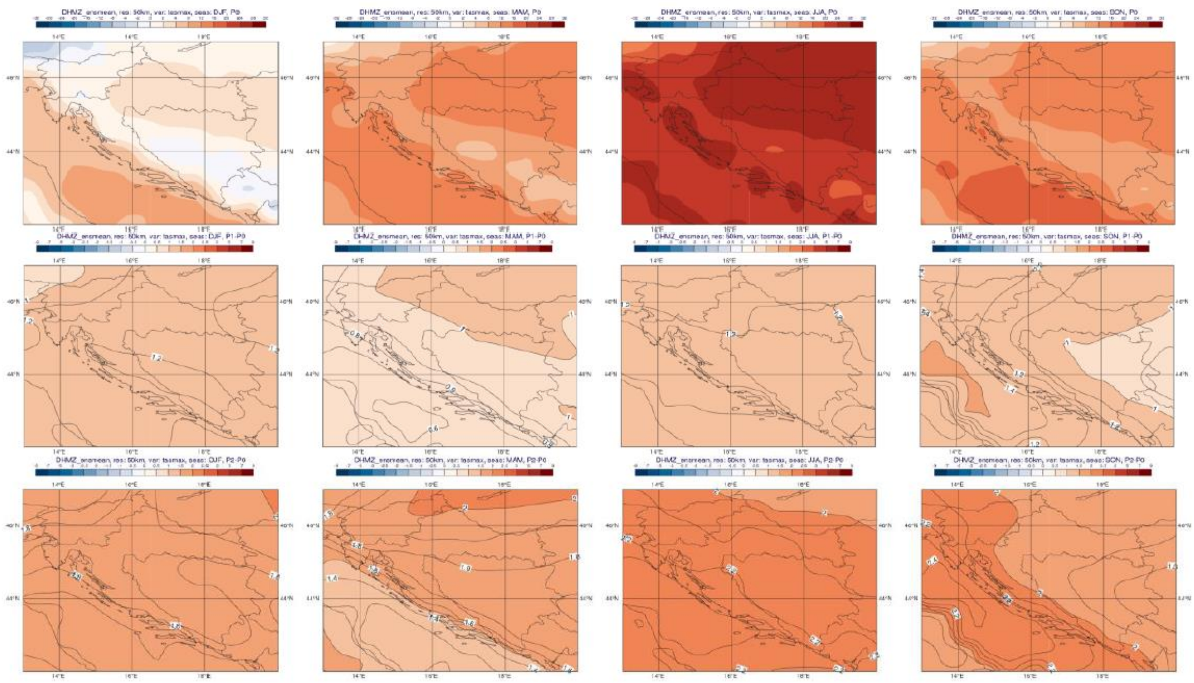

Figure 6-19: Maximum air temperature (°C) ensembles-mean from the four integration by RegCM model.
Left to right: winter, spring, summer and autumn. Top: referent period 1971 – 2000; middle: change in the period 2011 – 2040; bottom: change in period 2041 – 2070.

Extreme temperature conditions

Extreme temperature conditions were analysed on the basis of the frequency of the number of occurrences of an event (extremes) in the season, i.e. the change of frequency in the future climate.

Future changes for the RCP4.5 scenario

In the period from 2011 to 2040, a rise in the number of hot days (when the maximum temperature is over 30 °C) is expected in summer, which could also result in prolonged periods with high air temperature (heat waves). An increase in the number of hot days from an average of 15–25 days in the reference climate period (1971 – 2000) would amount in most of Croatia to between 6 and 8 days, and more than 8 days in Eastern Croatia and somewhere in the Adriatic. In mountainous areas also, the rise of hot days in the future climate would be the same as in the vast majority of the country. The rise in the number of hot days would continue in the period 2041 – 2070. The increase of hot days' number of slightly more than 12 days is expected in the whole of Croatia, which in mountainous areas would lead to almost doubling of the number of hot days compared to the reference period.

In the future climate until 2040 the increase in number of summer days with warm nights (when the minimum temperature is higher than or equal to 20 °C) is expected, and the highest increase is projected for the Adriatic area. By 2070, a further significant increase in the number of days with warm nights is expected.

The expected number of winter ice days (when the minimum temperature is below -10 °C) would fall in the period between 2011 and 2040 compared to the reference climate. For the period 2041 – 2070, a further decrease in the number of ice days is projected.

Future changes for the RCP8.5 scenario

Under this scenario, a slight increase in hot days is expected by 2040, and by 2070 this increase would be about 30 % higher compared to the RCP4.5. Compared to the RCP4.5 scenario, the projected number of days with warm nights will only slightly increase by 2040, but significant increase is expected in the period 2041 – 2070, especially in eastern Slavonia and coastal regions. Further decrease of the number of ice days, especially in the period 2041 – 2070, is also expected.

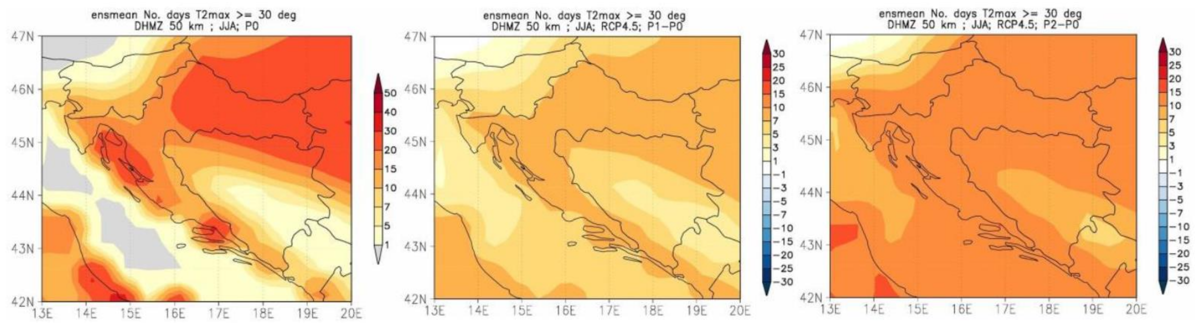

Figure 6-20: Number of the days with the maximum temperature above 30 °C as ensembles-mean from the four integration by RegCM model.
Left to right: winter, spring, summer and autumn. Top: referent period 1971 – 2000; middle: change in the period 2011 – 2040; bottom: change in period 2041 – 2070

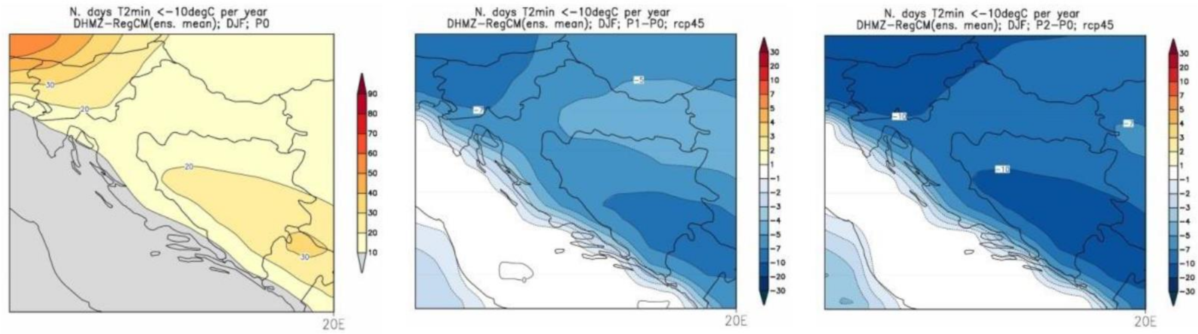

Figure 6-21: Number of winter days with minimum temperature lower than -10 °C (cold days) as ensembles-mean from the four integration by RegCM model.
Left: referent period 1971 – 2000.; middle: change in the period 2011 – 2040; right: change in the period 2041 – 2070

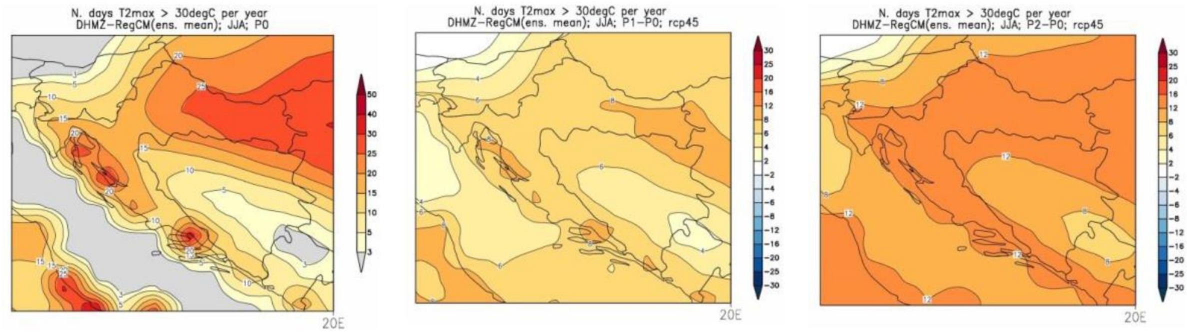

Figure 6-22: Number of summer days with the maximum temperature above 30 °C (hot days) as ensembles-mean from the four integration by RegCM model.
Left: referent period 1971 – 2000.; middle: change in the period 2011 – 2040.; right: change in the period 2041 – 2070.

Precipitation

Observed movements
During the period from 1961 to 2010, annual precipitation levels in the Republic of Croatia show prevalent statistically insignificant trends, which are positive in the eastern lowlands (increase) and negative in other areas of Croatia (decrease). Poor trends are noticeable in most seasons, but the exception is the summer precipitation that has a clearly marked negative trend across the country (decrease). In autumn there are weak trends of mixed sign, and the increase in precipitation in the interior is mainly due to the increase in the number of days with large daily precipitation quantities. During the winter, precipitation trends are not significant and are mostly negative in the southern and eastern regions. In the rest of the country precipitation trends are of mixed. In spring, the results show that there are no significant changes in the total precipitation in the southern and eastern part of the country, while the negative trend (decrease) is present in the remaining parts.

Future change of precipitation for the RCP4.5 scenario
At an annual level, a very small decrease of average annual precipitation is projected until 2040, which will have no significant impact on the total annual volume. In north-western Croatia, the signal of change is going in the direction of a smaller annual precipitation increase. Until 2070 it is expected further reduction of the average annual precipitation (up to about 5 %), which will extend to almost the entire country, except at the northernmost and westernmost parts. The largest decrease is expected in the

southern Lika region up to the Dalmatian hinterland along the border with Bosnia and Herzegovina (about 40 mm) and in the southernmost land areas (about 70 mm).

The projected change in the total amount of precipitation per season between 2011 and 2040 differ. In winter in Croatia as a whole, and in the spring in most of Croatia a smaller increase in precipitation is expected. In summer and autumn, the decrease in total precipitation will prevail throughout the country. The expected increase in precipitation in winter is between 5 and 10 % in the northern and central regions, and in spring the total precipitation growth in western regions will be smaller. In the spring considerably lower precipitation levels are expected in the eastern and southern regions. The largest summer precipitation decrease, 5–10 %, is expected in northern Dalmatia and southern Lika, whereas decrease in other parts should be less than 5 %. In autumn, the largest projected reduction in the total precipitation amount is about 20 mm in Gorski Kotar and in the northern part of Lika, which makes about 5 % of the total precipitation in that season, and in the far south the decrease is also about 5 %.

In the period 2041 – 2070, the decrease of precipitation is expected in all seasons, except in winter. The biggest decrease (slightly more than 10 %) will be in the spring in southern Dalmatia and in the summer, 10 – 15 %, in the mountainous areas and in northern Dalmatia. The largest increase in total precipitation, 5 – 10 %, is expected on the islands in autumn and in northern Croatia in winter.

Future change to the RCP8.5 scenario
Until 2040 the increase of total precipitation in relation to the reference climate in winter and spring is expected in most of the country. This increase would be the largest, 8 – 10%, in northern and central Croatia in the winter. In the summer, the predominant decrease in total precipitation is projected, mostly in Lika – up to 10%. In autumn, a slight increase in total precipitation is expected.
In the period 2041 – 2070, the increase of total precipitation for the winter is projected in whole of Croatia, and mostly, by 8-9%, in the northern and central regions. In the summer, total precipitation is expected to decrease throughout the country, mostly in northern Dalmatia - 5 – 8 %. In the spring and autumn, the signal of change includes both increase and decrease of precipitation. However, in autumn the decrease of total precipitation rate would prevail in most of the country, except in northern Croatia.

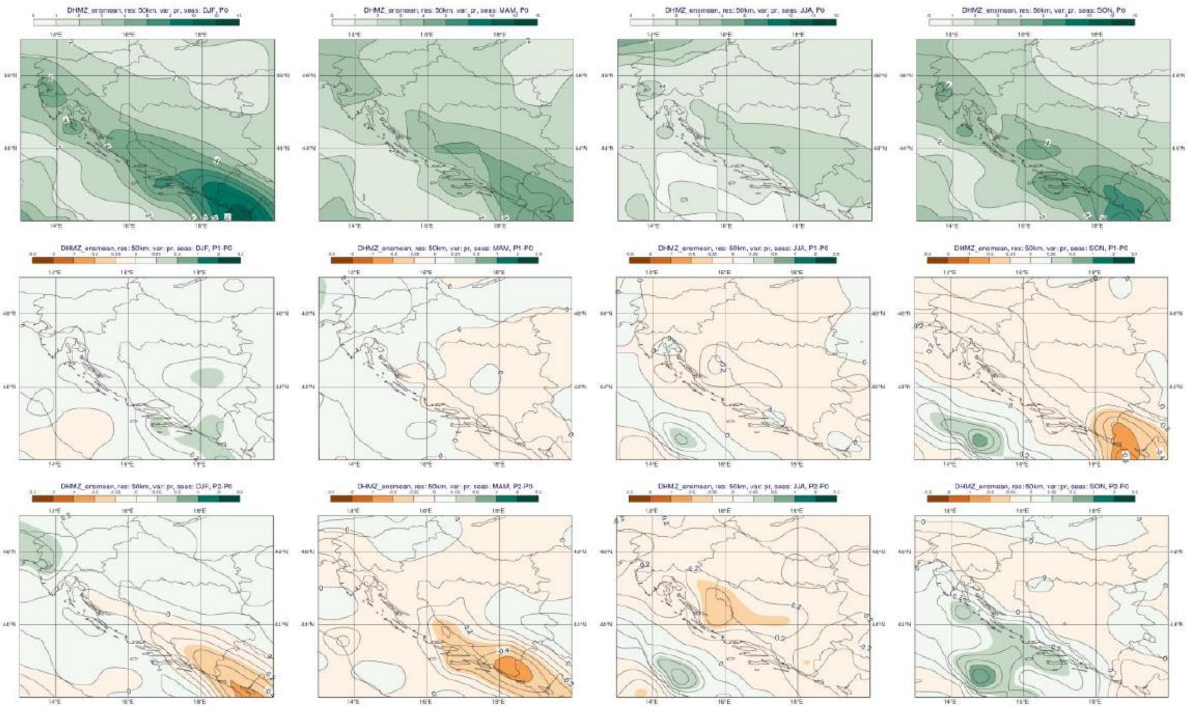

Figure 6-23: Total precipitation (mm/day) ensembles-mean from the four integration by RegCM model. Left to right: winter, spring, summer and autumn.
Top: referent period 1971 – 2000; middle: change in the period 2011 – 2040; bottom: change in period 2041 – 2070

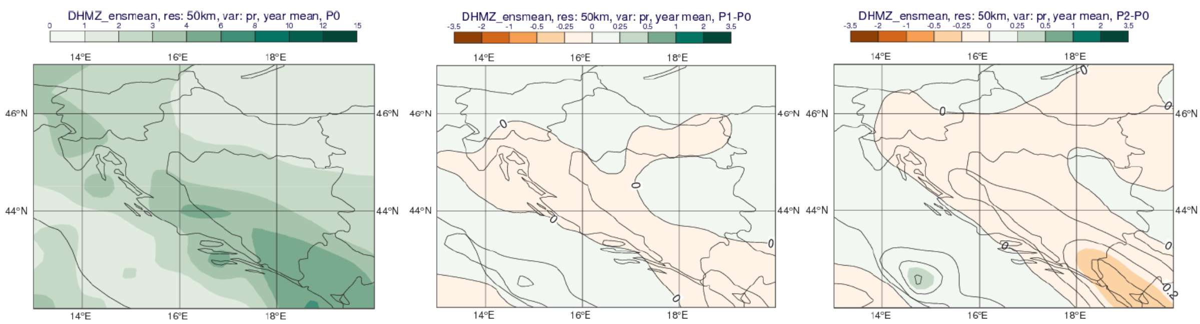

Figure 6-24: Total annual percipitation (mm/day) ensembles-mean from the four integration by RegCM model.
Left: referent period 1971 – 2000.; midle: change in the period 2011 – 2040; right: change in the period 2041 – 2070

<u>Rain and dry periods</u>

<u>Scenario RCP4.5</u>
Until 2040, the expected number of rainy periods (a series of at least 5 days when the total precipitation is greater than 1 mm) would generally decrease, except for winter in central Croatia when it would slightly increase. These changes are generally small. Further decrease of the number of rainy periods is expected in the mid-21st century (2041 – 2070). The biggest decrease would be in the mountainous and coastal Croatia in winter and spring, but also in summer in the parts of mountainous Croatia and Northern Dalmatia.In the period from 2011 to 2040, the number of dry periods could increase in autumn in almost the whole country and in the northern areas in spring and summer. The number of dry periods in the winter would decrease in central Croatia and in some locations in the coastal area in spring and

summer. An increase in the number of dry periods is expected in practically all seasons by the end of 2070. The most prominent increase would be in spring and summer, and slightly less in winter and autumn.

Scenario RCP8.5.

In the spring season important for vegetation no significant change in the number of dry periods is expected by 2040, but in the period 2041 – 2070 there will be an increase in the number of dry periods that would affect most of Croatia.

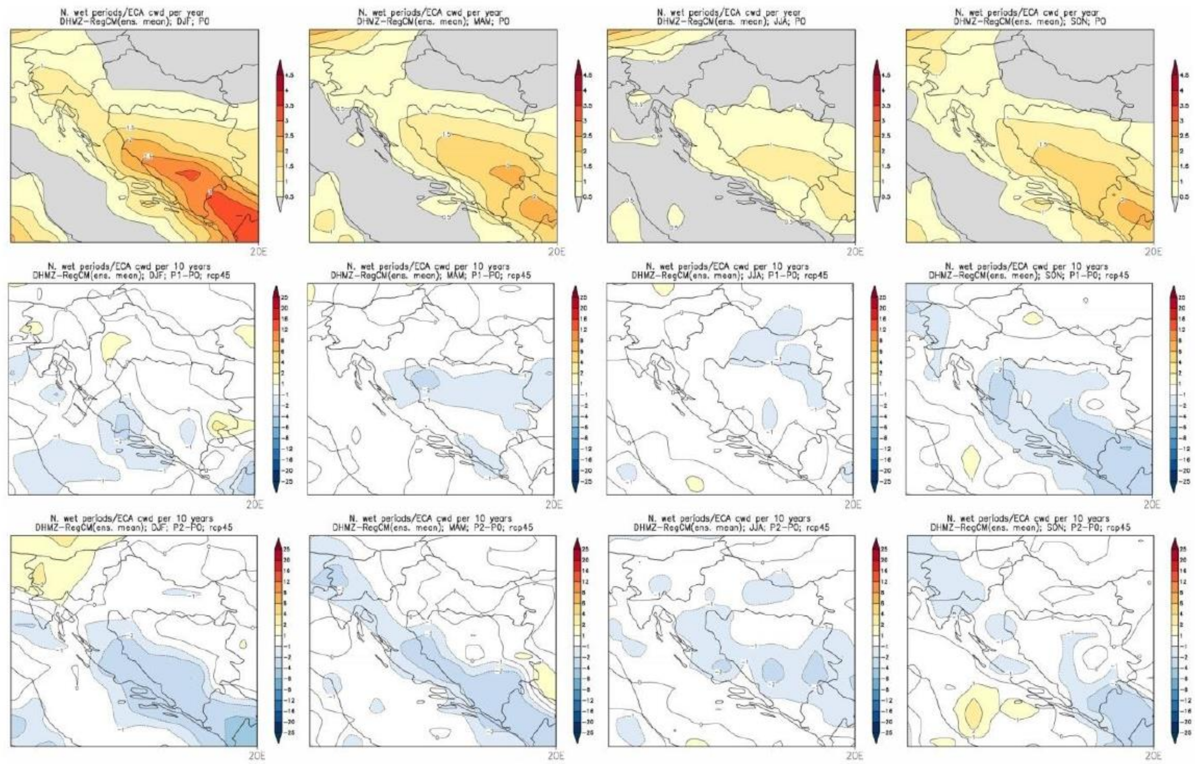

Figure 6-25: Number of rainy period as ensembles-mean from the four integration by RegCM model. Left to right: winter, spring, summer and autumn. Top: referent period 1971 – 2000.; middle: change in the period 2011 – 2040; bottom: change in period 2041 – 2070. Mean number of period was defined in the referent climate for one year, and for future climate in 10 years.

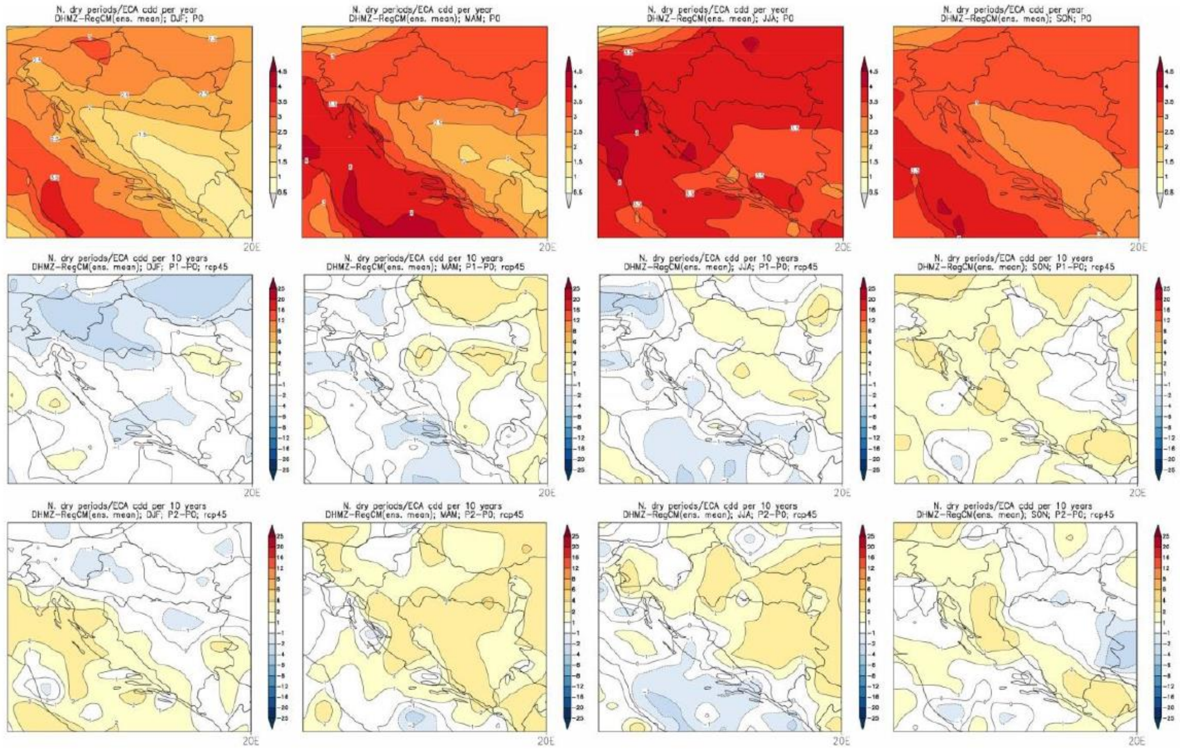

Figure 6-26: Number of dry period as ensembles-mean from the four integration by RegCM model. Left to right: winter, spring, summer and autumn. Top: referent period 1971 – 2000; middle: change in the period 2011 – 2040; bottom: change in period 2041 – 2070. Mean number of period was defined in the referent climate for one year, and for future climate in 10 years

Medium wind speed at 10 m

The average projected wind speed in the period from 2011 to 2040 will not change in winter and spring, but projections suggest a possible rise during summer and autumn in the Adriatic. The projected increase in average wind speed is particularly pronounced in autumn in the northern Adriatic (up to about 0.5 m/s), representing a change of about 20-25 % compared to the reference period. The slight increase in average wind speed is also projected in autumn in Dalmatia and the mountains. Between 2041 and 2070, a moderate decrease in average wind speed is expected in winter in parts of northern and eastern Croatia. In summer and autumn, the simulated trend of wind speed improvement in the Adriatic continues, similar to the period between 2011 and 2040.

Maximum wind speed at 10 m

At an annual level, in future climates between 2011 and 2040 and between 2041 and 2070 the expected maximum wind speed would remain virtually unchanged in relation to the reference period, with the highest values of 8 m/s on the southern Dalmatian islands.

Until 2040, a slight reduction of the maximum wind speed for seasonal averages is expected in all seasons, except in summer. Winter is expected to show reduction of the maximum wind speed by about 5 %, in the regions where under the reference climate the wind is the strongest - in the southern Adriatic and in the hinterland of central and southern Dalmatia. In the period 2041–2070, the maximum wind speed reduction is expected in all seasons except in summer. The largest decrease in the maximum wind speed in this period is expected in winter in the southern Adriatic. It is worth noting that the 50 km resolution (the resolution used in this climate modelling) is insufficient for a more accurate description of spatial (local) variations of maximum wind speeds which depend on many details of more accurate scales (orography, terrain orientation - ridges and valleys, vegetation, urban barriers, etc.).

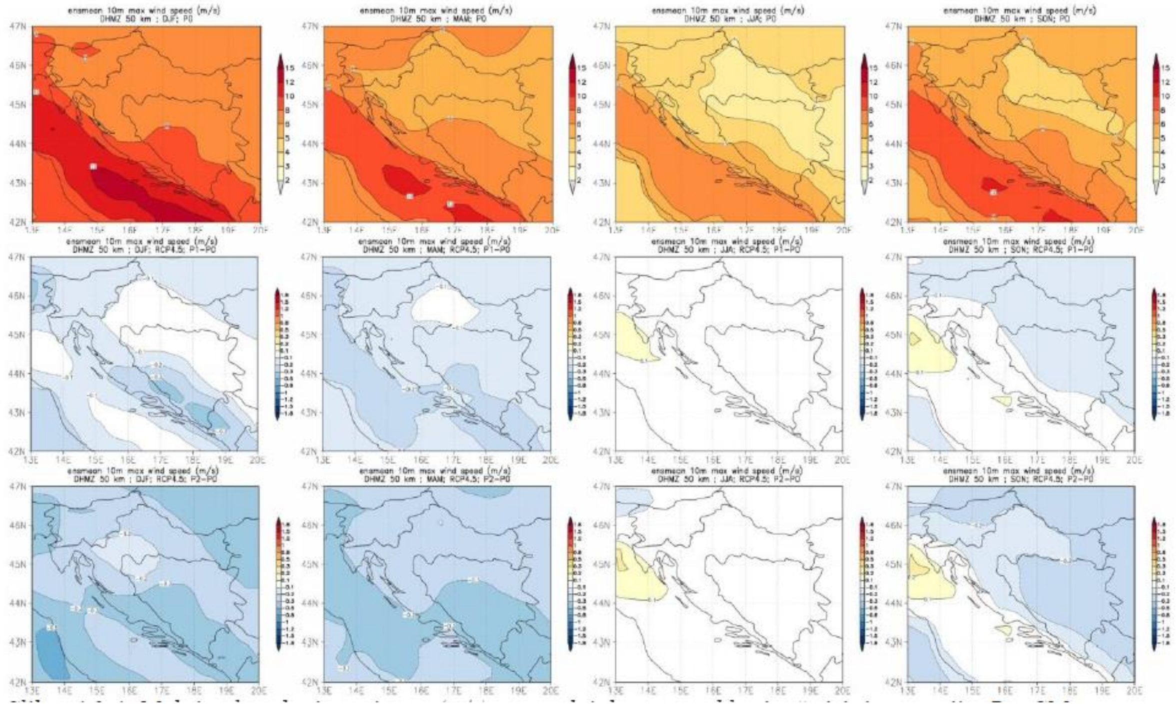

Figure 6-27: Maximum wind speed (m/s) ensembles-mean from the four integration by RegCM model.
Left to right: winter, spring, summer and autumn. Top: referent period 1971 – 2000.; middle: change in the period 2011 – 2040.; bottom: change in period 2041 – 2070.

<u>Evapotranspiration</u>

In the future climate period, between 2011 and 2040, the increase of the evapotranspiration by 5 to 10 % is expected in most of the areas in spring and summer, and a more significant increase is expected only on the outer islands and in western Istria. In most of northern Croatia, no change in the overall summer evapotranspiration is expected. Until 2070, the expected change for most of Croatia is similar to that in the period between 2011 and 2040. A somewhat more pronounced increase (10–15 %) is expected in summer in the coastal areas and in the hinterland as well as up to about 20 % on the outer islands.

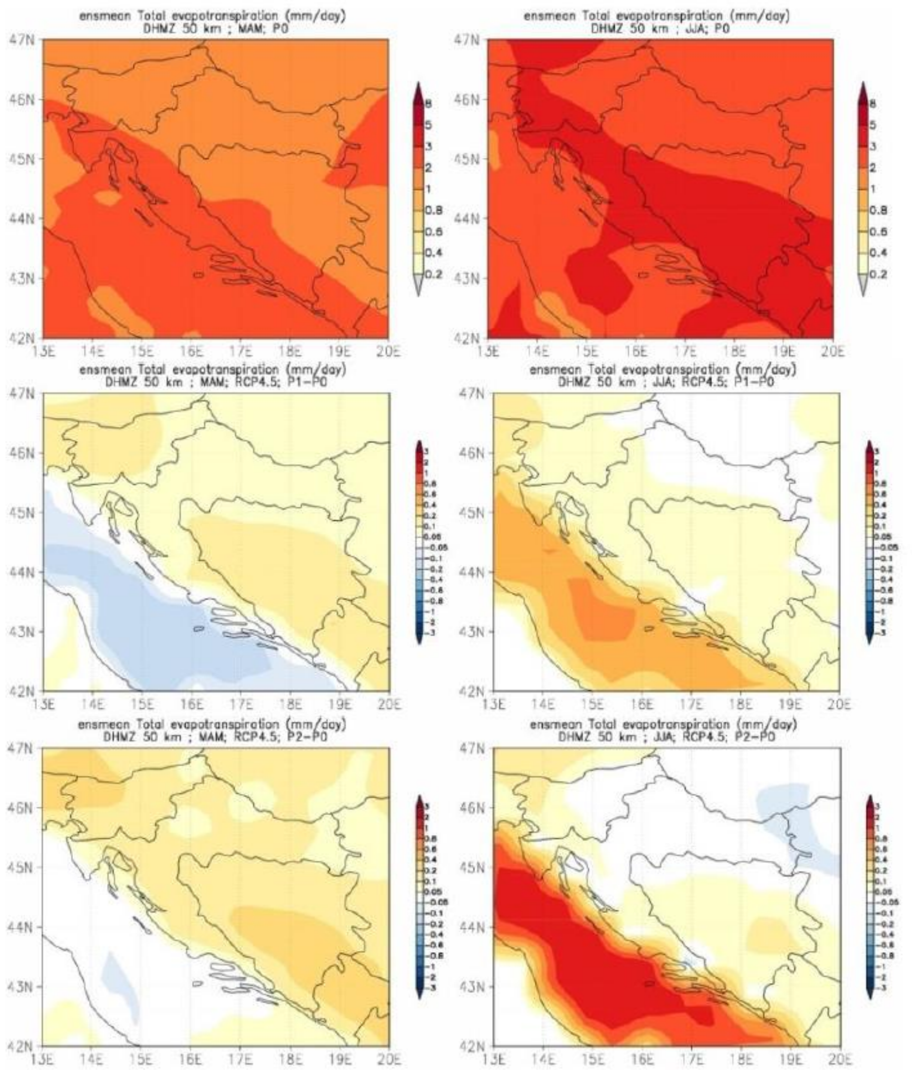

Figure 6-28: Evapotranspiration (mm/day) ensembles-mean from the four integration by RegCM model.
Left to right: winter, spring, summer and autumn. Top: referent period 1971 – 2000.; middle: change in the period 2011 – 2040; bottom: change in period 2041 – 2070

Air humidity

By 2040, air humidity increase is expected throughout the year and mostly in summer in the Adriatic. In the period 2041 – 2070, a uniform increase in air humidity is expected throughout Croatia, somewhat higher in the summer in the Adriatic.

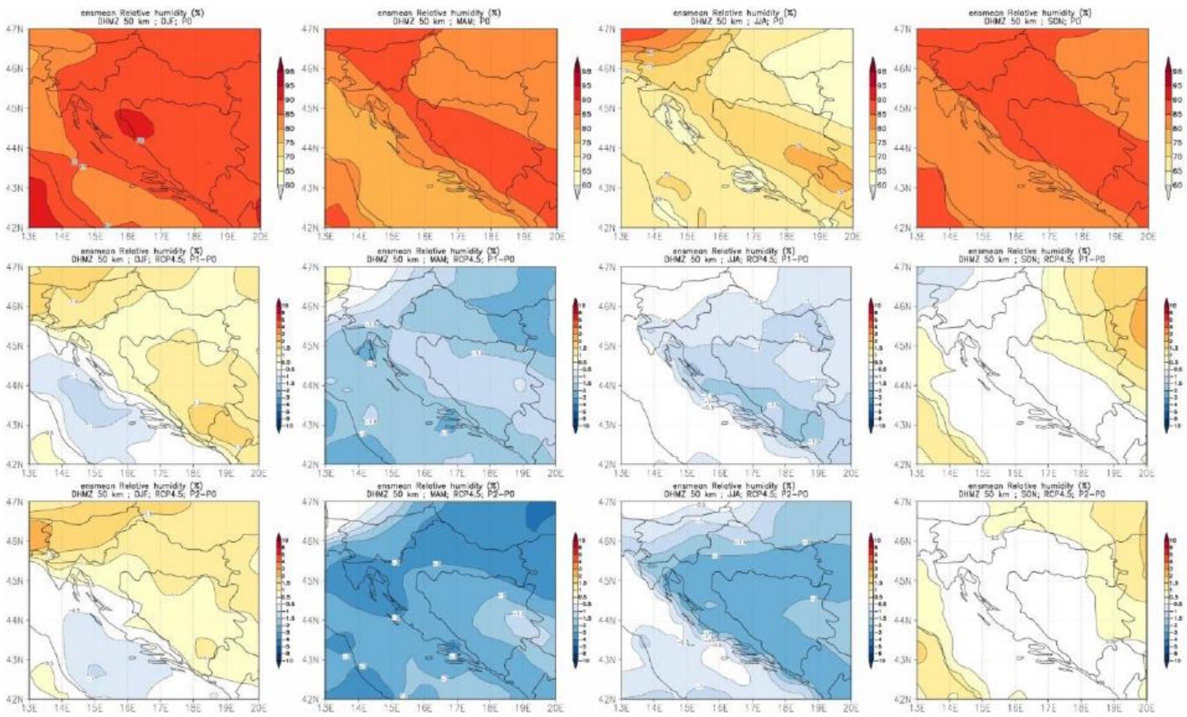

Figure 6-29: Relative air humidity (%) ensembles-mean from the four integration by RegCM model. Left to right: winter, spring, summer and autumn. Top: referent period 1971 – 2000; middle: change in the period 2011 – 2040; bottom: change in period 2041 – 2070

<u>Solar irradiance</u>

The projected changes in the incoming solar energy flux in the period from 2011 to 2040 do not go in the same direction in all seasons. While in winter throughout Croatia, and in spring in the western regions decrease of the incoming solar energy flux is projected, in summer and autumn and in northern areas in spring, the increase in value is expected compared to the reference period. All changes range from 1 to 5 %. In the summer season, when the inflow of solar energy is the largest (in the coastal areas and the hinterland 250-300 W/m^2), the projected increase is relatively small. In the period between 2041 and 2070, the incoming solar energy flux is expected to increase in all seasons except in winter. The highest increase is in summer, 8 to 12 W/m^2 in mountainous and central Croatia, whereas the lowest is in central Dalmatia.

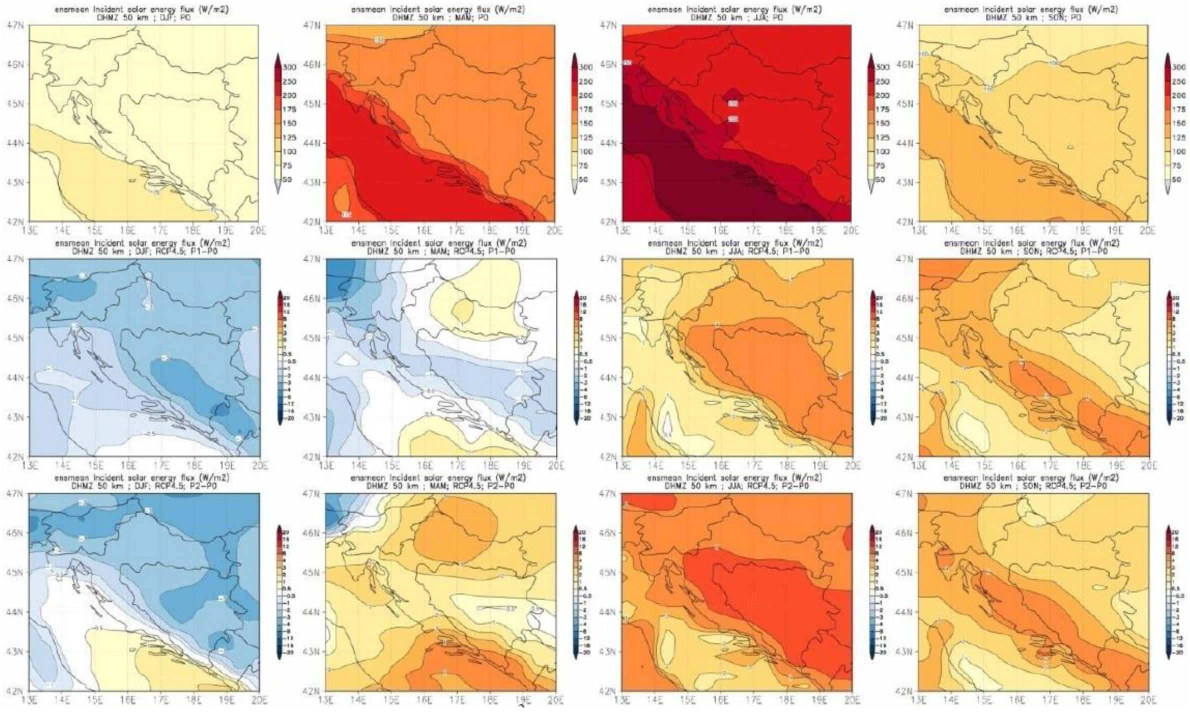

Figure 6-30: Incoming sun energy flux (W/m2) ensembles-mean from the four integration by RegCM model.
Left to right: winter, spring, summer and autumn. Top: referent period 1971– 2000; middle: change in the period 2011 – 2040; bottom: change in period 2041 – 2070

Snow cover

Until 2040, decrease of the snow water equivalent, i.e. the snow cover is projected in winter. The reduction is the largest in Gorski Kotar and would amount to 7 – 10 mm, which makes up slightly less than 50 % of snow water equivalent in the reference climate. In the period from 2041 to 2070 further reduction of the snow water equivalent is expected throughout Croatia. Hence, a stronger reduction in the snow cover in the future climate is expected in those areas that have the highest amounts of snow in the reference climate – in Gorski Kotar and other mountainous regions.

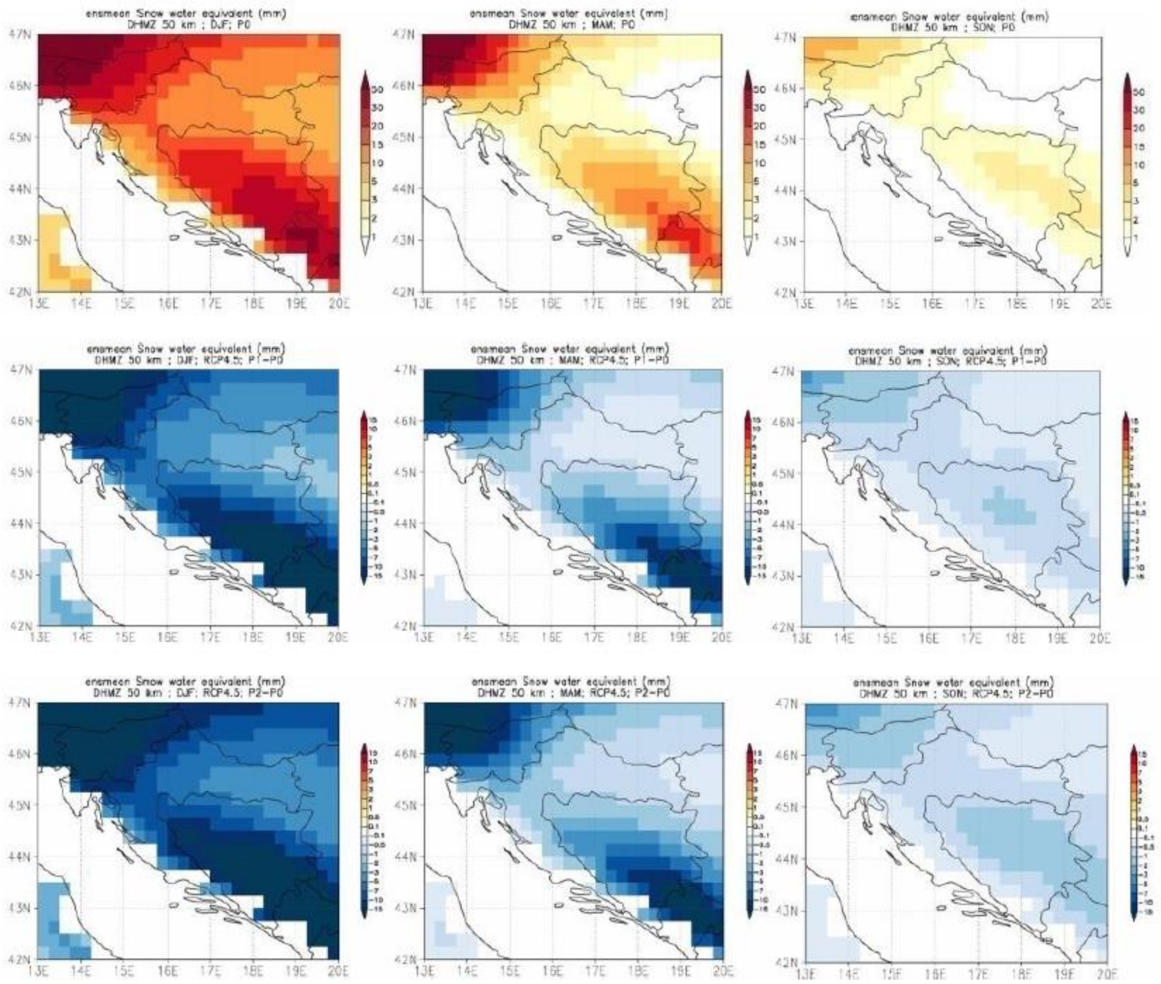

Figure 6-31: Water equivalent of snow (mm) ensembles-mean from the four integration by RegCM model.
Left to right: winter, spring, summer and autumn. Top: referent period 1971 – 2000; middle: change in the period 2011 – 2040; bottom: change in period 2041 – 2070

Soil humidity

It is expected that in the period up to 2040 soil humidity will decrease in northern Croatia, and by 2070 throughout Croatia as well (in the central part of northern Croatia for more than 50 mm). The highest decrease in soil humidity is expected in the summer and fall months.

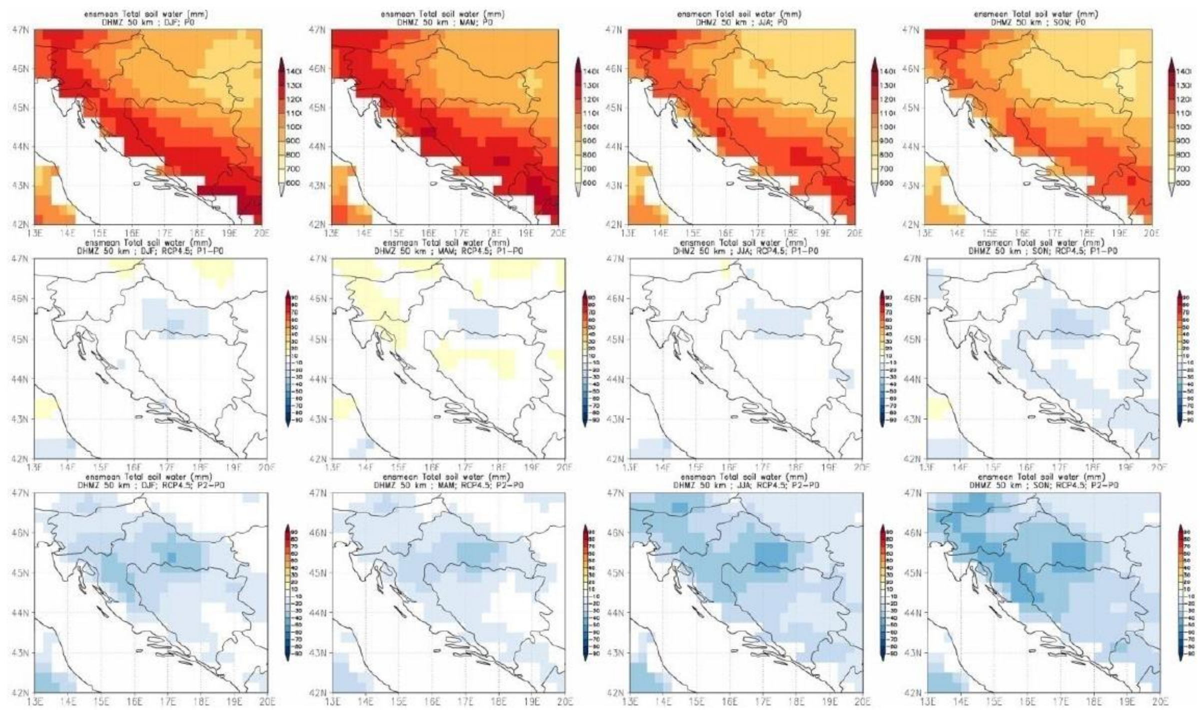

Figure 6-32: Soil humidity (mm) ensembles-mean from the four integration by RegCM model.
Left to right: winter, spring, summer and autumn. Top: referent period 1971 – 2000; middle: change in the period 2011 – 2040; bottom: change in period 2041 – 2070

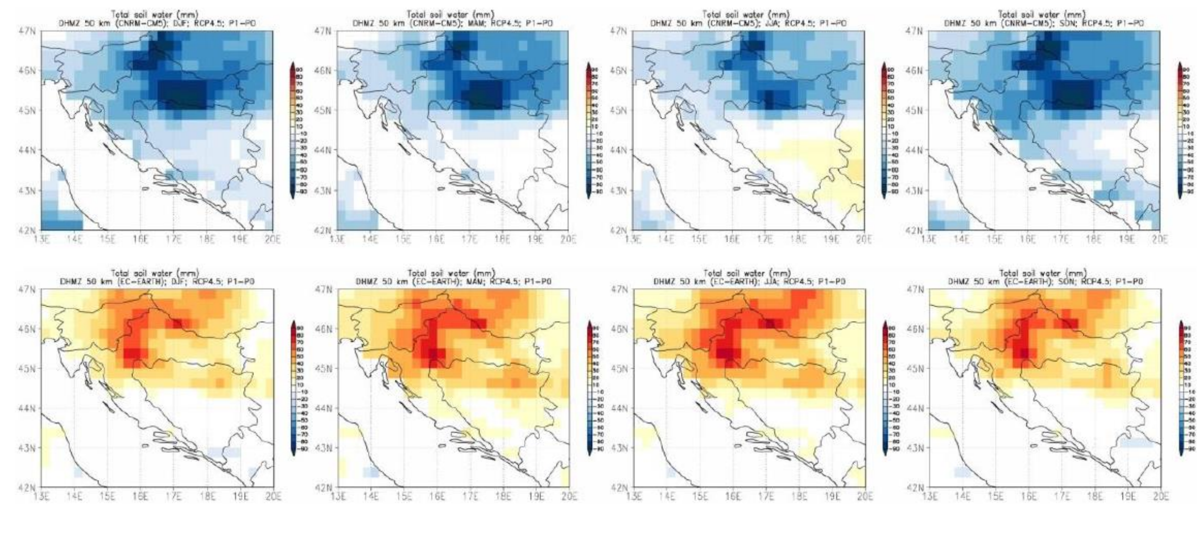

Figure 6-33: Soil humidity (mm) for two individual integration by RegCM model.
Left to right: winter, spring, summer and autumn. Top: change in the period 2011 – 2040 with edge conditions of Cm5 global model; bottom: change in the period 2011 – 2040 with edge conditions of EC-Earth global model

<u>Surface runoff</u>

In the period between 2011 and 2040 for most parts of Croatia no significant change in surface runoff is expected during most of the year. However, in mountainous areas and partly in the hinterland of Dalmatia, surface water flow could be reduced by about 10 % in winter, in spring and autumn. By 2070, the amount of runoff will have declined slightly, mostly in spring, when this reduction could affect the whole of Croatia. This decrease in runoff coincides with a decrease in the total amount of spring precipitation in the mid-21st century.

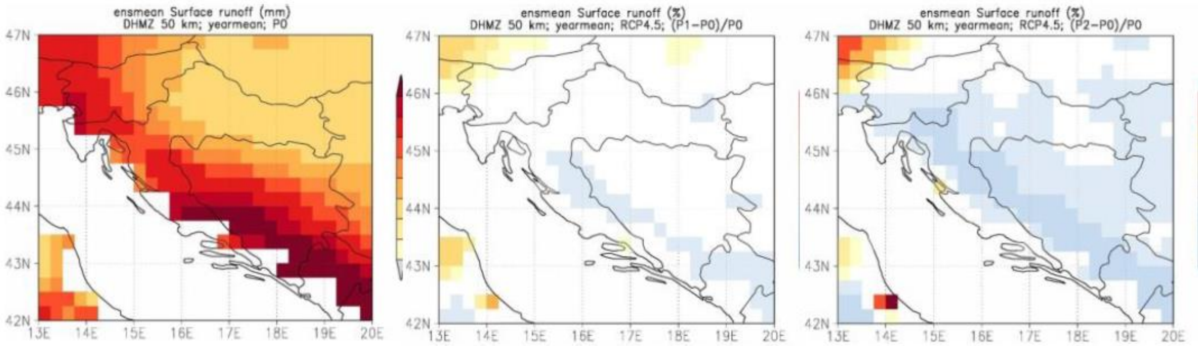

Figure 6-34: Annual surface runoff (mm) ensembles-mean from the four integration by RegCM model.
Left: referent period 1971 – 2000.; middle: change (%) in the period 2011 – 2040.; right: change (%) in period 2041 – 2070.

<u>Sea level</u>

The projections of sea level rise have not been obtained with the RegCM model, but the results have been taken from the IPCC AR5 and have been made with the conclusions based on the research of domestic authors and monitoring of the current movement of the mid-level change in the Adriatic Sea. According to the CMIP5 Global Model (IPCC AR5) results for the mid-21st century (2046 – 2065) show expected increase in global mean sea level under the RCP4.5 of 19 – 33 cm, and with the RCP8.5 of 22 – 38 cm. In the period from 2081 to 2100 for the increase would be 32 – 63 cm the RCP4.5 and 45 – 82 cm for the RCP8.5. This global sea level rise will not be evenly reflected in all areas. Projections of change in the Adriatic Sea level by the end of the 21st century (according to the IPCC AR5 and domestic sources) provide a framework increase in the range of 32 to 65 cm and this has also been used when proposing measures related to the mean sea level change. However, it is worth pointing out that there are considerable uncertainties that are already to be dealt with in the calculation of the sea level for the historical climate.

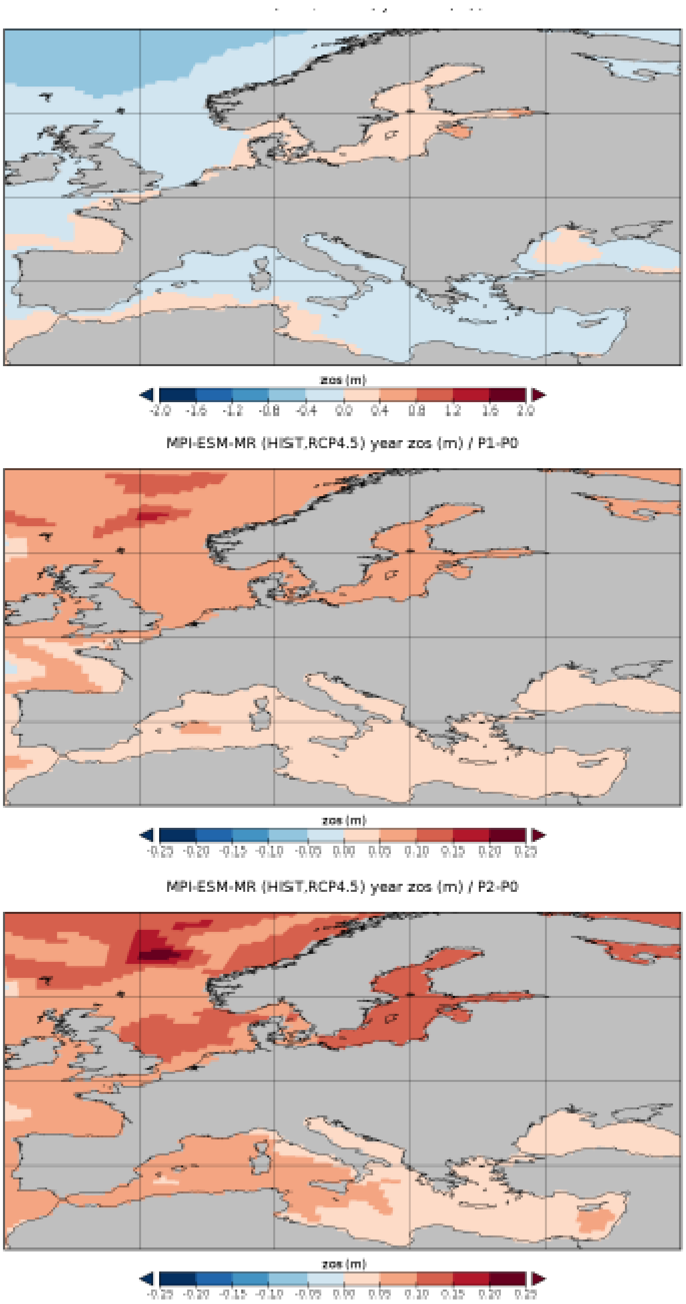

Figure 6-35: Mean sea level (m) in MPI-ESM global model.
Up: referent period 1971 – 2000 (P0), level in relation to geoid (m); middle: change in the period P1 (P1 minus P0); bottom: change in the period P2 (P2 minus P0)

Two climate scenarios, which are considered in climate modelling within the framework of the Adaptation Strategy's development, are: (1) the future envisaging the mitigation and adaptation measures (RCP4.5), and (2) the future that does not foresee changing of the existing climate change adaptation policy, i.e. taking of significant reduction and adaptation measures (RCP8.5) is not foreseen. The RCP4.5 scenario is the most common scenario used in drafting adaptation strategies. The summary overview of features of climate change parameters for the Republic of Croatia according to the RCP4.5 scenario is given in Table 6-7.

Table 6-7: Climate projection in the Republic of Croatia to year 2040 with a view to year 2070

Climatological parameter		Future climate projections according to the RCP4.5 scenario compared to the period 1971-2000 obtained by climate modelling 2011 – 2040	2041 – 2070
PRECIPITATION		**Average annual quantity**: a slight decrease (except for a slight increase in the northwest of Croatia)	**Average annual quantity**: *further decrease trend* (up to 5%) in almost all of Croatia except for north-western parts
		Seasons: different signs; **winter and spring** in most of Croatia *a slight increase* + 5-10 %, and **summer and fall** decrease (most - 5-10 % in southern Lika and north Dalmatia)	**Seasons**: *decrease* **in all seasons** (up to 10 % of the mountains and northern Dalmatia) *except* **in winter** (increase of 5 – 10 % in northern Croatia)
		Decrease in the number of **rainy seasons** (except in central Croatia where it would slightly increase). The number of **dry seasons** would increase.	The number of **dry seasons** would increase.
SNOW COVER		*Decrease* (highest in Gorski Kotar, up to 50 %)	*Further decrease* (especially mountainous areas)
SURFACE RUNOFF		There are no major changes in most regions; but in the mountainous areas and the hinterland of Dalmatia a *decrease* up to 10 %	*Decrease* of runoff throughout Croatia (especially in spring)
AIR TEMPERATURE		Medium: *increase* of **1 to 1.4 °C** (all seasons, the entire Croatia)	Medium: *increase* from **1.5 to 2.2 °C** (all seasons, the entire Croatia - especially continent)
		Maximum: increase in all seasons **1 – 1.5 °C**	Maximum: up to **2.2 °C** in summer (up to 2.3 °C on islands)
		Minimum: the highest *increase* **in winter, 1.2 – 1.4 °C**	Minimum: the highest *increase* in continent **in winter** 2.1 – 2.4 °C; and 1.8 - 2 °C coastal zones
EXTREME WEATHER CONDITIONS	**Heat** (number of days with Tmax> +30 °C)	**6 to 8 days** *more* than the reference period (reference period: 15 – 25 days a year)	Up to **12 days** *more* than the reference period
	Cold (number of days with Tmin <-10 °C)	*Decrease* in the number of days with Tmin <-10 °C and increase in Tmin values (1.2 – 1.4 °C)	*Further decrease* in the number of days with Tmin <-10 °C
	Warm nights (number of days with Tmin ≥ + 20 °C)	*Increase*	*Increase*
WIND	**Medium speed** at 10 m	**Winter and spring** *without change*, but **in the summer and especially in the autumn** on the Adriatic *increase* up to 20-25 %	**Winter and spring** *mostly without change, but the trend of strengthening* in **summer and autumn** in the Adriatic.
	Max. speed at 10 m	On an annual basis: *no change* (the highest value in the islands of southern Dalmatia) Per season: *decrease* in **winter** in southern Adriatic and hinterland	Per seasons: *decrease* in all seasons except in the summer. *The highest decrease* in **winter** in southern Adriatic
EVAPOTRANSPIRATION		Increase in **spring and summer** 5 – 10% (outlying islands and west Istria> 10%)	Increase in **spring and summer** 5 – 10% (outlying islands and western Istria > 10%)

AIR HUMIDITY	Year-round increase (**most in summer** in the Adriatic)	Year-round increase (**most in summer** on the Adriatic)
SOIL HUMIDITY	*Decrease* in northern Croatia	Decrease throughout Croatia (**most in summer and autumn**).
SOLAR IRRADIANCE (INPUT SOLAR ENERGY FLUX)	In the summer and autumn increase throughout Croatia, in spring increase in northern Croatia, and decrease in western Croatia; in winter decrease throughout Croatia	*Increase* in all seasons except winter (the highest increase in mountainous and central Croatia)
MEAN SEA LEVEL	2046 – 2065 **19 – 33 cm** (IPCC AR5)	2081 – 2100 **32 – 65 cm** (estimation of average mean values for the Adriatic from various sources)

6.2. VULNERABILITY ASSESSMENT

This subchapter provides a brief overview of relevant research and their basic characteristics conducted so far as well as vulnerability and expected impacts of climate change, per specific sector. Main documents used for this purpose were:

- “Overview of research and activities done so far related to climate change impacts and adaptation in the Republic of Croatia”,
- “Working draft Climate Change Adaptation Strategy in the Republic of Croatia for the period to 2040 with a view to 2070 (Green Book)”
- “Draft Climate Change Adaptation Strategy in the Republic of Croatia for the period to 2040 with a view to 2070 (White Book)”
- “Report on estimated impacts and vulnerabilities to climate change for each sector”

all prepared within the project “Strengthening the capacity of the Ministry of Environment and Energy for adaptation to climate change and preparation of the Draft Climate Change Adaptation Strategy”.[18] Formal adoption of the current draft of the Climate Change Adaptation Strategy for the period for the period to 2040 with a view to 2070 (White Book) is expected beginning of 2019.

Detailed insight into research done so far (around 150 references) revealed that there are significant differences in both scope and number of research between sectors as well as that the majority of work had dealt with specific aspects of the sector concerned lacking an integrative approach to climate change issues. The latter indicates the need for intensifying research related to impacts, vulnerability and adaptation to climate change.[19] Within this report, certain relevant research have been presented while the complete overview can be found in documents mentioned earlier.

[18] Detailed information and documentation from the project “Strengthening the capacity of the Ministry of Environment and Energy for adaptation to climate change and preparation of the Draft Climate Change Adaptation Strategy “ can be found at the following website: http://prilagodba-klimi.hr/dokumenti/.

[19] It should be noted that there are papers and publications relevant to multiple sectors such as “A Climate for Change: Climate change and its impacts on society and economy in Croatia” (UNDP, 2009), which represents the first integral assessment of climate pressures, vulnerability of important sectors and mitigation and adaptation measures for entire Croatia, “Climate Change Adaptation Plan for the City of Zagreb” (Energy Institute Hrvoje Pozar, 2014) representing good starting point for preparation of adaptation action plans for areas in Croatia beyond the City of Zagreb etc.

“Report on estimated impacts and vulnerabilities to climate change for each sector” represents so far the most comprehensive assessment of climate change impacts and vulnerability levels for the most important sectors for Croatia. Climate change impacts were analysed and vulnerability assessed for eight “resource” sectors (hydrology, water and marine resources, agriculture, forestry, fishery, biodiversity, energy, tourism, health) and two “transversal” sectors (spatial planning and coastal areas management, risk management) based on modelling results and scenarios, existing research and activities related to climate change impacts and adaptation in the Republic of Croatia. For each sector possible impacts and vulnerability levels were estimated as an integral conclusion based on estimation of occurrence possibility and impact degree. Within this subchapter only impacts for which high vulnerability was estimated are presented.

6.2.1. Hydrology, water and marine resources

Overview of existing research

In the area of hydrology, water and marine resources, the search through databases and available publications revealed relatively large number of documents thematising climate change issues and possible impacts on water resources (freshwater and marine) from different aspects. In some work, potential impacts have even been quantified.

Multi-annual Programme of construction of regulation and protection water structures and melioration structures (Croatian Waters, 2013) resulted, among other, with the prepared “Preliminary risk flood assessment” followed by a twinning project “Developing flood hazard maps and flood risk maps” through which a methodological approach of such map presentation was developed. The Government of the Republic of Croatia adopted in 2016 the River Basin Management Plan 2016-2021 (OG No. 66/2016) which also includes the Flood Risk Management Plan which considers climate change impacts and defines adequate measure programme.

International Sava River Basin Commission developed in 2014 the Water & Climate Adaptation Plan for the Sava River Basin – Final Report which represents a planning document providing layouts of water resources’ quantities in the Sava basin, trends, climate change estimations, hydrological modelling of possible climate change consequences to water resources, economic assessments of climate change impacts and adaptation measures.

Furthermore, in 2014 a research was conducted that analysed crucial aspects of water resources management for past, current and future conditions with a special emphasis on climate and global changes that lead to hydrological, extreme situations. The work presents different examples of climate and hydrological events in Croatia and in Europe as well as adaptation possibilities with suggestion of new principles for water resources management [27].

One of the publications thematise climate change impacts on water resources and construction of multi-purpose economic systems as a possible response to these changes. It lists examples of hydro-energy systems in Croatia that have a role in ensuring water supply and flood protection, possible problems related to water resources in the future should the unfavourable climate scenarios do actualize, as well as adaptation measures that could be implemented within which construction of multi-purpose systems are recommended [28].

A certain number of research and publications deals with recorded trends and probabilities of high sea level occurrence as well as the interconnection of climate changes and changes of physical parameters in the Adriatic Sea. Maritime and Coastal Management Strategy of the Republic of Croatia (draft) states estimated damages – consequences of Adriatic Sea level rise for 2050 and 2100 for coastal areas while its accompanying documents additionally analyse certain aspects (measure valorisation, monitoring programme). Croatian Hydrographic Institute analysed historical information on sea floods in the Adriatic coast and suggested a methodology for flood hazard assessment and assessment of high sea levels for mareographic stations on Croatian coast of the Adriatic (Dubrovnik, Ploče, Sućuraj, Split-harbour, Zadar, Bakar and Rovinj) as well as monitoring improvement [29]. Another research in 2011 determined trends of sea level rise on Croatian coast from 0.5 to 0.8 mm/yr. Expected sea level rise for 21st century has also been investigated [30]. Furthermore, research has been conducted related to trends of physical parameters of the Adriatic sea and thermohaline circulation weakening phenomena, which can have substantial consequences to the Adriatic living organisms, all pointing to direct connection between climate change and physical change in the Adriatic sea [31]. One of more recent publications is the work of a group of authors which provides summarized overview of all research and their basic results related to sea level fluctuations of the Adriatic. It presents an overview of historical sea level fluctuations, results/fluctuations during instrumental monitoring period, as well as predictions of sea level fluctuations in the future. Events of extreme sea level rise have also been analysed. The work represents the most complete overview of features and fluctuation dynamics of the Adriatic sea so far [32].

Estimation of data needed and guidance for scientific research

Based on overview of existing research of climate change impacts on water and marine resources it can be concluded that cross-sectoral, interdisciplinary research addressing climate change in several domains (e.g. changes in water quantities but also changes in aquatic ecosystems and possible adaptation measures) are rare. The Green Book evaluated that cross-sectoral research aiming to ensure adequately quantified results which can represent basis for reliable assessments of possible adaptation measures are necessary. As priorities in the water and marine resources and their features' change dynamics conditioned by expected climate change, the following research is recommended:

- Analyses of climate change impact on small torrents and assessment of their impact on water ecosystems of surface and ground waters
- Analyses of climate change impact on groundwater levels of alluvial areas – development of methodology and mathematical model
- Climate change impact on risk increase related to salinization of coastal, karst springs and water aquifers and analyses of possible solutions for protection
- Analyses of climate change impact on sea temperature and sea water quality change in coastal area
- Analyses of climate change impact on drainage and rivers' and lakes' temperature change
- Analyses of climate change impact on the Adriatic Sea thermohaline circulation and related changes of abiotic and biotic factors

Vulnerability assessment

The Republic of Croatia is relatively rich in water, but not in water supply because of its geological structure with a large share of the surface with karst structures and large spatial-temporal heterogeneity of runoffs. Importantly, the karst areas that occupy about half of the territory of the Republic of Croatia generally have a small possibility of accumulation of water reserves for a long time period during critical dry periods. The state of water and sea resources in the territory of the Republic of Croatia is largely dependent on transboundary impacts due to the global impact of climate change on the dynamics of ocean and sea level change as well as the high share of cross-border and transboundary watercourses in relation to Croatia's total water resources. It is expected that deterioration of hydrological conditions due to climate change will increase the frequency and duration of dry periods on the one hand, and the frequency and intensity of flood situations on the other hand.

The projected increase in air temperature for the period up to 2070, as well as stagnation or minor reported trends of minimal change in total precipitation rates, will result in increased evapotranspiration, reduction of surface and underground runoff and, consequently, even more pronounced reduction in water resources. In such conditions, synergistic effects of negative impacts are expected due to an increase in anthropogenic pressures, above all expressed in the increased water demand. Adverse climate change will be particularly jeopardized vulnerable coastal karst aquifers and other aquatic phenomena in coastal area (lakes, watercourses, springs) precisely because of the cumulative effect of possible changes with reduced flows and groundwater levels and more intensive sea penetration into the karst coastal aquifers and lakes, as well as spreading of salty seawater along the watercourse basins deeper into the hinterland. The results of the performed modelling show that the intensity of short-term severe precipitation will increase in the future, of both rare and frequent possibilities of the phenomenon, creating preconditions for frequent occurrences of floods in flood watercourses, urban areas and river basins.

Particularly negative impacts of climate change are expected at watercourses in the coastal area due to the coinciding and cumulative effect of sea level rise and the occurrence of extreme flows. With the reduction of the mean annual and minimum annual flows and the increase of maximum annual flows, very pronounced changes in water temperatures are expected, which will have a negative effect on aquatic ecosystems, their diversity and reception capacity as well as the possibility of their use for other purposes. In such circumstances it is necessary to achieve the goal - to preserve good status of water in such-changed climate conditions as a result of climate change and to ensure a reduction of flood risk.

The expected rise in sea levels, but also the impact of future tides, waves and storms will have an impact on coastal infrastructure. The most vulnerable will be urban areas with low coastline (e.g. places on islands such as Cres, Mali and Veli Lošinj, Krk, Rab, Krapanj, Vela Luka and others, but also in coastal Croatia such as Nin, Trogir, Ston etc.). The particular negative impact of sea level rise is expected to be at sandy shores, which will be subject to increased erosion and other morphological change in terms of changing of their geometries, which can lead to their complete disappearance. However, in areas where this is possible, depending on the geomorphological features of the coast, urbanization of the area and so forth, the emergence of new sandy shores is expected. Negative changes are expected for the artificial parts of the coast, where built beaches will lose their functional optimums, and structural damage can also occur.

Increased degree of vulnerability of the marine environment caused by climate change will also be manifested in the risks related to the thinning of the Adriatic Sea's thermohaline circulation, which can significantly affect a variety of abiotic and biotic processes and changes, especially related to sea ventilation and change in oxygen concentration in deeper layers, increasing the acidity of the sea, as well as a series of related biological processes and impacts on marine biodiversity and fishery.

Following abovementioned, expected main impacts of climate change that cause high vulnerability in the domain of hydrology, water and marine resources are:

- Reduction of water levels in watercourses and in springs
- Reduction of underground water resources and lowering groundwater levels
- Reduction of water levels in lakes and other lake-type natural or built-up systems
- Sea level rise and change of its thermohaline features
- Salinization of coastal aquifers and aquatic systems
- Water temperature rise followed by reduction of reception capability of aquatic receivers
- Increased frequency and intensity of flooding in vulnerable areas
- Increasing the frequency and intensity of torrents
- Increasing the frequency and intensity of rainwater flooding in urban areas

6.2.2. Forestry

<u>Overview of existing research</u>

Research and work in forestry sector done so far have analysed to a certain extent climate changes and their impacts in this sector. There is research showing vulnerabilities of specific tree species (mostly to drought) that result in crown defoliation, higher susceptibility to pest attacks etc. For example, one of the publications provides an overview of results of tree crown defoliation monitoring within the ICP Forest permanent experimental plots grid which is performed in Croatia from 1987 for the purposes of the Convention on Long-range Transboundary Air Pollution (CLRTAP) implementation. Significant tree crown defoliation was recorded, ranging from 20.6 % (2002) to 27.7 % (2010), which is being linked with climate characteristics of current and previous years. Furthermore, with certain species (common beech, narrow-leafed ash, sessile oak) increase of significant defoliation was recorded after years of drought while, for instance for common oak, such phenomena has not been identified. Assumption is that long term drought, as a possible climate change consequence, will deteriorate tree defoliation at permanent grid plots [33].

The impact of climate on forest productivity is being researched within the EFFEctivity project implemented by the Croatian Forestry Institute and financed by the Croatian Science Foundation. Different methods are combined in the project (field measurements, micrometeorological method of eddy covariance, remote sensing and chronosequencing) in order to perform modelling of common oak forest productivity. Research results so far in Jastrebarski lugovi show a trend of decreasing productivity of common oak in the period from 2015-2100 [34], while for Spačva there are currently no published results.

Climate change, and especially weather extremes, directly influence forest pests and related damages. These are manifested through the impact on development, survival, reproduction and spreading of pests as well as through the impact on host's resilience and sensitivity. Pest expansion to new climatic areas is expected due to warming. Several projects so far showed that genotypes in the last decade migrated more to the north, which is mostly connected to climate change. By recording changes that arise as a result of pest-host-climate change interaction, monitoring database is being established which should serve as the basis for decision making and control strategy definition. In Croatia, a Croatian Science Foundation project "Defoliators as invasive forest pests in changing climate conditions" was implemented within which an extensive research on targeted pests in Croatia was conducted, their biology and host biology, and all aspects of bioecology (such as genetic constitution and origin, heat demand, possible hosts, palatability, antagonists) that all together influence the spreading into new area due to climate change impact [35].

Furthermore, other research results showed that some species act opportunistically by adjusting to climate condition changes. For example, one of the publications presents results from response strategy research of 11 bioclimatic types to extreme climate variability and their potential adaptation to such conditions. Time series from 1998-2005 and spatial resolution of 1.2 km were used. For quantification of vegetation response to climate variations, resilience indices were employed while taking into account seasonal variability as well. Results showed that some species act opportunistically, such as beech and oaks, which adjust to climate condition change [36].

One of the papers from 2009 provides an overview of research and policies in Croatia relating to mitigation and adaptation as well as possible forest distribution as a consequence of expected climate change. Till 2030, the following scenario is anticipated:

- The expansion of lowland forest distribution cannot be determined for certain because the model did not include hydrological regime changes which is an important factor for lowland forest distribution.
- It is fairly certain that the distribution of beech and fir forest in Gorski kotar will be reduced.
- Expansion of pubescent oak forest (Quercus pubescens).
- Reduction of evergreen oak forest distribution (Quercus ilex) [37].

Some research tackled the interconnection between vegetation types, soil and average groundwater level in the soil. Groundwater monitoring results obtained from 56 piezometric stations set up in 6 forest complexes in central Croatia in the period from 1991-2003, which can serve as an indicative example of the link between vegetation type, soil and average groundwater level in the soil, indicate decrease of groundwater level in two parallel periods (1991-1996 and 1887-2000) as well as a significant decrease of groundwater level caused by large drought in 2003. The decrease of groundwater level was the sharpest in eastern Slavonia which is connected with crown defoliation in common oak [38].

Within the Croatian Forestry Institute project "Changes of soil carbon storage and calculation of total nitrogen and organic carbon trends in the soil and the C:N ratio" for Croatian Agency for the Environment and Nature (2014-2017), among other, dealt with establishing monitoring systems (field measurements) for carbon storage and assessing changes considering previous data which is useful in the end also for parametrization and validation of the Biome-BGCMuSo model.

Estimation of data needed and guidance for scientific research

In general, there is a small number of scientific research dealing with climate change impacts and adaptation possibilities in forestry along with fact that they are of unequal scope and quality. Existing work mostly does not address sector's, certain forest community's or tree specie's vulnerability in such a way that it can serve as a basis for adaptation measures' definition. Hence, recommendation for future research is for the latter to encompass:

- analyses of forest ecosystem vulnerability
- analyses of possible future climate with a special focus on climate extreme frequency (drought/fires, ice rain event, hurricane wind, floods)

- projections of possible future distribution (optimum) of forest species based on the previous two analyses
- impact of climate change on forest tree pests and projections of their distribution
- development of tools (public policies) for private stakeholder mobilization and improvement of private forest management systems
- improving modelling of occurrence and behaviour of forest fires
- research on climate change impact on forest tree phenophases (especially of species of economic importance)
- research related to strategic planning and implementation of green infrastructure concept in rural and urban areas
- integral approach to climate change problem i.e. establishing cross-sectoral research groups on national level

Vulnerability assessment

In the forestry sector there are several major expected impacts that cause high vulnerability. This is primarily related to a higher frequency and length of the forest fire season, including fires on the continent. The current trend in the number of forest fires shows that there were significantly more fires in the dry years in the Mediterranean area, while projections show that the risk of forest fires in the future will be higher for the whole of the Republic of Croatia. Furthermore, the phenological phases of trees are expected to move in the sense of earlier start of vegetation and the extension of the vegetation season depending on species and habitats. Due to change in habitat conditions, migration of species and pests, including invasive species, could occur. The productivity of some forest ecosystems, such as oak-tree forests, could be reduced, although it should be emphasized that it depends not only on atmospheric change but also on the ways of management and other impacts. Due to the increased frequency of forest fires and the occurrence of strong winds, icing events that cause damage, floods, pest attacks and the like, higher damages to forest ecosystems are expected, such as a reduction in the value of wood varieties and the loss of generally beneficial forest functions.

Expected main impacts of climate change that cause high vulnerability in forestry sector are:

- Increased incidence of forest fires including the occurrence of fires in the continental part of Croatia due to increased temperature and decreased precipitation
- Decreased productivity of some forest ecosystems
- Migration of harmful organisms
- Moving of phenological phases of forest tree species
- Damage to forest ecosystems due to the frequency of extreme weather events
- Reduced value of certain generally-beneficial functions of forests

6.2.3. Agriculture

Overview of existing research

In agriculture sector there have been certain research that generally address climate change topic but without analysis of specific adaptation measures and their effects. Publications that deal with climate change adaptation in agriculture more closely mostly analyse the impact of drought on particular crop yield (primarily cereals) and dairy cow yields, irrigation needs, optimization of crop fertilization with nitrogen (as a climate change adaptation measure) and adaptability of cereal cultivars (mostly wheat) with good morphological, economic and quality characteristics to drought and other climate variabilities.

For example, within the VIP project financed by the Ministry of Agriculture, the issue and possibility of cultivating highly adaptable wheat cultivars with good morphological, economic and quality characteristics as well as variability sources necessary for the development of new genotypes with enhanced adaptability was analysed [39]. The project assessed also the impact of drought on health and consequently cow productivity at household and large farms level [40].

Furthermore, one of the papers from 2014 analysed the impacts of extreme weather conditions on agricultural crop production and considered justification for applying different climate models and modelling in predicting impacts of weather conditions on crop yields. It was concluded that, with high quality input data and methodological approach, advanced models can provide fairly good prognosis for specific yield locations which can be expected in the event of extreme weather conditions [41].

In the phenology research domain, a paper from 2008 provides time (historical) overview of phenological observations and research on flora in Croatia and considers achievements and challenges faced by the Croatian scientific community dealing with this problem in different time periods. Phenological data for agricultural crops are stated, some of which are forwarded to the European phenological database [42].

Estimation of data needed and guidance for scientific research

Given the research conducted so far, recommendation for future research in the agriculture sector include:

- assessment of climate change impacts on agriculture sector from an economic, ecological and sociological aspect. Addressing impacts for both crop production and animal breeding on regional level is preferable.
- vulnerability assessments – determing most vulnerable agricultural crops, livestock as well as regions
- examination of specific agro-technical measures'(irrigation, fertilization etc.) efficiency in particular production conditions (different cultures, livestock, regions etc.) from an agronomic, economic, ecological and sociological aspect
- research on the development of agro-technical measures that form soil's organic matter (humus) since this is multiply useful adaptation measure with no negative effects
- research in the area of livestock breeding since in Croatia there is almost no research on adaptation measures in livestock breeding
- expansion of the existing climate model for maize to other crops

Vulnerability assessment

According to some predictions, agriculture is the sector that will suffer the highest damage from the consequences of climate change. It is expected that, due to climate change, the yield of agricultural crops in the Republic of Croatia will be reduced by 3 – 8% by 2050.

Longer and more frequent drought periods, as well as the increasing threat to agricultural crops from heat stress over the last decades, especially in Dalmatia, are a clear signal, primarily to fruit growers, olive growers and winemakers to implement climate change adaptation measures. The drought in the summer months in the period between 1980 and 2014 was the largest single cause of damage caused to Croatian agriculture by climate variability, while in the period from 2013 to 2016 it caused damage of a total of 3 billion kuna, or 43% of direct aid paid to agriculture in the same period.

It has been observed that climate change already affects the phenological phases of apple, grapevine, olive and corn, so that the vegetation period begins earlier, lasts less time, and ultimately yield drops. The lack of ground water (drought) and higher air temperatures in the upcoming period will be two key issues in the struggle of agriculture with climate change. At the same time, climate change will also have some positive effects in the agricultural sector, such as enabling the cultivation of some new crops and cultivars in areas where that has not been possible so far.

Expected main impacts of climate change that cause high vulnerability in agriculture sector are:

- Change in the duration/length of the vegetative period of agricultural crops and lower yields
- Higher demand for irrigation water due to frequent droughts
- Longer vegetation period will enable the cultivation of some new cultures and varieties
- More frequent flooding and stagnation of surface water - which will reduce or completely destroy yields

6.2.4. Fishery

Overview of existing research

One of the existing research described changes in the Adriatic sea ecosystem in the last few decades as a consequence of climate change, as well as projections of future changes and defined larger number of adaptation measures, primarily for fish and shellfish farming [43].

A paper from 2010 shows vulnerability of the fishery sector, catch and mariculture to climate change impact, especially to sea temperature rise as well as the adaptation possibility to expected changes in the future. Vulnerability is manifested in changes of population number of certain economically significant fish species, behaviour changes and fish population distribution [44]. Furthermore, research of group of authors analysed changes in Adriatic ichthyofauna composition through a period of 25 years. Quantitative and qualitative analyses through that period of time indicated an increase in number of certain thermophilic fish species but also a decline in number or disappearance of species for which sea temperature rise is not favourable [45].

Considering abovementioned and other existing research, it can be concluded that research on climate change impacts on fishery in Croatia and adaptation to the latter conducted so far refer primarily to marine fisheries while research in freshwater fishery domain are less abundant. Out of all parameters relating to climate change, fluctuations of sea surface temperature have been primarily monitored and, to a lesser extent, salinity variations while data on sea acidity changes are lacking. Few and incomplete research addressing climate change impact on different trophic levels in a marine ecosystem and consequently population of specific fish species exist.

In the fishing domain, long term data regarding monitoring of impacts of temperature and salinity fluctuation on specific pelagic fish species' number and distribution exist, as well as data on changes in duration of particular pelagic species' spawning season.

In mariculture, data are limited to certain areas in the southern Adriatic showing positive impact of sea temperature increase on fish and shellfish species which suit warmer waters and negative impact on growth and reproduction of species finding colder waters more appropriate. Along with the latter, data on impact of sea salinity changes on economically important fish and shellfish specie farming are also available.

Estimation of data needed and guidance for scientific research

The Green Book identified the need for comprehensive research addressing the development of adequate applications (models) which will enable modelling of future fisheries sector as a response to climate change projections till the middle and end of century as well as the need to:

- establish continuous monitoring of stock levels, as well as ontogenetic cycles of marine and freshwater organisms
- develop computations models applicable for specific aquatic species i.e. parts of our acquatorium
- research of climate change impact on habitats suitable for specific fish specie
- research on quantitative impact of invasive species on economically significant existing blue and white fish species
- research related to the possibility and perfecting of invasive species' economic exploitation and farming
- research related to finding alternative shellfish species for farming due to impossibility to breed oysters
- research related to marine organisms farming on mainland with sea water conditioning

Vulnerability assessment

The major expected impacts of climate change in the fisheries sector will be additional pressure on the marine ecosystem that is already under the influence of numerous anthropogenic factors, in particular overfishing, habitat destruction and pollution.

The estimated increase in the Adriatic Sea's temperature by 1.6 to 2.4 °C by 2070 will result in the migration of fish (especially shrimp and hake) to deeper waters and towards the north, a higher number of invasive species and the reduction or disappearance of domestic species and change in choice of breeding species. Reducing of primary production is expected to result in the number of pelagic fish dropping due to changes in water circulation caused by thermohaline causes. Increasing temperatures and reduced fresh water quantities will limit the availability of water for freshwater aquaculture. The positive effects of rising water temperatures will be accelerated growth and shorter breeding cycle of fish. The acidity of the Adriatic Sea is estimated to increase by 0.1 to 0.2 degree of pH, which will prevent shellfish breeding in certain areas.

Future climate change will jeopardize the economic viability of fishing, especially coastal and demersal. In the cultivation of marine organisms, the impact will be twofold: positive for breeding tuna and sea bream, and negative for the cultivation of sea bass and oysters. The fisheries sector will be particularly vulnerable to global trends in supply and price of fish flour and fish oil as a result of climate change.

Following abovementioned, expected main impacts of climate change that cause high vulnerability in the fishery sector are:

- Migration to the northern Adriatic Sea or to the deeper sea of cold-water species due to rising sea temperatures
- Increase in the number of alien species and the influence on domestic species due to rising sea temperatures
- Decrease of primary production with consequences on the number of pelagic fish due to change in water circulation due to thermohaline causes
- Weaker growth and higher mortality of shellfish due to increased sea acidity

6.2.5. Biodiversity

Overview of existing research

Regarding biodiversity domain, larger number of papers has been published that, more or less, touch upon climate change, their consequences and impact in Croatia. A numbers of scientific papers more systematically represent scientific research related to vulnerability assessments of specific species of jellyfish (Aurelia sp.), taxonomic groups (Acari) or habitats (common fir, Abies alba [46]). There are no synthetic papers that analyse the impact of climate change on biodiversity; thus, published or overall general measures for mitigation and adaptation do not exist. Further on, publications to be singled out are the basic publication Biological and landscape diversity of Croatia: Overview of biological and landscape diversity of Croatia with strategy and action plans for protection (Radović, 1999) and document Analysis of the state of nature in the Republic of Croatia for the period 2008-2012 (draft), which deals with biodiversity of Croatia, and generally most comprehensive and most specific publication related to climate change and its consequences - A Climate for Change: Climate change and its impacts on society and economy in Croatia (UNDP, 2009).

Red books of Croatia [47], published in the period from 2005-2015, are basic documents which provide an overview of the endangered species status from specific taxonomic and/or ecological groups in Croatia. Climate change impacts is recognized as more or less significant threat depending on the different groups (from the complete non-recognition of the endangerement to the recognition of climate change as an important factor endangering certain species and their habitats).

Estimation of data needed and guidance for scientific research

Regarding biodiversity, several domains have been identified for which the Green Book proposes further activities and research encompassing:

- identification of species, habitat types and areas most sensitive to climate change and identification of optimal indicator species and habitats,
- systematic analysis of vulnerability of ecosystem and ecosystem services to climate change,
- developing specific mitigation and adaptation measures for climate change impacts,
- establishment of a monitoring system of indicator species and habitat types, in particular in marine ecosystems, inland wetlands and mountain areas,
- analyzing the increase of the negative impacts of sectoral pressures in synergy with climate change on biodiversity,
- designing, stimulating and promoting the use of ecosystem approaches to mitigation and adaptation to climate change between sectors,
- monitoring the spread of foreign and invasive alien species and analyzing the effects of climate change on the dynamics of spreading alien species and increasing the risk of invasiveness,

- developing and implementing measures to control the spread and suppression of invasive alien species favoring climate change.

It has also been estimated that research for each area of the Ecological network should be a priority since they represent the most valuable areas of Croatia and that the research should encompass:

- determining the state and vulnerability of the ecosystem due to climate change,
- assessment of the sensitivity of target species and habitat types to the impact of climate change,
- restoration of degraded habitats to increase the resilience of the ecosystem to climate change
- restoration of ecological corridors using green and blue infrastructure,
- in accordance with the monitoring results, adjusting conservation and management measures with a view to mitigating of the impacts and increasing the efficiency of adaptation to climate change,
- monitoring of the state and effects of climate change on the goals of conservation and integrity of the ecological network area.

Vulnerability assessment

Croatian biodiversity is currently largely endangered by modifications of natural ecosystems, unsustainable exploitation of natural resources and pollution. The most important climate impacts in this sector are: change in average air temperatures; reducing the amount and changing in spatial distribution of precipitation; the phenomenon of climate extremities and the rise of sea level.

As a consequence, at the habitat level the following is expected: increase in arid areas; reduction, change in share and disappearance of some habitats and species, with the decline in biodiversity and appearance and spread of some alien invasive species, drying out of wetland habitats, submersion of coastal habitats, salinization of land and freshwater habitats by the sea.

Expected main impacts of climate change that cause high vulnerability in the biodiversity sector are:

- Abortion of flowering of plant cryophilic and stenothermical species with shortening of vegetation and reduction of vigour
- Damage to and extinction of populations due to climatic extremities (long-lasting droughts, excessive short time precipitation, stormy winds, excessive sunlight, etc.)
- Spread of thermophilic species range (both positive and negative) due to an increase in average air temperature
- Reduction of turgor and vigour, drying and extinction of hygrophilic species due to decrease in quantity and change of precipitation schedule
- reduction of the surface and disappearance of habitat types that depend on water regime (eg mires, forests of common oak, damp meadows ...)
- Spread of xerofilic species range (both positive and negative) due to decrease of quantity and change of precipitation schedule
- Reducing populations of forest species due to frequent fires caused by increased average air temperature and reduced and unevenly distributed precipitation
- changes in living conditions and composition of living communities in freshwater, marine and mountain ecosystems
- Reduction and disappearance of freshwater species of the Adriatic basin due to salinization of coastal habitats caused by sea level rise

- Sea species spreading to the north and the appearance of thermophilic (tropical) alien invasive marine species due to rising sea temperature

6.2.6. Health

Overview of existing research

The largest number of relevant research conducted in the health domain relates to monitoring and interpretation of aeroallergen distribution in Croatia. A statistically significant and positive correlation between the pollen concentrations of all species and medium daily temperature values has been confirmed as well as a statistically significant and negative correlation between pollen concentrations of all species and precipitation only for the City of Zagreb and Zagreb County.

A review of published publications in Croatia shows a continuous increase in the number of vector-related research due to climate change impact on their distribution. For example, a group of authors was assessing the risk of mosquito-transmitted diseases in relation to climate change. The work is based on the results of the mosquito collection in Croatia from 2004 to 2007 and points to the risk of transmitting diseases for which mosquitos represent their causative agent vector, in a very short period of time from the records of the species in Croatia [48]. Furthermore, another study had the main objective to examine and determine whether the changes in temperature influence seasonal and spatial distribution of tickling meningoencephalitis (TME) and clinical peculiarities of the disease in the Koprivnica-Križevci County area [49].

Fewer research relates to food contamination due to environment factors influenced by climate changes while the least research is conducted in the area of life quality and mental health. In Croatia, the results of the study on the impact of meteorological conditions on the number of admissions in emergencies with symptoms of cardiovascular diseases have been published. Research in the field of impact on quality of life and mental health has been published primarily those under the influence of climate change and migration.

One of the studies analysed the correlation between mortality and environmental temperature in the cities of Osijek, Zagreb, Rijeka and Split as representative locations in four Croatian climatic regions. It was concluded that, although the population in a given area develops adaptation mechanisms, the excessive flow of mortality follows a predictable pattern and is significantly affected by the duration of the extreme weather event and the climatic characteristics of the area. The study also defined adaptation measures [50].

In Croatia, research on a very large number of respondents is missing, which is a very important factor in evaluating the relevance of the results obtained. The continuation of this kind of research would give additional input and value to research.

Estimation of data needed and guidance for scientific research

Recommendations for further research within the health sector refers to the following topics:

- impact of climate-meteorological conditions on the number and causes of emergency admissions, hospitalization, illness and mortality, quality of life and mental health
- impact of climate-meteorological conditions on the growth and development of bacteria, viruses, molds and other microbiological and chemical factors during breeding, production, storage, distribution or preparation of food
- influence of climatic-meteorological conditions on growth and development of water pathogens for human consumption, recreational waters, surface, underground and other types of water
- influence of sectorial priority climatic parameters on the distribution and life cycle of vectors such as mosquitoes and ticks and the influence of these parameters on factors of pathogen development (viruses, bacteria, etc.) in these animal vectors
- influence of climatic parameters on human organism load with environmental factors related to climate change

Vulnerability assessment

Vulnerability in the health sector is most likely to be manifested by an increase in the number of people with acute and chronic illnesses, i.e. increased mortality due to extended periods with high air temperatures; increased illness of vector diseases; increase in respiratory disease due to increased allergenic pollen in the air, etc.

Increase of average temperature and precipitation effects distribution of vector diseases. For example, average temperature increase accelerates mosquito development, number of bites and incubation period during the development life cycle of a virus within the mosquito while on the other hand increase in precipitation increases the number of reproduction suitable locations of vectors, such as mosquito.

Considering health sector vulnerability caused by aeroallergens' impact on acute diseases occurrence and deterioration of chronic diseases at population level, an important adaptation direction assumes stakeholder networking, fusion of results of different environmental monitoring and establishment of tools, such as simplified cartographic illustrations and traffic light displays.

Lower drinking water health safety for human consumption can be expected due to lower availability and increased utilization of resources. The impact of climate conditions is important due to indirect impacts on surface waters and water for recreation, especially in the case of improperly organized supply or drainage systems (waste and drainage water). The impact of seawater on health is significant not only because of the rise in sea temperature and, for example, the growth of toxic algal blooms, but also because of the eutrophication processes due to the large amount of organic matter that comes into the marine ecosystem with human activity.

Climate change will have a significant impact on food security, i.e. availability, distribution and consumption of food. The increase of the acute infections of the digestive system incidence may be expected. Increase in the share of chronic disorders such as endocrine diseases and digestive diseases such as cancer and chronic diseases like Crohn's disease, ulcerative colitis, etc. is also expected. The reduced level of food safety due to microbiological or chemical contamination, as a result of changed macro-climate and microclimate conditions, presents significant vulnerability and future burden on the health system. Contrary to the negative consequences described above, and due to the expected reduction in the period of low air temperature and snow cover (snow water equivalent), lower mortality is expected, i.e. a lower number of sudden deaths due to low temperature effects on health. As the climate model for both future periods predicts a reduction in the amount of snow water equivalent, i.e. the amount of water that would occur in the event of instant snow melting, an impact on reducing the number of injuries and more efficient diagnosis and injury therapy due to the reduction of the occurrence and duration of extreme snow precipitation is possible.

Following abovementioned, expected main impacts of climate change that cause high vulnerability in the health sector are:

- Increased mortality of the population
- Change in epidemiology of chronic non- infectious diseases
- Change in epidemiology of acute infectious diseases
- Reduced quality of outdoor and indoor air due to extremely high and low temperatures and precipitation
- More frequent and longer periods of unavailability of safe (health safe and compliant) water for human consumption
- Increased levels of contaminants in the environment
- Impact on epidemiology of diseases related to climatological factors

6.2.7. Energy

Overview of existing research

By browsing publicly available scientific and technical research databases, it is clear that research and research projects on energy sector adaptation to climate change are rarely conducted in Croatia. Significantly more research and scientific projects exist in regards to climate change mitigation, especially regarding energy efficiency and greenhouse gas emission reduction.

Research done so far mostly relates to the impact of climate change on electricity production from renewable sources by exploring the impact of meteorological parameters on production potential and analysing possible scenarios for future periods. For example, in 2013, two studies were carried out, one related to wind power plants (the impact of climate change on wind power generation, in particular the impact of wind speed change on production), the other to hydroelectric power plants (research that most meteorological parameters have on electricity generation from the meteorological parameters to assess the need for electricity generation from hydro power plants with the aim of planning the production and management of the system, as well as determining the potential output) [51] [52]. The paper exploring the possible impact of climate change on the energy generation from renewable energy sources in the Republic of Croatia, such as photovoltaic and wind power plants, as well as hydropower, was carried out in 2012 [53]. The climatic data used in the research are retrieved from the global climate model ECHAM5-MPIOM, and the data are dynamically adjusted to the RegCM regional climate model in DHMZ. The results based on the IPCC A2 scenario for the two future periods, 2011-2040 and 2041-2070, were analysed. It was concluded that climate change could have the greatest impact on renewable energy sources in the coastal part of the country, and an increase in production is expected due to the increase in wind speed, but also reduction of production from hydro power plants. Significant changes in photovoltaic power generation are not expected.

Estimation of data needed and guidance for scientific research

By searching through publicly available scientific and technical research databases, no work has been found on the issue of climate change impacts on the electricity generation or thermal energy production in thermal power plants, on the security of energy supply in general, and on energy consumption.

According to the above mentioned, it is necessary to study the effects of climate change on production, transformation and transmission of energy as follows:

- the impact of climate change and vulnerability of large and small hydropower plants, since future hydroelectric power plants have the largest share in electricity generation in the Republic of Croatia, with particular attention being paid to expected annual and seasonal changes of precipitation (duration, intensity and frequency), increased flood and drought risk, as well as to the reduction of groundwater resources and water resources in general, especially in the coastal area where there most of hydroelectric power plants are situated
- impact of climate change and power plants' vulnerability by analysing the effects of climate change and possible modification of cooling systems so to ensure regular and non-changing production
- the impact of climate change on the power system stability and the security of energy supply - it is necessary to start exploring the impact and risks to the entire energy infrastructure with a special emphasis on the transmission and distribution system
- the impact of climate change on plants' operation powered by renewable energy sources

Vulnerability assessment

Climate parameters directly affect the energy sector in the form of increased or reduced energy resource needs at certain time periods. Climate extremes and natural disasters will significantly disrupt the safe supply of energy. The global rise of temperature in all seasons will increase the cooling energy consumption in the summer and reduce the energy needed for heating in winter. Extreme climate events will negatively affect the production, transmission and distribution of energy. Decreasing of precipitation in the summer period will lead to a reduction in the hydroelectric power plant contribution, while increasing the need for electricity in the summer months. By reducing the amount of precipitation, there will be a problem with the thermal power plant cooling flow system, which will also negatively affect the generation.

Hence, expected main impacts of climate change that cause high vulnerability in the energy sector are:

- Decrease in the production of electricity in hydropower plants due to reduced precipitation by up to 10% in all seasons except winter and consequentially lowered flow rate, numerous dry periods and increased evapotranspiration
- Increase in the consumption of electricity for cooling purposes (higher number of cooling degree days) due to increased average air temperature
- Reduction of thermal energy production in thermal power plants due to increased average air temperature in the winter months
- Decrease in the production of electric and thermal energy in thermal power plants due to insufficient cooling of the plants due to flow reduction
- Damage to power plants and infrastructure due to extreme weather events – ice breaking and floods

6.2.8. Tourism

Overview of existing research

Based on the search and overview of available publications, it can be concluded that, so far, there is a relatively modest number of documents/research dealing with climate change impact on tourism and also on mitigation and adaptation to climate change in the tourism sector. Nevertheless, scientific and professional publications on this topic are increasingly being developed in the last years. For example, in 2016, a research was conducted showing that by 2025 the number of tourists in coastal and mountainous Croatia will increase, while on the number of tourists in the Zagreb region temperature does will have no significant influence [54]. Furthermore, another paper uses the tourist climatic index to quantify the potential of various types of tourism in the Republic of Croatia for the time period of 2011-2040 and 2041-2070 [55]. A group of authors explored the position of Croatia in the context of global climate change. Based on the results of the analysis of long-term climate characteristics in the Republic of Croatia, as well as the relevant predictions of future features of the most important climatic elements, the authors have determined and analysed in detail possible effects of climate change on tourist demand trend in the Republic of Croatia. Based on the findings thus obtained, they proposed adequate solutions in response to the possible negative consequences of climate change, advocating in particular on the combination of the implementation of the mitigation strategy, adaptation strategy and the development of ecotourism in the Republic of Croatia [56].

Estimation of data needed and guidance for scientific research

Given the importance of the tourism sector for the economy of the Republic of Croatia, it is extremely important to intensify research on climate change impacts on the tourism sector and its vulnerability to climate change, identifying key topics as:

- Implications of global climate change on local tourist flows and seasonality
- Economic effects of the destruction of tourism infrastructure caused by climate change
- Implications of climate change on tourism-oriented countries such as the Republic of Croatia (within this topic it is necessary to suggest a tourism product or service that could be offered in the future in order to maintain and increase the tourist share in total international arrivals)
- Further research on the process of climate change impacts and vulnerability and adaptation of the tourism sector to climate change

Vulnerability assessment

Change in climate parameters will have different implications for individual tourist destinations, but they can be both positive and negative. Because of climate change, the further-north regions of Europe could become attractive enough for vacation during the summer months (also due to proximity to western European and northern European guests), and the Mediterranean and the Republic of Croatia could remain attractive (only) in the rest of the year. The tourism sector will be compelled to enrich its offering and to offer higher quality products, which can positively affect competitiveness and guest composition. Favourable climate conditions on the coastal part of the Republic of Croatia in post season and pre-season can positively affect the reduction of seasonal influences and the financial efficiency of tourism in the form of extension of the season. The opportunities for tourism development in mountains and continental areas will increase.

Expected main impacts of climate change that cause high vulnerability in the tourism sector are:

- The tourist offer is not tailored to projected climate change (high temperatures, increased solar irradiance, frequency of extreme weather events, etc.)
- Changing attractiveness of the coastal parts areas and inland areas of the Republic of Croatia
- Damage to and/or reduced functionality of various infrastructure systems (water supply, drainage, beach infrastructure, horticulture etc.)
- Deterioration of the status of ecosystems important for tourism and biodiversity due to the indirect and direct effects of climate change

6.2.9. Spatial planning and coastal area management

Overview of existing research

In Croatia, so far, spatial planners have not conducted scientific research related to vulnerability assessments (spatial units and anthropogenic structures in them – buildings, infrastructure, economic buildings and installations) and climate change adaptation measures that would be planned through spatial plans. Assessments of vulnerability to climate impacts, in the area of spatial planning and anthropogenic structures within them, are also not part of spatial plan development practice nor are vulnerability assessments for the purposes of the strategic environmental impact assessment for spatial plan. The latter indicates that climate change, as a factor in spatial planning, is yet to be positioned. Considering multidisciplinary nature of spatial planning, it should be noted that there are research and professional publications which are formally a result of work in other sector but they are useful and necessary in the development of spatial plans and spatial planning strategic documents.

In 2012, Croatia has ratified the Protocol on Integrated Coastal Zone Management in the Mediterranean and, by doing so, committed to develop a national strategy for integrated coastal zone management and coastal implementation plans and programmes pursuant to the common regional framework. The first Draft of the Strategy for marine environment and coastal zone management of Croatia has been prepared in 2015 based on series of expert background documents [57]. Adoption of the Strategy is expected by the end of 2018.

Regarding coastal area management, project “Integration of climatic variability and change into national strategies to implement the ICZM Protocol in the Mediterranean” financed by the Global Environment Facility and lead by the Mediterranean Action Plan of United Nations Environment Programme that has been implemented between 2012-2015 should be highlighted as an example of capacity building activity for adapting coastal area to climate changes. Within the framework of the project, a comprehensive assessment of the vulnerability of the sea level to the Croatian coast has been carried out including the costs and benefits of adaptation. In addition, the DIVA model and several complex models to integrate sea level scenarios, socioeconomic scenarios, impact assessments based on natural and socioeconomic parameters (population and property), sea level damage and adaptation costs for selected measures (coastal patches and walls, beach replenishment). Extreme sea levels include a general sea level rise and are used to estimate exposure to flooding as the most significant impact of climate change in the coastal area of the Republic of Croatia. The damage estimates are quantified through several indicators such as the number of inhabitants living in the area below the extreme sea level, the spatial coverage of the largest floodplains etc. One of project’s results is the “Integrated Coastal Zone Management Plan (ICZM) for Šibenik-Knin County” which has also been officially adopted by the County. Namely, the coastal area of this county, and particularly the wider area of Šibenik, is the so-called hot spots of the

Adriatic part of Croatia. Within the project, other publications such as "Local Assessment of Vulnerability to Climate Variability and Change for Šibenik-Knin County Coastal Zone" have been prepared.

In 2008, a special research included sea level measurement analysis at four locations at the eastern Adriatic coast in the past 40 years. The results of the analysis showed, as a result of local altitude rise or lowering due to tectonic disorders, an increase between 0.53 and 0.96 mm / year or a decrease between 0.50 and 0.82 mm / year. The estimation of the impact of the assumed sea level rise of 20 and 86 cm in the coastal area is made by an expert assessment method due to lack of adequate quantitative data. It is estimated that in most part the coast is not susceptible to presumed changes. However, some important places, such as the historic centres of some cities, the Neretva River valley and the Vransko Lake on the island of Cres, can be significantly threatened. The paper provides the first very framing guidelines for adaptation to sea level rise as well as other measures to strengthen adaptation capacity [58].

Estimation of data needed and guidance for scientific research

Preliminary priorities for future research, related to the needs of spatial planning and coastal area management, include:

- Improvement of the impact and damage assessment caused by sea level rise for the Republic of Croatia using more accurate data at all stages of modelling, both at the level of the entire coastline and in particular for the most vulnerable areas identified in the previous assessments
- Development of national capacities for the development of future integral assessments and development of models such as DIVA with emphasis on their local application
- Implementation of periodic assessments of settlement vulnerability to the occurrence of heat islands and extreme precipitation including research on correlation between typology of urban physical structures and vulnerability to heat islands as well as extreme precipitation in order to identify optimal options for adaptation measures and better understanding of the importance of adaptation measures in the spatial planning domain compared to adaptation measures for other sectors related to vulnerability to extreme weather conditions in settlements
- Analysis of spatial planning documentation in relation to coastal vulnerability assessments of climate change aimed to have an insight into number of conflict situations where interventions are planned in areas of increased vulnerability that will be exposed to adverse impacts of climate change (possible realization through research of possibilities for strategic impact assessment process improving for spatial plans and the Spatial Development Strategy of the Republic of Croatia)

Vulnerability assessment

Spatial planning and management of the coastal area, including partially the management of the marine environment, has a dual function. On the one hand, it has an integrative function in the planning of spatial development and land use and sea area use, while on the other hand, it deals with quite specific measures that are in the function of adapting the built environment to climate change. In addition, it should be noted that spatial planning plays an extremely important role in reducing the effects of climate change, as changes in the land use (for example, from agriculture or forests to construction or change of forests into agricultural land) are considered to be the most important causes of increase of greenhouse gas emissions. This cross-sectoral activity also includes islands, which represent a particular geographic and problematic area.

The average sea level rise estimates on the Croatian coast range from 0.32 m to 0.65 m by year 2100, with recent estimates increasing the value to 1.1 m. When these are joined by the effects of intermittent extreme sea levels ranging from 0.84 m to 1.15 m, extreme intermittent sea levels occurring at the end of the century will be in the range of 1.4 m to 2.2 m. Temperature rise is the most probable aspect of climate change, which among other things, is manifested by the growth of a number of days with a temperature higher than 35 ° C. The largest increase, from 3 to 5 days by 2040, is expected in most of northern Croatia, in the part of the northern Primorje and in the part of the middle of Dalmatia, where this increase is locally more than 100% compared to today's climate. In the period 2041-2070, a further increase of the same parameter is expected from 7 to 10 days in the same areas. Such extended periods of extreme temperatures influence the increased development of heat islands in urban environments. The projected change in the total amount of precipitation is different for different regions and different seasons. A slight increase is expected in the number of days with extreme precipitation in the fall and winter in the southern regions, particularly in the central and southern Adriatic. Larger quantities and irregular incidence of heavy precipitation affects the existing and planned infrastructure for collecting and draining of precipitation waters.

Expected main impacts of climate change that cause high vulnerability in the domain of spatial planning and coastal area management are:

- flooding in settlements due to rise and extreme sea levels as a result of extreme weather conditions and general rise of the mean sea level (high vulnerability)
- the occurrence of heat islands in settlements due to the influence of extreme temperatures, in particular the increase of hot days and days with temperatures above 35 °C (medium vulnerability)
- flooding in settlements as a consequence of the higher incidence and intensity of extreme weather conditions that characterize large amounts of precipitation in the short term (medium vulnerability)

6.2.10. Risk management

Overview of existing research

By reviewing published professional and scientific work done in regard to impact, vulnerability and adaptation in disaster risk management, aimed to build capacities related to climate change adaptation, revealed that the work is largely descriptive. Publications mostly address risk assessments and provide overview of decision, informing and monitoring system capacities i.e. primarily define informing algorithms in cases of emergencies and disasters. Crisis management plan related to human and animal food security is one of the good practice examples adequately defining also other aspects such as extraordinary measures financing. However, research on risk management and risks during specific disasters and emergency events is lacking and more evaluation including financial and other management success parameters aimed to determine well-founded selection of management is needed.

A research that can be highlighted is, for example, a work related to the Sava River floods 2014, where climatic and hydrological conditions, in which floods occurred in early 2014, were presented. Work suggests the inevitability of the flood, the need to change the attitude towards floods, and the need to invest more energy to reduce the damage caused by floods. It was found that technical, construction measures to prevent floods do not guarantee absolute safety and should not remain the only measure in the struggle against the harmful effects of water [59]. Furthermore, the research specifically provides an overview of the resilience capacity of specific facility types of major importance during natural disasters. The published data provide guidelines for future capacity assessment and other strategic objects and processes in relation to threats due to expected climate change. A review of the situation in Croatia and Serbia provided recommendations and tools to raise the health care institutions' capacity and strengthen the health sector's resilience, and indirectly other, in the case of natural disasters [60].

Estimation of data needed and guidance for scientific research

Recommendations for further research in the risk management domain include:

- Research of priority environmental impacts related to climate change through the networking of separated systems and the establishment of a unique database of indicators and results obtained during regular national or local monitoring or scientific research
- Strengthening the function and importance of Croatia's risk mitigation platform and a unique database of indicators, threats, damages and losses in order to research and compare analysis results prior to and after emergencies or disasters for the purpose of assessing vulnerability, threats and best structural and non-structural risk management measures associated with climate change
- Establishing multidisciplinary priority guidelines and exploring the effectiveness of applying algorithms for actions related to climate change
- Research on community loads after exposure to priority climate-related risks, through integrated monitoring of environmental impact indicators on health in environmental and human samples

Vulnerability assessment

The current readiness of the civil protection system in the area of response was assessed as high, while readiness in the area of prevention was assessed as low, which is in line with the actual situation given the insufficient scope of investment. A positive example of professionally directed multidisciplinary preparation of a strategic document adapted to the direction of future adaptation to climate change is the development of the "Disaster Risk Assessment for the Republic of Croatia", a document adopted by the Government of the Republic of Croatia in November 2015. In this national strategic document, the impact of climate change on each individual risk has been estimated. Negative impacts of climate change have been reported for nine out of the eleven identified risks.

Disaster Risk Management is defined as undertaking of preventive and planning activities aimed at reducing vulnerability and mitigating the adverse effects of disaster risks. Climate change can increase the risk of emergence and intensity of catastrophes (risk potential). The main expected impacts that cause high or medium vulnerability in this sector are: landslides; open type fires due to extended periods of high solar irradiance and extended periods of high air temperatures; extreme temperatures due to extended periods of high solar irradiance and extended periods of high air temperatures; pandemics due to the effect on the transfer of diseases or the characteristics of diseases caused by precipitation levels, humidity and evaporation rates and complex risks particularly in urban areas.

In Croatia, the particular vulnerability of the risk management system is insufficient support in the implementation of internationally recognized guidelines, priority actions in risk management and sustainable development with active inclusion and partnership of all stakeholders in accordance with the Sendai disaster risk reduction framework 2015- 2030.

Following abovementioned, expected main impacts of climate change that cause high vulnerability in the domain of hydrology, water and marine resources are:

- Open-type fires due to extended periods of high solar irradiance and extended periods of high air temperatures
- Epidemics and pandemics due to the impact on the manner of transmission of diseases or the features of diseases caused by changing precipitation, humidity and evaporation rates
- Increased scope of community health and socioeconomic burden due to environmental contamination after risks such as flooding or landslides

6.3. CLIMATE CHANGE ADAPTATION MEASURES PER SECTOR

Lack of knowledge in planning adaptation measures in all sectors represents the main obstacle for successful climate change adaptation. Key support in approaching the issue of reducing climate change vulnerability refers to building knowledge base and capacities to observe and analyse data, information exchange mechanisms and development of local and sectoral specific action plans for climate change adaptation, risk prevention plans and management on national, regional and local level. The development of required ICT tools (geographic information systems – GIS, detection and monitoring systems, early warning systems, risk and assessment mapping) represents a necessity and its crucial to enable related development. Given aforementioned, one of the priorities is to ensure continuity of research activities.

Furthermore, Ministry's priority activity is strengthening the strategic frame for climate change adaptation on local and regional level. Integration of climate change and climate change adaptation into the planning process will be accomplished through the development of action plans for climate change adaptation on local and regional level, development of action plans for climate change adaptation of vulnerable sectors, integration of adaptation measures in strategic and development documents, preparation of plans for prevention of climate change impacts in climate change vulnerable sectors and through the development of methods and standards for implementation of adaptation measures. Also, one of the necessary measures is strengthening of local and regional governments and other relevant national, regional and local stakeholders regarding climate change adaptation.

Draft Climate Change Adaptation Strategy in the Republic of Croatia for the period to 2040 with a view to 2070 (White Book) and other related background documentation analysed certain sectors from an aspect of impacts and challenges causing certain level of vulnerability as well as from an aspect of possible responses do reduce high vulnerability.

6.3.1. Hydrology and water resources

Possible responses to reduce high vulnerability in the sector Hydrology, water and sea resources management are as follows:

- Strengthening the research and management capacities to assess the occurrence and risk of adverse impacts of climate change and adaptation of freshwater and marine water systems
- Construction, reconstruction and upgrading of existing systems for protection against harmful effects of water, water use systems (multi-purpose systems, water supply, energy, irrigation, etc.) and water protection in new (future) climatic conditions
- Strengthening the resilience of coastal water-communal infrastructure against the possible impacts of climate change
- Applying an integrated approach to water resources and systems management and intensifying of cross-sectoral observations and activities
- Strengthening the protection of natural water and maritime systems, particularly protected areas, from the adverse impacts of climate change and their adaptation

6.3.2. Forestry

Recognized possible responses to reduce high vulnerability in the Forestry sector include:

- Establishment of cross-sector monitoring of forest ecosystem status as a prerequisite for informed planning and implementation of adaptation measures
- Developing recommendations for mitigating the adverse impact of harmful organisms under the influence of climate change
- Identification of species and provenance of forest trees that are genetically best adapted to the influence of climate change and are of economic significance
- acquainting participants in the forest sector about the impact of climate change on forest ecosystems, vulnerabilities, risks and possible adaptation measures
- Establishment of green infrastructure in larger urban areas
- Strengthening of the fire protection capacity

6.3.3. Agriculture

Possible responses to reduce high vulnerability in the Agriculture sector encompass:

- Strengthening the capacity to understand and implement climate change mitigation measures
- Increasing the absorption capacity of soil for water on agricultural land
- Conservation oriented soil treatment
- Breeding of species, sorts and breeds resistant to climate change
- Irrigation of agricultural land
- Construction of water accumulations
- Application of anti-erosion measures

6.3.4. Land covered with natural vegetation and Livestok

Land covered with natural vegetation and within that context possible responses to reduce high vulnerability have not been specifically defined by the the Draft Adaptation Strategy of Croatia but are rather represented as part of other sectors (agriculture, forestry, biodiversity). Regarding livestock, possible response to reduce high vulnerability is already presented in Agriculture sector through breeding of breeds more resistant to climate change.

6.3.5. Biodiversity and natural terrestrial ecosystem

As possible responses to reduce high vulnerability in the Biodiversity sector the following has been recognized:

- Strengthening awareness of the importance of natural ecosystem services and their impact on all aspects of life and economy
- Defining habitats and species most vulnerable to climate change consequences
- Defining the zero state and establishment of monitoring for the most vulnerable habitats and biodiversity
- Preservation of habitats and species susceptible to climate change
- Defining measures to reduce the spread and limit alien invasive species populations
- Reduction of anthropogenic impacts on natural ecosystems, primarily via sustainable development measures
- Implementation of integrated management of freshwater ecosystems
- Strengthening the capacity of research institutions and responsible authorities to manage natural ecosystems and biodiversity
- Providing an economically stimulating regulatory environment for the implementation of planned projects (tax reliefs, funds withdrawal platform, investment aid etc.)

6.3.6. Coast and coastal area

Possible responses to reduce high vulnerability in the Coastal area management domain are interconnected with spatial planning and hence already included within that domain.

6.3.7. Marine ecosystems and fish resources

Recognized possible responses to reduce high vulnerability in the Fishery sector encompass:

- Strengthening the capacity for predicting the future status of bio resources
- Development of techniques and tools for exploiting alien species
- Strengthening research capacities in the field of selective breeding, feeding of fish and breeding in recirculation systems
- Increased resilience of aquaculture to reduced flow of water, change in physicochemical parameters of water and occurrence and spread of diseases
- Mitigating negative impacts of climate change by applying integrated forms of aquaculture

6.3.8. Human health

Possible responses to reduce high vulnerability in the Health sector include:

- Strengthening the competence of the health system in climate change impacts on health
- Strengthening the competence of the health system as the response during future adaptation
- Determination of sectoral priorities of climate change related activities
- Extension of monitoring system of health and environmental indicators related to climate change and risk assessment

6.3.9. Energy

Recognized possible responses to reduce high vulnerability in the Energy sector are:

- Strengthening the capacity for climate hazards impact assessments, risk prevention, readiness measures and outstanding events responses
- Increasing the resilience and flexibility of the existing power system to the impacts of extreme and climate hazards and expected climate change
- Increasing the transmission and distribution grid's resilience to the impacts of extreme and climate hazards and expected climate change
- Increasing the security of electricity supply in the summer
- Providing an incentivizing legal framework for the use of renewable energy sources with the aim of diversifying sources and increasing decentralized production of electricity and thermal energy

Draft Climate Change Adaptation Strategy for the period for the period to 2040 with a view to 2070 (White Book) also analysed tourism, spatial planning and risk management domain, from the aspect of impacts and challenges causing certain level of vulnerability to possible responses to reduce high vulnerability. Possible responses to reduce high vulnerability in three mentioned sectors are presented further on.

As possible responses to reduce high vulnerability in the sector Tourism, the following has been identified:

- Adaptation of the tourism sector to changed operating conditions due to climate change impacts
- Harmonization of tourism activities with projected climate change
- Strengthening the competence related to adaptation to climate change of all people directly related to the tourism sector
- Inclusion of climate change adaptation measures in all segments of sustainable Croatian tourism
- Inclusion of climate change adaptation measures in all segments of sustainable Croatian tourism
- Revitalization of tourist offer in the entire territory of the Republic of Croatia and exploitation of up-to-now insufficient or unused potentials

Possible responses to reduce high vulnerability in the Spatial planning and management of the coastal area domain refer to:

- Improving the information base as a foundation for making rational decisions related to planning of climate change adaptation measures
- Capacity strengthening within the spatial planning system with the aim of integrating adaptation measures into spatial planning and management of coastal areas
- Integrating of the adaptation measures into the spatial planning system
- Application of spatial planning measures to programs and rehabilitation projects of the most endangered areas/locations
- Raising of public and decision-makers' awareness in planning of climate change adaptation measures

Possible responses to reduce high vulnerability in the Risk management domain encompass:

- Strengthening the competences of key participants in managing climate change risks
- Strengthening capacities for management and recovery after the risks related to climate change
- Establishing of multidisciplinary priority guidelines for climate change management.
- Expanding the risk tracking and risk assessment system using climate change risk monitoring tools
- More effective remediation of damage as a consequence of climate change risks
- Modification of the community's burden after exposure to climate change related risk

7. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

Article 4, paragraph 3 of the Convention stipulates that the Parties to the Convention which are developed and other developed parties included in Annex II shall provide new and additional financial resources to fully meet the costs incurred by the developing country Parties in meeting their obligations under Article 12 Paragraph 1. They shall also provide financial means, including those for the transfer of technology required by developing country Parties in order to fully comply with the costs incurred for the implementation of the measures covered by Article 4, paragraph 1 of the Convention.

In this sense, the Law on Air Protection stipulates the use of revenues from the greenhouse gas emissions auctioning, including the financing of mitigation measures for climate change and adaptation in third countries. The development of the Plan for using of these funds is also stipulated and it should be adopted by the Government of the Republic of Croatia.

7.1. FINANCIAL RESOURCES

By the decision on the adoption of the Plan for the use of financial resources obtained from the sale of auctioning revenues in the Republic of Croatia by 2020 (OG 19/18), funds for financing projects in third countries are planned.

7.2. KNOWLEDGE AND TECHNOLOGY TRANSFER

As an Annex I country, the Republic of Croatia has so far not pursued separate activities related to the financing of transfer of knowledge and technology in the field of environmental protection to developing countries. In accordance with the Plan for the use of auctioning revenues in the Republic of Croatia by 2020, the Bilateral Assistance Program for Third Countries in the Area of Climate Change for the period 2018-2020 is being drafted, whose adoption is planned during 2018 and the application since 2019.

It is important to note that as the most recent EU member state with recent experience in the transposition and implementation of EU environmental legislation, the Republic of Croatia is participating in the TAIEX assistance program, with which Croatia is involved in the transfer of knowledge and experience to potential candidate countries for membership in the EU, which are also non-Annex I states (e.g. Bosnia and Herzegovina, Montenegro, Serbia, Albania).

As part of the transfer of knowledge, the Republic of Croatia also participated in the project "Regional Network for Environment and Climate - ECRAN" (2013 - 2016). Given that the project's task was to continue working on linking and transferring knowledge and experience in the field of environment and climate between the countries in the region, experts from the Republic of Croatia were involved in the implementation of the project on "soft" technology transfer from the field of climate change.

8. RESEARCH AND SYSTEMATIC OBSERVATION

8.1. GLOBAL CLIMATE OBSERVATION SYSTEM

Global Climate Observation System (GCOS) was established in 1992 and the Republic of Croatia, represented by the Meteorological and Hydrological Service, has been its member since then. This system includes observations in all parts of the climate system – in the atmosphere, ocean, sea and land. It is intended to define and cover all the observations required for monitoring the climate system including satellite observations at the global, regional and national levels, and to create conditions for observation enhancement.

Global Earth Observation System of Systems (GEOSS) is a new initiative taken with the objective to co-ordinate and enhance all current observing systems at the global level in support of the requirements of user areas: natural disasters, health, energy, climate, water, weather, ecosystems, agriculture and biodiversity. The Republic of Croatia joined the GEOSS in 2004.

8.2. RESEARCH

8.2.1. General policy on and funding of research and systematic observation

- The Croatian Science of Foundation (HRZZ) is responsible for research funding in Croatia.
- Meteorological and Hydrological Service (DHMZ) performs climate research on regular basis; it is public authority for meteorology and hydrology, and it is acreditised as a scientific organisation. The DHMZ research is financed primarily from the state funding (Ministry of Environment and Energy), and partly by HRZZ and EU funds through different research projects.
- Climate research projects funded by HRZZ are generally in the partnership of DHMZ with other relevant institutions and faculties in Croatia: University of Zagreb – Department of Geophysics, Faculty of Agriculture (AF), Faculty of Forestry; Institute of Oceanography and Fisheries (IZOR), Faculty of agriculture in Osijek, University of Rijeka - Faculty of Engineering; Croatian Forest Research Institute, Croatian Center for Agriculture, food and rural affairs (HCPHS), Institute for agriculture and tourism Poreč (IPT) and The Institute of Economics (EI)
- DHMZ contributes to the State of Environment report issued every four years and coordinated by Croatian Agency for the Environment and Nature (HAOP). It is an indicator-based report aimed at monitoring the objectives of the Environmental Strategy and Action Plan.

8.2.2. Research

In DHMZ, significant efforts are made with regard to the research related to climate studies and climate change. The results of the studies are published in international scientific journals and the results are further implemented in practice for endusers' needs. In addition, one of the main goals of the past and ongoing research projects is to prepare the basis for action and future climate change policy.

Some of the relevant projects:

Croatian climate variability and change — from global impacts to local green solutions (CroClimGoGreen)
Funding: *Croatian Science Foundation*
Duration: *February 2018 – February 2023*

Installation research project will be dealing with local and global effects on urban climate and urban heat island (UHI) mitigation. Research will comprise UHI detection and analysis of UHI characteristics for Zagreb based on data measurements and urban heat load modelling using MUKLIMO_3 model. Urban climate characteristics will be analyzed in current and future (warmer) climate conditions. Impact of changes in city infrastructure on UHI will be estimated, as well as efficiency of certain climate change mitigation measures, i.e. green and blue infrastructure mitigation measures. Climate variability and climate change in Croatia will be analyzed in the context of climate of Europe influenced by global and regional processes.

Viticulture and climate change in Croatia (**VITCLIC**; http://www.pmf.unizg.hr/geof/en/research/climatology/vitclic)
Funding: Croatian Science Foundation
Duration: April 2017 – March 2019

One of the aims is to combine the data on maturation on a grape quality with agroclimatic indices based on the meteorological data for the past and current climate and on projections for future climate. Based on the assessment of indices, regions of Croatia suitable for growing of specific grapevine cultivars will be determined and will be used for the decision of the new plantations. Obtained results will be a base for the adaptation strategy of grapevine growing technology (irrigation, ampelotehnics, rootstocks, etc.) on prevailing climatic condition. The project is coordinated by the Department of Geophysics, Faculty of Science, University of Zagreb, while DHMZ, AF, HCPHS, IPT and EI have been engaged.

The Adriatic decadal and interannual oscillations: observations, modelling and consequences (**ADIOS**; http://jadran.izor.hr/~vilibic/ADIOS/)
Funding: Croatian Science Foundation
Duration: March 2017 – March 2021

The major objective of the ADIOS project is to investigate and to quantify processes driving interannual to decadal thermohaline variations in the Adriatic-Ionian basin. This objective will be achieved by (i) documenting interannual to decadal variability from long-term oceanographic series and existing climate models, (ii) investigating short- and long-time processes that drive the Adriatic-Ionian thermohaline circulation, primarily the Adriatic dense water formation and the BiOS (Adriatic-Ionian Bimodal Oscillating System), and (iii) assessing past and future Adriatic climate and variability from the Adriatic-adopted high-resolution atmosphere/ocean climate model runs. The project is coordinated by the Institute of Oceanography and Fisheries, while several national and international research institutions have been engaged.

Drought Risk in the Danube region (**DriDanube**; www.interreg-danube.eu)
Funding: Danube Transnational Programme
Duration: January 2017 – June 2019

The main objective of the project is to increase the capacity of the Danube region to manage drought related risks. The project aims at helping stakeholders involved in drought management to improve the drought emergency response and prepare better for the next drought. These goals will be achieved by producing the new monitoring tools and the strategy for drought risk assessment. DHMZ is the partner for Croatia and its associated partner is the Ministry.

A pan-European framework for strengthening Critical Infrastructure resilience to climate change (**EU-CIRCLE**; http://www.eu-circle.eu/)
Funding: EU Horizon2020 programme
Duration: June 2015 – May 2018

The aim of this project is to develop methodology needed for the documentation, monitoring and prediction of the weather and climate extreme impacts on critical infrastructure. The task of DHMZ was to analyse and adapt available results of the various types of the climate information (global and regional climate model, regional and local models for the extreme weather events, available observational datasets). The three partner institutions from Croatia are in the project: DHMZ, The University of Applied Sciences Velika Gorica and National Protection and Rescue Directorate (DUZS).

Climate Change Adaptation Strategy (http://prilagodba-klimi.hr/)
Funding: EU Transition Facility
Duration: May 2016 – November 2017

DHMZ provided expert and technical support for the purpose of the project "Strengthening the Capacity of the Ministry of Environment and Energy for Climate Change Adaptation and development of the Draft Strategy for Climate Change Adaptation". DHMZ task was to perform a large ensemble of regional climate model simulations for the period 1971-2070 and support the analysis of the projected climate change on the vulnerable impact sectors. This was done in close collaboration with the University of Zagreb Computing Centre (Srce).

Climate of the Adriatic REgion in its global context (**CARE**; http://www.pmf.unizg.hr/geof/znanost/klimatologija/care)
Funding: Croatian Science Foundation
Duration: July 2014 – June 2018

This project explores the climate system over the Adriatic region, governing processes in atmosphere and ocean and their interaction. The project is based on observational data as well as on climate modelling of the past and projection of the future climate, and it utilizes state-of-the-art methods of data analysis and modelling. Particular attention was paid to the analysis of drought, floods and heat waves as well as the change in climate suitability for tourism. The obtained gridded fields became a reference data for the validation of climate models and an input into the flash-flood warning systems. This project is realized with the collaboration with Department of Geophysics, Faculty of Science, University of Zagreb

Climate Local Information in the Mediterranean region Responding to User Needs (CLIM-RUN; http://www.climrun.eu/)
Funding: European Commission
Duration: March 2011 – February 2014

The main objective of the project was to establish an effective exchange of information between the science and stakeholder communities that is especially important for regions that are particularly vulnerable to climate variability and change such as the Mediterranean. To that issue, DHMZ in the partnership with UNDP Croatia was focused on the activities related to two sectors that are directly and indirectly affected by climate issues: energy and tourism.

8.3. DATA COLLECTION AND SYSTEMATIC OBSERVATIONS

8.3.1. Existing observation networks

The Republic of Croatia has a long tradition in monitoring of all segments of the climate system. The Meteorological and Hydrological Service (DHMZ – Državni hidrometeorološki zavod) is a national institution for meteorology and hydrology and has been carrying out meteorological observations for operational needs since 1851. Croatian institutions that maintain observing systems in the climate segments of atmosphere, sea and land and biodiversity are:

- Meteorological and Hydrological Service,
- State Institute for Nature Protection,
- Ministry of Maritime Affairs, Transport and Infrastructure,
- Ministry of Environment Protection and Energy,
- Institute for Medical Research,
- Public Health Institute,
- Institute for Oceanography and Fisheries,
- Croatian Hydrographic Institute,
- "Ruđer Bošković" Institute,
- "Andrija Mohorovičić" Geophysical Institute,
- Croatian Forest Research Institute.

Apart from the institutions listed, numerous institutions and sectors of economy run their own systematic or sporadic observations. Table 8-1 shows all stations in Croatia for observation of climate system segments including national contributions to observation of: surface-based and upper-air atmospheric essential climate variables, atmospheric composition, oceanic and terrestrial domain essential climate variables.

Table 8-1: National contributions to observation of: the surface and the upper-air atmospheric essential climate variables, the atmospheric composition, the oceanic and the terrestrial domain essential climate variables

Contributing networks specified in the GCOS implementation plan	**ECVs– Essential climate variables**	**Number of stations or platforms currently operating**	**Number of stations or platforms operating in accordance with the GCMP (Global Climate Monitoring Principles)**	**Number of stations or platforms expected to be operational in 2020**	**Number of stations or platforms providing data to the international data centres**	**Number of stations or platforms with complete historical record available in international data centres**
GCOS Surface Network - GSN	Air temperature	158	120	160	40	40
	Precipitation	366	250	350	40	40
World Weather Watch/Global Observing System (WWW/GOS) of surface network	Air temperature and pressure, wind speed and direction, water vapour, precipitation	40	40	150	40	40
Baseline Surface Radiation Network –BSRN	Sunshine duration	40	40	50	40	40
Sun irradiation and balance of radiation	Surface radiation	10	10	20	5	5
Drafting sea buoys	Air temperature and pressure	0	0	5	0	0
Fixed buoys	Air temperature and pressure	2	2	7	1	1
Voluntary Observing Ship Climate Project – VOSClim	Air temperature and pressure, wind speed and direction, water vapour	5	5	10	5	5
Ocean Reference Mooring Network and sites on small isolated islands	Air temperature, air pressure, wind speed and direction, precipitation	5	5	10	3	3
GCOS Upper Air Network - GUAN	Upper-air temperature, wind speed and direction, water vapour	1	1	1	1	1
Full WWW/GCOS Upper Air Network	Upper-air temperature, wind speed and direction, water vapour	2	2	2	2	2
World Meteorological Organization/ Global Atmosphere Watch (WMO/GAW), Network for Atmospheric CO2 & CH4 and other greenhouse gaseous	Carbon dioxide	1	1	5	0	0
	Methane	0	0	0	0	0
	Other greenhouse gaseous	5	5	10	5	5
WMO/GAW Ozone-sonde network	Ozone	0	0	0	0	0

Contributing networks specified in the GCOS implementation plan	ECVs– Essential climate variables	Number of stations or platforms currently operating	Number of stations or platforms operating in accordance with the GCMP (Global Climate Monitoring Principles)	Number of stations or platforms expected to be operational in 2020	Number of stations or platforms providing data to the internationa l data centres	Number of stations or platforms with complete historical record available in international data centres
WMO/GAW Aerosol Network	Optical depth of the aerosols	0	0	1	0	0
	Other properties of the aerosols	15	15	20	5	5
Global Sea Level Observing System (GLOSS)	Sea level	10	10	15	5	5
Argo Network	Temperature, salinity, current	2	2	5	1	1
GCOS baseline river discharge network	River discharge	300	300	350	50	50
WWW/GOS Synoptic Network	Snow cover	40	40	100	40	40

8.3.2. Modernization of the DHMZ meteorological observation network

Meteorological observations deal with two kinds of data - visual observations of weather phenomena and instrumental data. Some observations began in Croatia in the first quarter of 19th century. Currently, DHMZ is operating mainly manually, i.e. by observers at: 41 main meteorological, 117 climatological, 336 precipitation and 23 rain storage stations (Figure 8.2.2-1). Partially automated weather stations (AWS) are co-located at 32 main meteorological station sites, and 26 non-completed AWS are installed at other locations. Spatial distribution of AWS network is represented in Fig. 8.2.2-1 and temporal evolution of AWS network is represented in Fig. 8-1. Standard measurement time resolution at existing AMS is 10 minutes with the same potential of transmission. Terrestrial observations (such are: soil temperature, soil moisture, pan evaporation, and solar radiation measurements) are co-located at 19 main meteorological stations. DHMZ still takes care of the two radio-sounding systems in Zagreb and Zadar, 2 Doppler S-band + 6 small S-band weather radars and one sodar.

Cost benefit analysis indicates that further development of meteorological observation network in Croatia is justified as investment of 1USD results up to 7 USD benefit for society. Despite a respectable number of meteorological stations cited and data collected there is necessity for serious modernization of existing surface and upper air meteorological network what includes modernization existing and installation of new ones: 34 main meteorological stations, 139 climatological stations, 246 rainfall stations, 5 buoys, 1 wind profiler with radiometric upper-air temperature measurement, 1 lidar and 6 weather radars (Figure 8-3).

A realisation of observation meteorological network started by implementation of EU project „Modernization of National Meteorological Measurements Network in Croatia" (METMONIC) on 1 October 2017 during a 4-year period. The project is one of the priorities of Ministry for Environment Protection and Energy (MZOE) and Meteorological and Hydrological Service (DHMZ) under the EU thematic objective "adaptation on climate changes" in financial period 2014-2020 from which METMONIC is financing by 85 % of total amount costs and by Republic Croatia the rest 15 %.

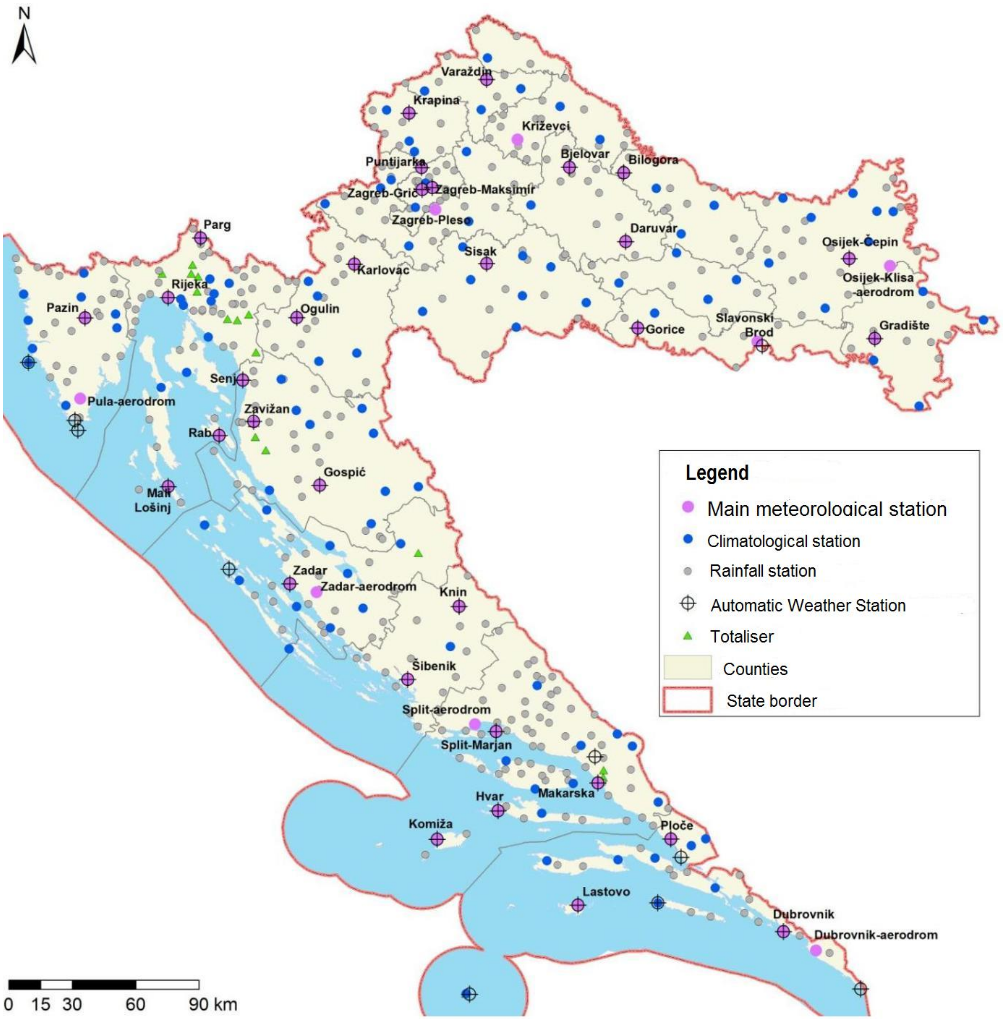

Figure 8-1: Distribution of conventional and automatic meteorological stations in Croatia

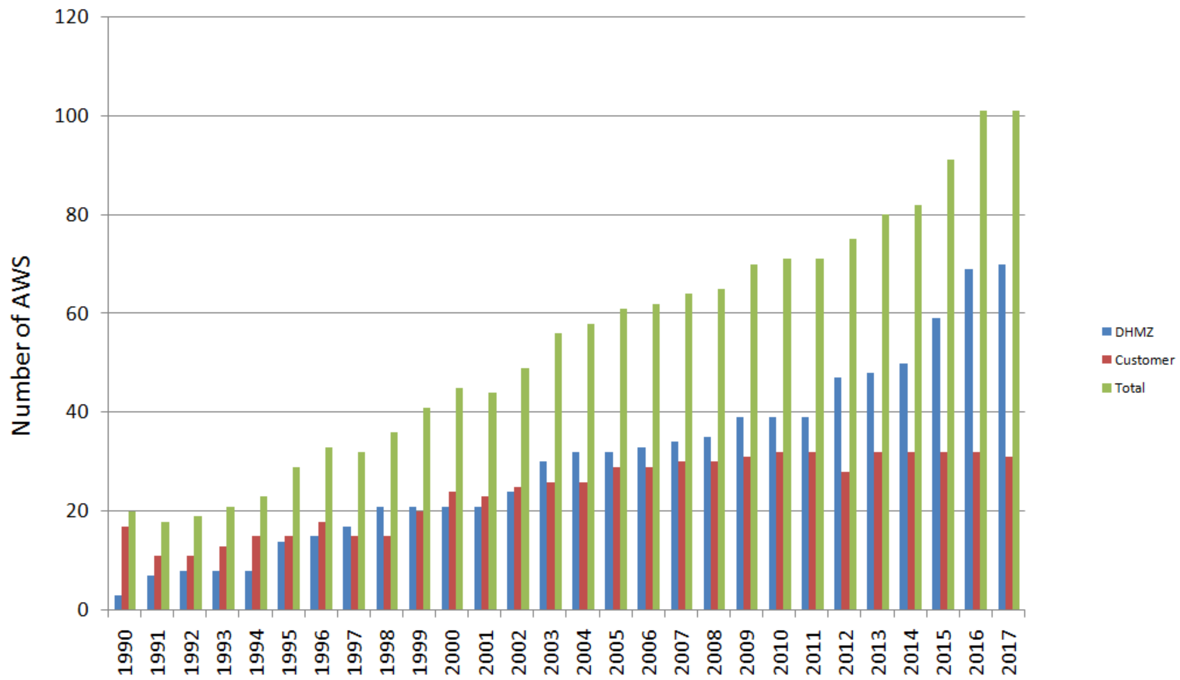

Figure 8-2: Development of AWS Network in Republic of Croatia from 1990 to 2017

Data obtained from the meteorological stations network modernised in this way (both surface and upper air) would serve the numerous purposes such as: monitoring and evaluation of long range transboundary pollutions; analysis and implementation of modelling techniques in terms of geographical distribution of concentration (of emissions) aiming to secure the issue of warning and immediate and appropriate information if necessary when there is a risk to human health from exposure to air pollution, particularly for sensitive groups of the population; climate monitoring and climate change model calibration and testing in order to enable adequate planning and management of human environment and sustainable activity sectors; performing detailed measurements in order to understand better the impact of pollutant and to develop appropriate policies for climate adaptation and mitigation including natural (e.g. floods and droughts) and human disaster risk reduction; renewable energy production purposes etc.

Figure 8-3: Expected modernized meteorological observation network in Croatia cofinanced by European Union fund for the period 2014-2020

9. EDUCATION, TRAINING AND PUBLIC AWARENESS

9.1. INSTITUTIONAL SYSTEM FOR EDUCATION

Sustainable Development Program was introduced in preschool education where young people learn about coexistence with nature and with every man, all with a view to develop a child's ecological awareness. The curriculum for elementary school in the Republic of Croatia prescribes compulsory and elective courses and guidelines for other forms of educational activity in elementary school. Environmental education and sustainable development is a school activity integrated into teaching and other forms of work. Climate change content is included within regular classes in subjects: nature and society, nature, biology, chemistry and geography, as well as numerous extracurricular activities.

From 2011 to 2016, the Republic of Croatia has implemented the Action Plan for Education for Sustainable Development. The objectives of this Plan, which were largely accomplished, were:

1.) Promote and introduce themes of sustainable development into a formal education system (include knowledge and skills, attitudes and values for sustainable development in elementary and high school curricula, promote participative educational methods and improve educational materials as support for the educational process at all levels, integrate the themes of education and training for children in sustainable development in pre-school education programs)
2.) Promote and implement education for sustainable development through informal education (enhance the capacity of stakeholders in local communities for sustainable development, increase skills and knowledge on sustainable development in the business world, enable additional acquisition of knowledge and skills about sustainable development of pupils and students outside formal education)
3.) Promote and enable education on sustainable development through non-formal education
4.) Ensure that the political, regulatory and operational frameworks support the promotion of education for sustainable development
5.) Promote research and development of education for sustainable development and provide access to appropriate tools and materials for education on sustainable development (promote innovative approaches to education on sustainable development)
6.) Strengthen the capacities of educators, teachers and lecturers at higher education institutions on sustainable development and decision-makers for quality decision-making on development issues (strengthening employee competences in the education process, defining competencies for education on sustainable development of educators, teachers, and lecturers at higher education institutions and decision-makers)
7.) Ensure prerequisites for quality education about sustainable development by developing and providing adequate educational materials (provide educational materials for education on sustainable development)
8.) Ensure greater visibility / recognition of the sustainable development principles as a support to social changes efforts.

Environmental and sustainable development projects such as the GLOBE and SEMEP international programs, the Eco School project, the national program Young Nature's Keepers and similar, provide thematic and content framework for environmental education activities, they enable networking with schools with similar interests and provide mutual support and exchange of experiences.

Since 1995, 130 schools in the Republic of Croatia have been involved in the Global Education and observing for the Environment program (GLOBE), whose students conduct regular and continuous measurements and observations in the immediate surroundings of the school. Measurements and observations are carried out in the area of atmosphere, water, soil and soil cover, and the results of the research are complemented and interlinked, thus achieving a complete environmental monitoring program. The use of information technology makes it possible to connect and exchange information between more than 23,000 schools from 111 countries around the world.

The International Eco School is a programm from Foundation for Environmental Education (FEE), recognized as one of the most successful models of environmental education in the world. The National Coordinator and Head of the Eco-School Program is our organization „Lijepa naša“. There are 316 educational institutions in Croatia, 81 kindergartens, 186 elementary schools, 7 COORs, 37 high schools, 2 students and 3 higher education institutions.

Education and Teacher Training Agency maintains annual conferences for biologists, chemists and geographers on sustainable development. The issue of climate change is being tackled in the context of other topics. The Agency promoted in the National Educational Curriculum and Civic Education (in the meantime a curriculum was developed and is in experimental implementation) and competences for sustainable development (according to UNECE). The experts of the Agency have concluded that it is necessary to focus on the development of competences (civic competence, critical thinking, ability to find and evaluate information, clarify values and attitudes, communication, creativity, complex thinking).

9.2. EDUCATION AND RESEARCH ON CLIMATE CHANGE THROUGH PROJECT ACTIVITIES

The number of workshops, seminars, roundtables and various printed publications on the subject of climate change and the related themes are gradually increasing in many Croatian institutions. Here are some of them:

- Based on the"Framework for the Long-term Strategy of Low-Carbon Development of the Republic of Croatia for the period up to 2050" in March 2015, the first introductory conference was held, where an approach to the Low-carbon Development Strategy was presented. The Strategy will be a fundamental document in the area of climate change mitigation, but also the roofing economic, sustainable development and environmental strategy. This strategy will open opportunities for innovation, the transfer of advanced technologies and structural changes to stimulate the growth of the economy. To prepare the Strategy, the professional team of experts consisting of people with various specialties and professions are included. In the preparation the Strategy a number of institutions, universities and individual experts are included, for the energy sector, transport, mining and petroleum engineering, agriculture, economics, sociology, technology development, etc. In the process of preparing the Strategy five sectoral workshops were held - Energy and Industry, Transport, Buildings, Agriculture, LULUCF and Waste management. At the workshops, participants-experts have presented the internal factors (strengths and weaknesses) and external factors (opportunities and threats) that characterize the current situation in the sectors of influence. In addition to the above workshops, working team during the development of the presented the results at conferences, forums and expert meetings.

- The Croatian Agency for Enviroment and Nature (HAOP) was created by merging the Croatian Enviroment Agency and the State Institute for Nature Protection. The agency's activity is the gathering and unification of data and information on the environment and nature in order to ensure the monitoring of the implementation of environmental and nature protection policies, sustainable development and carrying out professional activities related to environmental protection and nature protection. These activities cover the activities of establishing, developing, managing and coordinating information systems in the environment and nature in the Republic of Croatia, developing and maintaining appropriate databases and environmental and nature systems, and providing conditions for access to environmental and nature information, and State of the Environment Report for Republic of Croatia, preparation of data for the preparation of documents and reports related to environmental protection and sustainable development, monitoring and reporting on environmental health status.
- In April 2017, the 20th anniversary of the Croatian Business Council for Sustainable Development (HR PSOR) was celebrated. The topic of the solemn anniversary was the presentation of the Global Sustainable Development Goals (SDGs) and the role of the business sector in their realization.
- Ministry for Environment Protection and Energy, the Climate Activities and Sustainable Development Sector, Climate Activities and Ozone Protection Service and the Sustainable Development Service, are the focal point of the state system in the area of climate change. The Ministry carries out a series of activities related to the implementation of the obligations under Article 6 of the Convention. It is also the competent body for the implementation of the first two pillars of the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (the so-called Arhus Convention). The Republic of Croatia carries out activities covered by this Convention. Officials of the Ministry regularly participate in the work of round tables, public forums, radio and TV shows and lectures for the public.
- In December 2015, the Paris Climate Change Agreement was adopted, and the Republic of Croatia become the full party of the Paris Agreement on 23 June 2017. With the aim of celebrating the entry into force of the Paris Agreement for the Republic of Croatia and raising awareness of its importance and the importance of the obligations arising from it, and also with the aim of strengthening awareness of the sustainable development of the global community through the UN Sustainable Development Agenda up to 2030, one-day professional meeting on the subject: Paris Climate Change Agreement - Challenges and Opportunities was held on June 27, 2017. Representatives of the professional and scientific community, the economy, trade unions, NGOs and all other stakeholders were present at the conference. At the conference were presented the objectives of the Paris Agreement, the related global and EU policies, and the activities that are being implemented in the Republic of Croatia with a view to preventing and mitigating climate change and transition to a sustainable, low-carbon society.A National Advisory on Adaptation to Climate Change in Croatia was held in January 2014, organized by the Ministry of Environment and Nature Protection. The consultation was part of the CroAdapt project, which the Ministry carried out in cooperation with the Regional Environmental Center and the Baltic Environmental Forum from Germany, with the financial support of the German Federal Ministry of Environmental and Nature Protection, Construction and Nuclear Safety.

The CroAdapt project has stimulated a multi-level approach for adapting to climate change through the involvement of all relevant stakeholders in identifying adaptation options and planning the necessary measures. In the 2014-2015 period of the CroAdapt2 project, a series of regional consultative workshops for stakeholders were set up for the purpose of identifying regional and local climate change adaptation options. The project provided expert and technical support to the Ministry of Environment and Nature Protection through the implementation and systematization of results of consultations with local and regional stakeholders through nine regional workshops. Eastern Slavonia has also been recognized as a region of priority for the development and implementation of regional climate change policy, and is part of the activities devoted to strengthening the capacity of local stakeholders for planning adaptation in Eastern Slavonia as a future model region and an example of good practice in other regions. The regional approach of the CroAdapt project has contributed to a stakeholders increased awareness of climate change and adaptation, improved communication on climate change adaptation and a better overview of active local and regional stakeholders. As the most vulnerable sector in terms of climate change, the agricultural sector has been recognized, and as an activity that can begin for the sector, education on climate change and adaptation is immediately underlined. The concept of education was elaborated and a plan for cross-sector cooperation was prepared in this area.[20] In the project, the Regional Climate Change Adaptation Guidelines, the Climate Change Adaptation Bulletin for the wider public, have been prepared and, for the purpose of providing information on the content of the Ministry's climate change web site has been updated.

- With the support of the French Embassy in Croatia and the Ministry of Environment and Nature Protection, in October 2015, the Zagreb Climate Forum (ZCF) was held. This event brought together scientists, policy makers and civil society representatives to promote awareness and discussion in Central and South-Eastern Europe on climate change in all aspects - monitoring, effects, mitigation and adaptation. In addition, it was also a kind of introduction to the UN Framework Convention on Climate Change, in Paris, in December 2015, when a new global climate agreement was adopted. The Panel discussed the expected impact of climate change in Central and South East Europe, the fight against climate change as a political project and on future climate change management on a global scale. Also, workshops were held on climate change in urban areas, South East Europe's transition towards low carbon economy, water and adaptation to climate change and food safety in the context of climate change.
- For the Ministry of Environmental Protection and Energy, from May 2016 to November 2017, the project "Strengthening the capacities of the Ministry of Environmental Protection and Energy for adaptation to climate change and preparation of the Draft Climate Change Adaptation Strategy " has been funded by means of the Transitional Instrument for Technical Assistance of the EU. The purpose of the project was to draw up a draft National Climate Change Adaptation Strategy for the period up to 2040 with a view to 2070 and the draft Action Plan. The project provided assistance in defining vulnerable sectors, impact assessments, and priority measures and activities needed for sectors exposed to climate change to adapt. As part of the project, 10 expert workshops were organized for the sectors (agriculture, forestry, fisheries, ecosystems, hydrology, energy, spatial planning, tourism, health and risk management), 7 workshops for local and regional officials and the interested public and one workshop for knowlage and experience transfer from other countries in the design and implementation of climate change adaptation strategies.

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[20] http://www.mzoip.hr/hr/klima/prilagodba-klimatskim-promjenama/aktivnosti-prilagodbe-klimatskim-promjenama-u-hrvatskoj-/projekt-croadapt2.html

- The program of research and development encouragement activities in the field of climate change for the period from 2015 to 2016 was adopted by the Government of the Republic of Croatia (November 2015). It is the first in a series of planned funding programs for research and development in the area of climate change from the auctioning revenues (Plan of using financial means from the sale of allowances through auctions in the Republic of Croatia for the period from 2014 to 2016). It introduces good practice of linking the policy of reducing CO_2 emissions with the development of 'green' technologies. The Ministry has drawn up a Plan and coordinates the development and implementation of the Program in cooperation with the Ministry of Science and Education, the Croatian Science Foundation and the Fund for Environmental Protection and Energy Efficiency. The purpose of the Program is to contribute to the adoption of policies based on scientific knowledge.
- The "Sustainable Land Management and Climate Change" project, conducted by the Faculty of Agriculture, University of Zagreb, aims at obtaining real data on greenhouse gas emissions from agricultural soil in the Republic of Croatia. The project determined the $C\text{-}CO_2$ emission values from the soil in the atmosphere and explore the effects and dependence of $C\text{-}CO_2$ emissions with fertilization, vegetation, agroecological factors and some chemical and microbiological soil characteristics.
- Development of the study "Effectiveness and sustainability of the system for collecting and recovering substances that damage the ozone layer and fluorinated greenhouse gases with the impact analysis of the Regulation (EU) 517/2014 on Fluorinated Greenhouse Gases in the Economy of the Republic of Croatia", which was developed in 2016 by the Faculty of Mechanical Engineering and the Naval Architecture of the University of Zagreb. The study analyzes the existing system and gives the options for its advancement, which will, in a sustainable and effective manner ensure the treatment of ozone depleting substances and fluorinated greenhouse gases, and at the same time affect the reduction of climate change impact.
- In April 2018, a tender was launched by the Society for Formation of Sustainable Development-DOOR for education programs that will enable students in Croatia to have a better understanding of climate change. A new approach to student education is sought, one that involves building critical thinking and empowerment, practical work, and a model that includes the mechanism of long-term financial self-sufficiency.

9.3. WORK OF PROFESSIONAL INSTITUTIONS AND PROFESSIONAL COMMUNITY TROUGH INFORMING, PUBLIC CONSULTATIONS AND DISCUSSION

There are a number of reputable professional institutions operating in the Republic of Croatia which, over a longer period, conduct continuous informational and educational project activities, education and training of professionals, as well as interested public and economic entities on climate change and specific measures and instruments for mitigating them. The Croatian Chamber of Commerce (HGK), the Croatian Business Council for Sustainable Development (HR PSOR), the Croatian Employers' Association (HUP) and the Croatia Green Building Council should be highlighted here.

In the development of analytical and program documents related to climate change (adaptation plans, mitigation plans, strategies for low-level development, etc.), part of the education and training of the competent public is on the Republic of Croatia. The number of involved members is increased through the work on these documents. The development of these documents with a large participation of the participants is a process of education of educators. Members of this public can then be the carriers of educational activities in various settings and situations in the time that follows.

The project 'Integrating Climate Variability Effects and Changes in Integral Coast Management', funded by the Global Environment Facility (GEF) and the United Nations Environment Program (UNEP), is implemented in eight Mediterranean countries (Algeria, Albania, Montenegro, Egypt, Croatia, Morocco, Tunisia and Palestine). It is conducted by UNEP's Mediterranean Action Plan from Athens (UNEP MAP), with its two Regional Action Centers, the Blue Plan/BP (RAC) from Nice and the Priority Action Program (PAP/RAC) from Split. The project started in January 2012, and completed in December 2015.Within the project, four workshops were held and the last one was held in April 2015.[21]

Within the project, Croatia, along with Tunisia, has been selected as a pilot area for two activities:

1. Estimation of costs due to climate variability and change using the recognized Dynamic Integrated Vulnerability Assessment (DIVA). [22]
2. Developing an Integral Coastal Management Plan with a special focus on climate variability and change. The Integrated Coastal Zone Management Plan (IUOP) is being developed as part of the project for the defined part of the Šibensko-Kninska County, and the particularity of the developing process is the emphasis on climate variability[23] and change and the use of the participatory „Climagine“ method at local workshops where they discussed the vision of future development of the coast.

Both of these plans, the first on the local level in the Republic of Croatia, bring together a competent public, but through the participatory approach they expand the number of members of the public concerned, and indirectly can be considered as educational projects and activities. Learning here goes through practice, as learning by doing.

In November 2015, the Institute for Political Ecology held a conference entitled "Climate Justice" aimed at enhancing the dialogue between natural science researchers dealing with the physical basis of climate change and their impact on natural ecosystems and also social scientists linking these processes with their social effects along with the politics and economics of mitigation and mitigation of climate change.

Specific forms of education related to climate change are, for example, some fairs. Here we highlight the International Renewable Energy Fair in Varaždin, the oldest event of this kind in the Republic of Croatia, which was held for the seventh time in September 2016.

In September 2017 a press conference on the theme of the project "Ready for Climate Change" was held at the Faculty of Educational and Educational Sciences in Osijek, in a dispersed study in Slavonski Brod. The project "Ready to Climate Change" was funded entirely within the large European LADDER project, which co-finances micro-projects at the local level for up to five months, focused on education for development and raising awareness. The LADDER project is based on a DEAR approach (Development Education and Awareness Raising), ie education for development and raising awareness.

[21] https://planbleu.org/sites/default/files/upload/files/Climagine_4_Final_report.pdf
[22] https://pap-hecoastcentre.org/pdfs/DIVA%20Croatia.pdf
[23] https://pap-thecoastcentre.org/pdfs/LAV%20Sibenik.pdf

Its goal is to connect non-governmental organizations and local government units to work together in addressing global issues.

9.4. ACTIVITIES OF NON-GOVERNMENTAL ASSOCIATIONS

The civil sector in the field of environmental protection in the Republic of Croatia, and in particular some associations, were intensively educational and project-oriented in the period 2014-2017. on topics related to climate change. Examples are given below.

Zelena akcija (Green Action-Friends of the Earth Croatia) (ZA)

Green Action (ZA) is a non-governmental,non-profit and voluntary association of citizens for environmental protection. The aim of the action is to protect the environment and nature and to encourage development towards the low-carbon society, leading to the principles of social justice and systematic change. The most of the attention is given to activities aimed at encouraging public participation in decision-making on the environment and on improving the quality of life in Croatia. Green Action is a member of the largest network of environmental NGOs in the world Friends of the Earth.

For the period 2014 - 2017, a large number of activities in the field of action were conducted. The most important are:

- promotion of bicycle traffic during which more than 1.500 people participated in the "Break Free from fossil fuels" campaign in 2016;
- comments from the public and experts were collected during the of the public debate on the Low-Carbon Development Strategy of the Republic of Croatia. In addition, there was organized performance in front of the Government of the Republic of Croatia, which invited citizens to participate in the public debate on this key document for the transition of Croatia to the low-carbon society. Also, on July 10, 2017, a roundtable was organized with the Strategy authors, as well as a number of other experts;
- a brief video on the impact of climate change in Croatia (focus on Dalmatia) was produced during the International Climate Action Days (13 and 14 October 2017). A short video documented the consequences of climate change in Croatia - the more frequent and intense weather extremes. There was also an fundraising campaign for donating for afforestation the fire affected areas;
- public protests against coal-fired thermal power plants in Plomin and advocacy of investments in the OIE's national electricity industry;
- “Green Phone” Activities have continued, through which citizens can comment on irresponsible environmental protection. During 2017, 1.006 applications were received;
- a series of activities advocating more sustainable waste management have been organized within the campaign "Zagreb - the European Capital of Garbage". Actions were also carried out in other parts of the Republic of Croatia;
- participation in the climate march on COP23 in Bonn, Germany;
- a campaign against the construction of the Kosinj hydrenergic system. Other actions for nature protection were also held in the construction of hydro power plants context;
- a forum on which a scientific study of the natural gas impact on climate change was presented and also a stand against the gas terminal for the LNG on the island of Krk;
- active participation in the discussions on the nature protected areas in the Republic of Croatia;

- other seminars and education have been organized.

Society for Sustainable Development Design (DOOR)

Society for Sustainable Development Design (DOOR) is an association of experts engaged in the promotion of sustainable development in the field of energy. It operates in two strategic areas: mitigation of climate change and the suppression of energy poverty.

During the period 2014 - 2017, DOOR has carried out a large number of activities in order to raise awareness of the above topics. Most important are:

- seven major conferences on sustainable energy, climate, sustainable development, public participation in environmental protection and climate-energy policies;
- over a hundred educational publications, seminars, webinars and other educational materials for different stakeholder groups in the field of sustainable development and climate change (part: http://door.hr/knjiznica-2/);
- studies and analyzes, proposals for local plans, national plans, laws and policies (15 SEAPs, risk analysis and vulnerability to climate change, energy project analysis in the context of environmental protection, climate financing analysis, law-defining local plans);
- a few public actions, media campaigns, and lots of promotional material on the subject (leaflets, posters, billboards, other materials).

Eco Kvarner

Eco Kvarner is a non-profit non-governmental organization. The association works by providing information, education, with animation and organizing, participation in discussions and activities, submitting alternative proposals, initiating legal proceedings, supporting actions and protest actions. The goals of the association are environment and nature protection and the promotion of sustainable development of the Republic of Croatia. The association also promotes and strengthens the role of the public in exercising the constitutional right to a healthy environment and realization of professional insights on environmental issues.

Eco-Kvarner Association as part of its activities conducts:
Organizing forums, roundtables, expert consultations, workshops, sharing promotional material, organizing peaceful protests and public gatherings, petitions, letters, undertaking legally envisaged environmental protection measures, influencing legislation, collecting, processing and distributing information.

Žmergo

The Žmergo Association aims to preserve the environment, protect the natural and cultural heritage and promote sustainable development, and through its action, it has an impact on improving the quality of life both in the ecological and in the cultural and educational sense. From the activities from 2014 to 2017, the following can be highlighted:

- the national "Zelena čistka" campaign under which a one-day action to clean the wild waste landfill is organized and is attended by about 55 000 volunteers each year (including school students);

- the Green Hours Education Program and the “Tanjur pun dobrote” within which their own manuals were printed and about 40 workshops organized;
- composting manual and workshops for citizens.

Green Osijek

Association for nature and environment protection Green Osijek is independent, non-government, and non-profit. Its goal is to educate and activate citizens in the field of nature preservation, improvement of quality of living trough advocacy, promotion and implementation of the ecologically acceptable technologies and sustainable development. From the activities from 2014 to 2017, the following can be highlighted:

- activities of the Zlatna Greda Eco Center include activities of education of school age children in workshops “Schools in nature”, in accordance with the curriculum. Education is a combination of field work and workshops with interactive lectures - educational video material. The students are introduced to the natural values of ecosystems, biodiversity, the need to preserve nature and life in harmony with natural values. Two of the most significant programs we have with our children are the workshops "Our Rivers", "Flooded forests" and "Orientation in Nature".
- project ”DRAVA LIFE – Integrated River Management” Basic objective of the project is to create a new flood areas and increase natural and dynamic habitats of river Drava in Croatia. The main project activities are restoration of Drava habitats through the creation of new backwaters of the river, removal of water works and the protection of the steep river banks on these seven locations of river Drava will be of immense benefit to the endangered habitats and species in the Natura 2000 areas and will contribute to better protection against floods in the populated areas along the Drava River and will increase the recreational value of the area for the local population;
- project "EcoWET - Assessment of wetland ecosystem services in the cross-border area Croatia - Serbia" implemented with partners from Serbia. The main objective of the project is to contribute to the protection and sustainable use of wetland ecosystems of the Danube floodplain and its tributaries in the cross-border area of Croatia - Serbia through the evaluation of ecosystem services.

Sustainable Alternative to Community (O.A.ZA)

O.A.ZA. – Sustainable Alternative to Community has a goal to organize various activities for youth during which they can, in a positive and supportive atmosphere, develop their potential, and become exemplary carers of the sustainable social change. Promotes sustainable development and satisfying human needs while respecting the nature, resources and generations that will come after us. From the activities from 2014 to 2017, the following can be highlighted:

- OAZA for children is a project aimed at establishing school gardens in elementary schools and educate children about nature protection through the work in the gardens;
- A “Sustainable challenge” is a project through which young people compete in adopting habits that change their lifestyles to reduce the adverse environmental impact;
- “The Energy challenge” is one-month activity for young people in the City of Zagreb, which aims to increase awareness of the importance of reducing carbon dioxide emissions, increasing

rational energy consumption management and implementing sustainable behaviours among the target group.

9.5. WORK WITH PUBLIC

Daily and weekly newspapers in the Republic of Croatia monitor different areas of environmental protection; (drought, heat, floods, storms), the use of renewable energy sources and biofuels, and the international obligations and activities of the Republic of Croatia in the implementation of the Convention and the Kyoto Protocol. Radio and television stations in informational and scientific-educational programs provide information on climate issues on a periodic basis.

The Ministry of Environmental Protection and Energy as the competent body for climate change adaptation informs and works to raise awareness of the national, regional and local stakeholders about the expected effects of climate change in Croatia, as well as the ways of adjustment in line with the National Climate Change Adaptation Strategy. It is also necessary to prepare stakeholders for the fulfillment of the obligations arising from the National Strategy and Action Plan for Adaptation to Climate Change as well as the development and implementation of a public campaign on vulnerability to climate change and adaptation measures in vulnerable sectors.

Important Websites launched to inform, educate, exchange information on climate change and related topics (sustainable development, energy, energy efficiency, renewable energy sources, etc.):

- The public is informed through the Ministry's dedicated climate and climate change adaptation page and through a project page that will be gradually upgraded to the central page with relevant information on climate change, impacts, vulnerability and adaptation to climate change.
- The Environmental Protection and Energy Efficiency Fund website - www.fzoeu.hr provides data on fees paid by environmental polluters and users, special fees payable by owners and motor vehicle licensees, data on the collection and use of funds available to the Fund for financing projects, programs and other activities in the field of environmental protection and energy efficiency.
- The website of the Croatian Agency for Environment and Nature http://www.haop.hr/ contains, among other, the National Inventory Report on Greenhouse Gas Emissions.
- The National Meteorological and Hydrological Service regularly informs the public, users, and expert circles of climate assessment on a monthly, seasonal and annual basis via the web site www.meteo.hr and the press releases.
- The website of the UNDP project "Stimulating Energy Efficiency in Croatia" is available at www.energetska-efikasnost.undp.hr.

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ANNEX I. THIRD BIENNIAL REPORT OF THE REPUBLIC OF CROATIA UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (2/CP.17)

1. INFORMATION ON GREENHOUSE GAS EMISSIONS AND TRENDS

1.1. INTRODUCTION

In this chapter, the results of the greenhouse gas (GHG) emissions and removals calculation are presented for the period from 1990 to 2015, as calculated in National Inventory Report of the Republic of Croatia for the Period 1990-2015 (NIR 2017) [3]. The summary results of the greenhouse gas (GHG) emission calculation are presented for the period from 1990 to 2015. Further detail is provided in the Third Biennial Report.

1.2. OVERVIEW OF THE GREENHOUSE GAS EMISSION AND REMOVAL ESTIMATES AND TRENDS FOR THE PERIOD 1990-2015

Total emissions/removals of GHG and their trend in sectors are given in Tables 1-1, 1-2 and in Figure 3-1 while the contribution of the individual gases is given in Tables 1-3, 1-4 and Figure 1-2.

Table 1-1: Emissions/removals of GHG by sectors for the every five years from 1990 to 2005 (kt CO_2-eq)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**1990**	**1995**	**2000**	**2005**
	CO_2 equivalent (kt)			
1. Energy	21 831.8	16 122.0	18 350.8	21 730.0
2. Industrial processes and product use	4 628.8	2 440.5	3 127.5	3 507.6
3. Agriculture	4 039.1	3 008.2	2 888.0	3 029.7
4. Land use, land-use change and forestry	-6 589.4	-9 109.3	-7 505.3	-7 808.1
5. Waste	654.0	739.5	889.0	1 045.0
6. Other	NO	NO	NO	NO
Total (with LULUCF)	**24 564.3**	**13 200.9**	**17 750.0**	**21 504.3**
Total (without LULUCF)	**31 153.7**	**22 310.2**	**25 255.3**	**29 312.4**

Table 1-2: Emissions/removals of GHG by sectors for the period from 2010-2015 (kt CO_2-eq)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
	CO_2 equivalent (kt)					
1. Energy	19 903.9	19 634.8	18 187.4	17 415.7	16 459.8	16 728.0
2. Industrial processes and product use	3 315.3	3 083.7	2 809.2	2 538.6	2 688.0	2 665.5
3. Agriculture	2 717.5	2 785.6	2 704.6	2 537.0	2 427.0	2 555.3
4. Land use, land-use change and forestry	-7 263.8	-6 250.8	-5 977.5	-6 521.8	-6 591.3	-4 991.7

5. Waste	1 392.4	1 424.6	1 420.7	1 431.3	1 474.1	1 553.3
6. Other	NO	NO	NO	NO	NO	NO
Total (with LULUCF)	**20 065.2**	**20 677.9**	**19 144.4**	**17 400.7**	**16 457.7**	**18 510.4**
Total (without LULUCF)	**27 329.0**	**26 928.7**	**25 121.9**	**23 922.5**	**23 049.0**	**23 502.1**

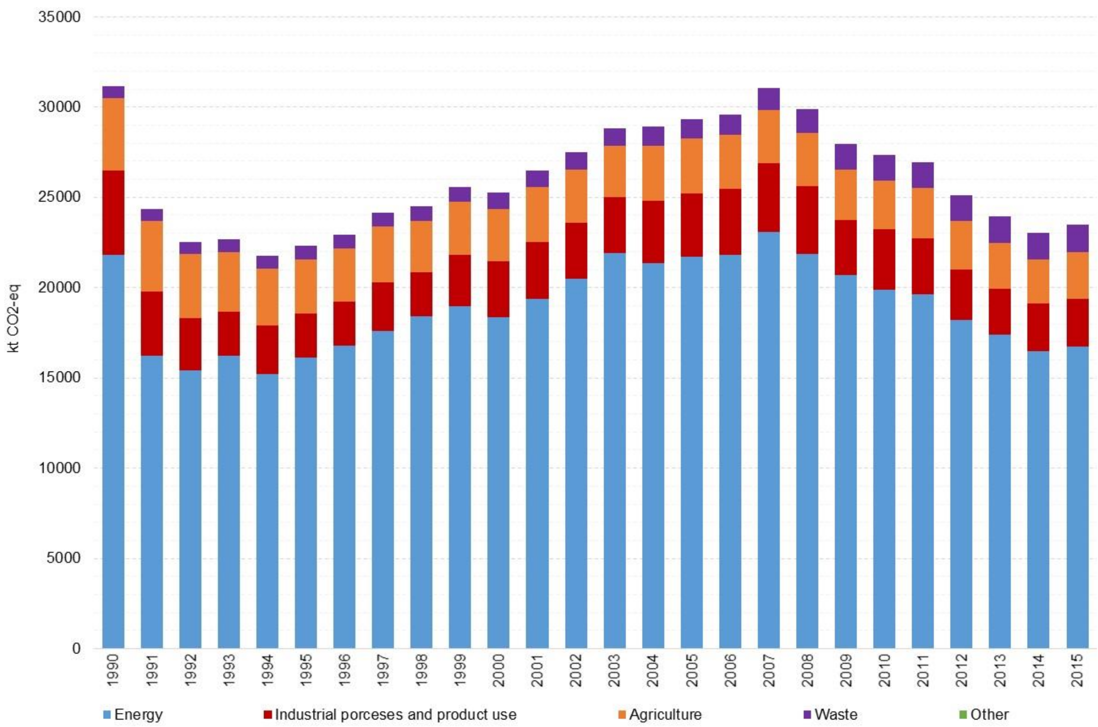

Figure 1-1: Trend of GHG emissions, by sectors

Table 1-3: Emissions/removals of GHG by gases for the every five years from 1990 to 2005 (kt CO_2-eq)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005
	CO_2 equivalent (kt)			
CO_2 emissions without net CO_2 from LULUCF	23,390.1	16,992.8	19,789.1	23,451.8
CO_2 emissions with net CO_2 from LULUCF	16,762.7	7,837.6	12,088.4	15,572.3
CH_4 emissions without CH_4 from LULUCF	3,744.2	3,033.7	2,887.9	3,173.8
CH_4 emissions with CH_4 from LULUCF	3,745.4	3,041.2	2,984.8	3,176.5
N_2O emissions without N_2O from LULUCF	2,768.7	2,243.3	2,418.8	2,407.9
N_2O emissions with N_2O from LULUCF	2,805.5	2,281.7	2,517.4	2,476.7
HFCs	NO	29.3	147.9	265.8
PFCs	1,240.2	NO	NO	NO
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO
SF_6	10.5	11.1	11.6	13.0
NF_3	NO	NO	NO	NO
Total (without LULUCF)	**31,153.7**	**22,310.2**	**25,255.3**	**29,312.4**
Total (with LULUCF)	**24,564.3**	**13,200.9**	**17,750.0**	**21,504.3**
Total (without LULUCF, with indirect)	**NA**	**NA**	**NA**	**NA**
Total (with LULUCF, with indirect)	**NA**	**NA**	**NA**	**NA**

Table 1-4: Emissions/removals of GHG by gases for the for the period from 2010-2015 (kt CO_2-eq)

GREENHOUSE GAS EMISSIONS	2010	2011	2012	2013	2014	2015
	CO₂ equivalent (kt)					
CO_2 emissions without net CO_2 from LULUCF	21,203.7	20,759.4	19,172.4	18,525.4	17,777.1	17,918.7
CO_2 emissions with net CO_2 from LULUCF	13,863.6	14,402.2	13,054.5	11,925.0	11,109.4	12,826.7
CH_4 emissions without CH_4 from LULUCF	3,415.1	3,384.4	3,311.2	3,267.6	3,226.5	3,430.6
CH_4 emissions with CH_4 from LULUCF	3,416.8	3,403.1	3,350.1	3,269.5	3,226.9	3,444.6
N_2O emissions without N_2O from LULUCF	2,322.3	2,379.2	2,231.9	1,714.5	1,624.9	1,727.6
N_2O emissions with N_2O from LULUCF	2,396.9	2,467.0	2,333.3	1,791.2	1,701.0	1,813.9
HFCs	378.9	396.2	397.3	408.9	413.6	419.9
PFCs	0.0	0.0	0.0	0.1	0.1	0.0
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO
SF_6	9.0	9.4	9.2	6.1	6.8	5.3
NF_3	NO	NO	NO	NO	NO	NO
Total (without LULUCF)	**27,329.0**	**26,928.7**	**25,121.9**	**23,922.5**	**23,049.0**	**23,502.1**
Total (with LULUCF)	**20,065.2**	**20,677.9**	**19,144.4**	**17,400.7**	**16,457.7**	**18,510.4**
Total (without LULUCF, with indirect)	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total (with LULUCF, with indirect)	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

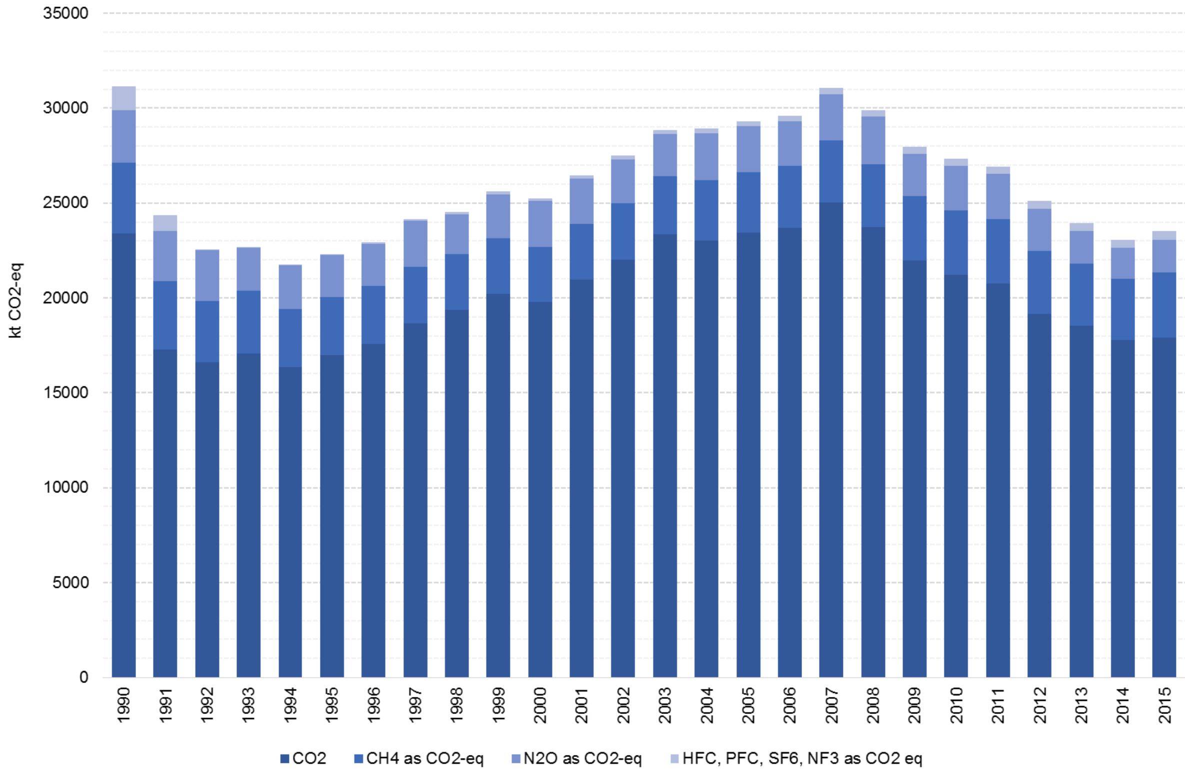

Figure 1-2: Trend of GHG emissions, by gases

1.3. DESCRIPTIVE SUMMARY OF THE GREENHOUSE GAS INVENTORY

1.3.1. Greenhouse gas emissions by sectors

The largest contribution to the GHGs emission in 2015 excluding LULUCF has the Energy sector with 71.2 %, followed by Industrial Processes and product use with 11.3 %, Agriculture with 10.9 % and Waste with 6.6 %. This structure is with minor changes consistent through all the observed period from 1990 to 2015. In the year 2015, the total GHG emissions in Croatia was 23 502.1 kt CO_2-eq excluding LULUCF sector while the total emission was 18 510.4 kt CO_2-eq including the LULUCF sector which represents removals by sink from 21.2 % in that year.

Energy sector

Energy sector is the largest contributor to GHG emissions. In the year 2015, the GHG emission from Energy sector was 1.6 % higher in relation to 2014 and 23.4 % lower in relation to 1990. Energy sector covers all activities that involve fuel combustion from stationary and mobile sources, and fugitive emission from fuels. The Energy sector is the main cause for anthropogenic emission of greenhouse gases. It accounts approximately 75 % of the total emission of all greenhouse gases presented as equivalent emission of CO_2. Looking at its contribution to total emission of carbon dioxide (CO_2), the energy sector accounts for about 90 %. The contribution of energy in methane (CH_4) in total CO_2-eq emission is substantially smaller (8 %) while the contribution of energy in nitrous oxide (N_2O) in total CO_2-eq emission is quite small (about 2 %). Emissions from fossil fuel combustion comprise the majority (more than 90 %) of energy-related emissions.

The largest part (35.6 % in 2015) of the emissions are a consequence of fuel combustion in Transport, then the combustion in Energy industries (28.7 % in 2015) and the combustion in small stationary energy sources, such as Commercial/ Institutional, Residential and Agriculture/ Forestry/ Fishing (19.3 % in 2015). Manufacturing Industries and Construction contribute to total emission from Energy sector with 13.3 %, while Fugitive Emissions from Fuels contribute with about 3.1 %.

Industrial processes and product use

In Industrial Processes sector, the key emission sources are Cement Production, Ammonia Production, Nitric Acid Production, Petrochemical and Carbon Black Production, Non-energy Products from Fuels and Solvent Use and Consumption of HFCs in Refrigeration and Air Conditioning Equipment, which all together contribute with 93.7 % in total sectorial emission in 2015. The iron production in blast furnaces and aluminium production ended in 1992, and ferroalloys production ended in 2003. Generally, GHG emissions from industrial processes declined from 1990 to 1995, due to the decline in industrial activities caused by the war in Croatia, while in the period 1996 - 2008 emissions slightly increased due to revitalization of the economy. The effects of the economic crisis influenced the emissions trend from 2008 onwards, followed by a moderate recovery since 2013. The decrease in emissions from chemical industry in 2013 and onwards is due to a strong reduction of N_2O emissions from the nitric acid production after applying abatement technology. In 2015 emissions from industrial processes were decreased by 0.8 % regarding 2014 and by 42.4 % regarding 1990. Industrial processes and product use contributes to total GHG emissions with 11.3 % in 2015.

Agriculture

Emission of CH_4 and N_2O in the Agricultural sector is conditioned by different agricultural activities. For the emission of CH_4, the most important source is livestock farming (Enteric Fermentation) which makes 40.1 % of sectoral CO_2-eq emission. The number of cattle showed continuous decrease in the period from 1990 to 2000. As a consequence, this led to CH_4 emission reduction. In the year 2000, the number of cattle has started increasing and this trend was mostly retained until 2006. From 2007 to 2010, cattle number decreased and remained at approximately the same level in 2013 and 2014. Compared to 2014, in 2015 CH_4 emission from Enteric fermentation increased by 4.83 %. As for Manure management emissions, CH_4 emission increased by 5.31 % in 2015 compared to 2014 while N_2O emission increased by 6.82 %. Emissions from Agricultural soils decreased after 1990 and during the war due to specific national circumstances and limited agricultural practice at that time. Afterwards, the emission trend is mostly influenced by the changes in the direct soil emissions; thus, emission increase can be noticed in 1997, 2001 and 2002 due to increase in mineral fertilizer consumption and crop production, later on also due to the increase of livestock population. N_2O emission from Agricultural soils increased in 2015 compared to 2014 by 5.22 percent. Overall, in the year 2015 the GHG emission from Agriculture sector increased by 5.02 % in comparison with 2014.

LULUCF

The Low on Forest (Official Gazette No. 140/05, 82/06, 129/08, 80/10, 124/10, 25/12, 68/12, 148/13, 94/14) regulates the growing, protection, usage and management of forests and forest land as a natural resource aimed to maintain biodiversity and ensure management based on principles of economic sustainability, social responsibility and ecological acceptability. Moreover, one of its the most important provisions, in the context of climate protection, is that forests should be managed in conformity with the sustainable management criteria, implying the maintenance and enhancement of forest ecosystems and their contribution to the global carbon cycle. Planning activities in forestry sector in Croatia are also regulated by the Low on Forest. Forest management plans determine conditions for harmonious usage of forest and forest land and procedures in that area, necessary scope regarding cultivation and forest protection, possible utilization degree and conditions for wildlife management. The Forest Management Area Plan (FMAP) for the Republic of Croatia determines the ecological, economic and social background for forest improvement in terms of biology and for the increase of forest productivity.

According to Forest Management Area Plan of the Republic of Croatia for the period 2016-2025, the forests and the forest land cover 47.5 % of the total surface area. By its origin, approximately 95 % of the forests in Croatia were formed by natural regeneration (according to the national definitions applied in the sector) and the 5 percent of the forests are grown artificially. The Plan determined the growing stock of 418 618 277 m^3 while its yearly increment amounts around 10.1 million of m^3. The most frequent species are Common Beech (Fagus sylvatica), Pedunculate Oak (Quercus robur), Sessile Oak (Quercus petrea), Common Hornbeam (Carpinus betulus), Silver Fir (Abies alba), Narrow-leafed Ash (Fraxinus angustifolia), Spruce (Picea abies), Turkey Oak (Quercus cerris), Black Locust (Robinia pseudoacacia), Black Alder (Alnus glutinosa) and other. The methodology used for CO_2 removal calculation is taken from the IPCC and it is based on data on increment and felling. The problem of deforestation in Croatia does not exist. According to present data the total forest area has not been reduced in the last 100 years.

Removal arisen in LULUCF sector contribute with 28.5 % to the total emissions of CO_2-eq in Croatia in year 2015.

Waste

Waste Waste sector includes following categories: solid waste disposal, biological treatment of solid waste, incineration and open burning of waste and wastewater treatment and discharge. Solid waste disposal represents dominant CH_4 emission source from that sector. Generally, 80.7 % of sectoral emissions refer to the emissions from solid waste disposal in 2015, compared to 53.3 % in 1990. An increase in generated solid waste exists during the entire reporting period, particularly until 2009. Starting with 2009 there is a decrease in registered waste quantities, caused primary by economic crisis but also other factors regarding to effects of measures undertaken to avoid/reduce and recycle waste. 18.6 % of sectoral emissions refer to the emissions from wastewater treatment and discharge in 2015, compared to 46.6 % in 1990. Decrease in emissions during the entire reporting period mainly is a result of population decrease (domestic wastewater) as well economic crisis that affected the reduction of economic activity from 2008 onwards (industrial wastewater). Biological treatment of solid waste and incineration and open burning of waste have considerably lower contribution to the sectoral emissions during the reporting period. Waste sector contributes to total GHG emissions with 6.6 % in 2015.

1.3.2. Greenhouse gas emissions by gases

The largest contribution to the GHGs emission in 2015 excluding LULUCF has CO_2 emission with 76.2 %, followed by CH_4 with 14.6 %, N_2O with 7.4 % and HFCs, PFCs and SF_6 with 1.8 %.

Carbon dioxide emission (CO_2)

Carbon dioxide is the most significant anthropogenic GHG. The most significant anthropogenic sources of CO_2 emissions in Croatia are the processes of fossil fuel combustion for electricity or/and heat production, transport and industrial processes (cement and ammonia production).

The energy most intensive stationary sub-sector is Energy Industries (electricity and heat production, refineries and oil and gas field combustion). In the framework of the sub-sector Manufacturing Industries and Construction, the largest CO_2 emissions are the result of fuel combustion in industry of construction material and petrochemical production, followed by food processing industry, chemical industry, industry of pulp, paper and print, iron and steel industry and non-ferrous metal industry. Furthermore, this sub-sector includes electricity and heat production in manufacturing industry for manufacturing processes.

Transport sector is also one of more important CO_2 emission sources. This sector includes emission from road transport, civil aviation, railways and navigation. In the year 2015, the CO_2 emission from Transport sector contributed with 32.8 % to the national total CO_2 emission. The largest part of the CO_2 emission from Transport sector arises from road transport (96.3 % of CO_2 emission from transport sector in 2015) followed by national navigation, domestic civil aviation and railways.

Biomass combustion (fuel wood and waste wood, biodiesel, biogas) also results in greenhouse gas emissions. CO_2 emission from biomass is not included in balance according the Guidelines, due to assumption that life-cycle CO_2 emitted is formerly absorbed for the growth of biomass. Sinks or CO_2 emissions resulted in change of forest biomass is calculated in LULUCF sector.

Fugitive GHG emission from coal, liquid fuels and natural gas, resulted from exploration of minerals, production, processing, transport, distribution and activities during mineral use is also included in this sector.

The most significant CO_2 industrial processes emission sources are production of cement, ammonia and lime. In 2015, mineral industry contributes in total sectorial CO_2 emission with 68.2 % and chemical industry with 27.9 %. Generally, CO_2 emissions from industrial processes declined from 1990 to 1995, due to the decline in industrial activities caused by the war in Croatia, while in the period 1996-2008 emissions slightly increased. Production of iron and aluminium was stopped in 1992. A decrease of economic activities after 2008 influenced a reduction in cement, lime, ammonia and steel productions. In 2015 CO_2 emissions from industrial processes decreased by 2.9 % compared to year 2014.

Methane emission (CH_4)

The major sources of methane (CH_4) emission are fugitive emission from production, processing, transportation and activities related with fuel use in Energy sector, Agriculture and Waste Disposal on Land.

In the Agricultural sector there are two significant methane emission sources present: enteric fermentation in the process of digestion of ruminants (dairy cows represent the major source) and different activities related with storage and use of organic fertilizers (manure management). The total methane emission for domestic animals is being calculated as a sum of emission from enteric fermentation and emission related to manure management. The emission trend depends on the livestock population trend.

Methane emission from solid waste disposal sites (SWDSs) is a result of anaerobic decomposition of organic waste by methanogenic bacteria. The amount of methane emitted during the process of decomposition is directly proportional to the fraction of degradable organic carbon (DOC) which is defined as carbon content in different types of organic biodegradable wastes. In Croatia, more than 1.6 million tons of municipal solid waste is produced annually and the average composition of it biodegradable part is: paper and textile (21-22 percent), garden and park waste (18-19 %), food waste (23-24 %), wood waste and straw (3 %). As for the Wastewater treatment and discharge in Croatia, aerobic biological process is used mostly in wastewater treatment. Anaerobic process is applied in some industrial wastewater treatment, which results with CH_4 emissions. Disposal of domestic and commercial wastewater, particularly in rural areas where systems such as septic tanks are used, are partly anaerobic without flaring, which results with CH_4 emissions.

Nitrous oxide emission (N_2O)

The most important sources of N_2O emissions in Croatia are agricultural activities, nitric acid production, but as well, the N_2O emissions occur in energy sector and waste management.

In the Agricultural sector, three N_2O emission sources are determined: direct N_2O emission from agricultural soils, direct N_2O emission from livestock farming and indirect N_2O emission induced by agricultural activities. According to IPCC methodology, the mineral nitrogen, nitrogen from organic fertilizers, amount of nitrogen in fixing crops, amount of nitrogen which is released from crop residue mineralization, soil nitrogen mineralization due to cultivation of histosols and amount of nitrogen from the application of sewage sludge is are separately analyzed.

In Industrial Processes sector, the N_2O emission occurs in nitric acid production, which is used as a raw material in nitrogen mineral fertilizers. In the framework of the N_2O reduction measure analysis, the possibility for application of non-selective catalytic reduction device was considered, whereby the nitric acid production influence on N_2O emissions would be practically eliminated.

In Energy sector the emission was calculated on the basis of fuel consumption and adequate emission factors (IPCC). The major sources of N_2O emission in Energy sector is use of three-way catalytic converters in road transport motor vehicles.

N_2O emission from the Waste sector indirectly occurs from human sewage. It is calculated on the basis of the total number of inhabitants and annual protein consumption per inhabitant. Data on the annual per capita Protein Intake Value were obtained by the FAOSTAT Statistical Database. Extrapolation method has been used for calculation of insufficient data.

Halogenated carbons (HFC, PFC),SF6 and NF3 emissions

Synthetic GHGs include halogenated carbons (HFCs and PFCs) and sulphur hexafluoride (SF_6). Although on an absolute scale their emissions are not great, due to their high global warming potential (GWP) their contribution to global warming is considerable. MEE is responsible for monitoring of consumption of substitutes and mixture of substitutes for gases that deplete the ozone layer. There is no production of HFCs PFCs, SF_6 and NF_3 in Croatia; therefore, all quantities of these gases are imported. Minor quantities of some substances are exported.

Croatia is an Article 5 country, according to the Montreal protocol, and has a longer period for using CFC, HCFC and halons. Because of that, Croatia started using HFCs 10 years later than other Annex I countries. According to survey carried out among major agents, users and consumers of these gases, information related to consumption of HFCs, PFCs, SF_6 and NF_3 (provided by the MEE) was used for emission calculation.

Other information (e.g. indirect ghgs)

The photochemicaly active gases, carbon monoxide (CO), oxides of nitrogen (NO_X) and non-methane volatile organic compounds (NMVOCs) indirectly contribute to the greenhouse gas effect. These are generally called indirect greenhouse gases or ozone precursors, because they are involved in creation and degradation of ozone which is also one of the greenhouse gases. Sulphur dioxide (SO_2), as a precursor of sulphate and aerosols, is believed to contribute negatively to the greenhouse effect. Emissions of indirect GHGs have been taken from the draft of emission inventory report 'Republic of Croatia Informative Inventory Report for LRTAP Convention for the Year 2015 Submission to the Convention on Long-range Transboundary Air Pollution'.

Although Parties may now choose to report indirect CO_2, in accordance with paragraph 29 of the UNFCCC Inventory Reporting Guidelines, Croatia does not choose to report indirect CO_2 emissions from the atmospheric oxidation of CH_4, CO and NMVOCs, or indirect N_2O emissions arising from sources other than those in the agriculture and LULUCF sectors.

1.3.3. Uncertainty assessment and verification

The uncertainties associated with both annual estimates of emissions and emission trends over time are reported according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The uncertainties are estimated using Tier 1 and Tier 2 (Monte Carlo analysis) methods described by the IPCC, which provide estimates of uncertainties by pollutant. The uncertainties are estimated for both excluding LULUCF and including LULUCF due to the Good Practice Guidance for Land Use, Land-Use Change and Forestry.

Uncertainty in the emissions and the trend excluding LULUCF

The estimate of CO_2-eq emissions in 2015 was estimated at 23 502.15 kt CO_2-eq. The estimate of CO_2-eq emissions in 1990 was estimated at 31 153.70 kt CO_2-eq. Monte Carlo analysis shows that with a certainty of 95 % it can be stated that the total simulated emissions of all categories excluding LULUCF for the year 1990 varies between 30 381.83 kt CO_2-eq (2.5 % percentile) and 32,804.17 kt CO_2-eq (97.5 % percentile). The Inventory trend excluding LULUCF is -24.56%, simulated trend is -24.44 % and the 95 % probability range of the trend is -28.78 % (2,5 % percentile) to -19.73 % (97.5 % percentile).

Uncertainty in the emissions and the trend including LULUCF

The estimate of CO_2-eq emissions in 2015 was estimated at 18 510.43 kt CO_2-eq. The estimate of CO_2-eq emissions in 1990 was estimated at 24 564.27 kt CO_2-eq. Monte Carlo analysis shows that with a certainty of 95 % we can say that the total emissions of categories for the year 2015 according to simulation varies between 15 727.38 kt CO_2-eq (2.5 % percentile) and 29 590.28 kt CO_2-eq (97.5 % percentile). The Inventory trend including LULUCF is -24,64 %, simulated trend is -18.64 % and the 95 % probability range of the trend is -46.56 % (2,5% percentile) to 14.97 % (97.5 % percentile), so the uncertainty introduced in trend varies from -21.91 % to 39.62 % with respect to the base year emissions.

The results of the uncertainty analysis are used to drive improvements of the inventory. Most efforts were made to collect detailed information on AD and EFs (especially country-specific EFs) in order to improve accuracy of the emission calculation.

Verification

The verification process of calculation is aimed at the improvement of the input quality and identification of the calculation reliability. The IPCC Guidelines recommend that inventories should be verified through the use of a set of simple checks for completeness and accuracy, such as checks for arithmetic errors, checks of country estimates against independently published estimates, checks of national activity data against international statistics and checks of CO_2 emissions from fuel combustion calculated using sectoral methods with the IPCC Reference Approach. Further verification checks may be done through comparison with other national inventory calculation data.

In the development of the Croatian inventory, certain steps and some of these checks were performed:

- Comparison with the national inventory data of other countries was conducted by comparing CRF tables or through a direct communication;
- Activity data were compared using different sources such as Croatian Bureau of Statistics and individual emission sources;
- The CO_2 emissions from fossil fuel combustion, within the framework of IPCC methodology, are estimated using two approaches: (1) Reference Approach and (2) Sectoral Approach (Tier 1).

1.3.4. Key categories

According to the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, key categories are those which represent 95% (Tier 1) or 90% (Tier 2) of the total annual emissions in the last reported year or belonging to the total trend, when ranked from contributing the largest to smallest share in annual total and in the trend.

Summary table with the key categories identified for the latest reporting year (by level and trend) on the basis of table 4.4 of volume 1 of the 2006 IPCC Guidelines is provided in Table 3-5.

Table 1-5: Key categories summary table for 2015

IPCC Source Categories	GHG	Criteria for Identification of key category			
1. Energy					
1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO_2	L1e, L2e	T1e	L1i	
1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO_2	L1e, L2e	T1e, T2e	L1i	T1i, T2i
1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO_2	L1e, L2e	T1e, T2e	L1i	T1i, T2i
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO_2	L1e	T1e, T2e	L1i	T1i
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO_2	L1e, L2e	T1e, T2e	L1i	T1i
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO_2	L1e	T1e, T2e	L1i,	T1i, T2i
1.A.3.b Road Transportation	CO_2	L1e, L2e	T1e, T2e	L1i, L2i	T1i, T2i
1.A.3.b Road Transportation	N_2O	L2e	T2e		
1.A.4 Other Sectors - Biomass	CH_4	L1e, L2e	T1e, T2e	L1i, L2i	T1i, T2i
1.A.4 Other Sectors - Biomass	N_2O	L2e	T2e		
1.A.4 Other Sectors - Gaseous Fuels	CO_2	L1e, L2e	T1e, T2e	L1i	T1i, T2i
1.A.4 Other Sectors - Liquid Fuels	CO_2	L1e, L2e	T1e, T2e	L1i	T1i
1.A.4 Other Sectors - Liquid Fuels	N_2O	L2e			
1.A.4 Other Sectors - Solid Fuels	CO_2		T1e, T2e		T1i,
1.B.2.a Fugitive Emissions from Fuels - Oil and Natural Gas - Oil	CO_2		T2e		T1i,
1.B.2.a Fugitive Emissions from Fuels - Oil and Natural Gas - Oil	CH_4		T1e, T2e		T1i, T2i
1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CH_4	L2e		L1i	
1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CO_2	L1e, L2e	T1e, T2e	L1i, L2i	T1i, T2i
2. Industrial Processes and Product Use					
2.A.1 Cement Production	CO_2	L1e	T1e	L1i	T1i
2.B.1 Ammonia Production	CO_2	L1e	T1e	L1i	T1i
2.B.2 Nitric Acid Production	N_2O	L1e	T1e	L1i	T1i
2.B.8 Petrochemical and Carbon Black Production	CO_2		T1e, T2e		T1i, T2i
2.C.2 Ferroalloys Production	CO_2		T1e		T1i
2.C.3 Aluminium Production	CO_2		T1e		T1i
2.C.3 Aluminium Production	PFCs		T1e		T1i
2.D Non-energy Products from Fuels and Solvent Use	CO_2		T2e		T1i
2.F.1 Refrigeration and Air conditioning - Aggregate	F-gases	L1e, L2e	T1e, T2e	L1i	T1i, T2i
3. Agriculture					

3.A Enteric Fermentation	CH_4	L1e, L2e	T1e, T2e	L1i, L2i	T1i, T2i
3.B Manure Management	CH_4	L1e	T1e	L1i	T1i
3.B Manure Management	N_2O	L1e, L2e	T1e, T2e	L1i	T1i, T2i
3.D.1 Direct N2O Emissions From Managed Soils	N_2O	L1e, L2e		L1i, L2i	
3.D.2 Indirect N2O Emissions From Managed Soils	N_2O	L1e, L2e	T2e	L1i, L2i	T2i
4. LULUCF					
4(III).Direct N2O emissions from N mineralization/immobilization	N_2O			L2i	T2i
4(V) Biomass Burning	CO_2				T1i
4.A.1 Forest Land Remaining Forest Land	CO_2			L1i, L2i	T1i, T2i
4.A.2 Land Converted to Forest Land	CO_2			L1i, L2i	T1i, T2i
4.B.1 Cropland Remaining Cropland	CO_2			L2i	T2i
4.B.2 Land Converted to Cropland	CO_2			L2i	
4.C.2 Land Converted to Grassland	CO_2			L2i	T2i
4.D.2 Land Converted to Wetlands	CO_2				T2i
4.E.2 Land Converted to Settlements	CO_2			L1i, L2i	T1i, T2i
4.G Harvested Wood Products	CO_2			L2i	T1i, T2i
5. Waste					
5.A Solid Waste Disposal	CH_4	L1e, L2e	T1e, T2e	L1i, L2i	T1i, T2i
5.D Wastewater Treatment and Discharge	CH_4	L1e, L2e		L1i	
5.D Wastewater Treatment and Discharge	N_2O	L2e	T2e		

L1e - Level excluding LULUCF - Tier1 T1e - Trend excluding LULUCF - Tier1
L2e - Level excluding LULUCF - Tier2 T2e - Trend excluding LULUCF - Tier2
L1i - Level including LULUCF - Tier1 T1i - Trend including LULUCF - Tier1
L2i - Level including LULUCF - Tier2 T2i - Trend including LULUCF - Tier2

1.4. INSTITUTIONAL AND ORGANIZATIONAL STRUCTURE FOR THE PREPARATION OF THE NATIONAL INVENTORY OF THE GREENHOUSE GAS EMISSIONS

1.4.1. National system

Institutional arrangement for inventory preparation in Croatia is regulated in Chapter II of the Regulation on the Monitoring of Greenhouse Gas Emissions, Policies and Mitigation Measures in the Republic of Croatia entitled National system for the estimation and reporting of anthropogenic greenhouse gas emissions by sources and removals by sinks. Institutional arrangements for inventory management and preparation in Croatia could be characterized as decentralized and out-sourced with clear tasks breakdown between participating institutions including Ministry of Environment and Energy (MEE), Croatian Agency for the Environment and Nature (CAEN) and competent governmental bodies responsible for providing of activity data. The preparation of inventory itself is entrusted to Authorised Institution which is elected for three year period by public tendering. Committee for inter-sectorial coordination for national system for monitoring of GHG emission (National System Committee) is included in the approval process; its members provide their opinion on certain parts of the Inventory within the frame of their speciality. Members of the National System Committee are nominated by the authorized Ministries and others relevant Institutions upon the request of the MEE.

MEE is a national focal point for the UNFCCC, with overall responsibility for functioning of the National system in a sustainable manner, including:

- mediation and exchange of data on greenhouse gas emissions and removals with international organisations and Parties to the Convention;

- mediation and exchange of data with competent bodies and organisations of the European Union in a manner and within the time limits laid down by legal acts of the European Union;
- control of methodology for calculation of greenhouse gas emissions and removals in line with good practices and national circumstances;
- consideration and approval of the National Inventory Report prior to its formal submission to the Convention Secretariat.

CAEN is responsible for the following tasks:

- organisation of greenhouse gas inventory preparation with the aim of meeting the due deadlines;
- collection of activity data;
- development of quality assurance and quality control plan (QA/QC plan) related to the greenhouse gas inventory in line with the guidelines on good practices of the Intergovernmental Panel on Climate Change;
- implementation of the quality assurance procedure with regard to the greenhouse gas inventory in line with the quality assurance and quality control plan;
- archiving of activity data on calculation of emissions, emission factors, and of documents used for inventory planning, preparation, quality control and quality assurance;
- maintaining of records and reporting on authorised legal persons participating in the Kyoto Protocol flexible mechanisms;
- selection of Authorised Institution (in Croatian: Ovlaštenik) for preparation of the greenhouse gas inventory;
- provide insight into data and documents for the purpose of technical reviews.

Authorised Institution is responsible for preparation of inventory, which include:

- emission calculation of all anthropogenic emissions from sources and removals by greenhouse gas sinks, and calculation of indirect greenhouse gas emissions, in line with the methodology stipulated by the effective guidelines of the Convention, guidelines of the Intergovernmental Panel on Climate Change, Instructions for reporting on greenhouse gas emissions as published on the Ministry's website, and on the basis of the activities data;
- quantitative estimate of the calculation uncertainty for each category of source and removal of greenhouse gas emissions, as well as for the inventory as a whole, in line with the guidelines of the Intergovernmental Panel on Climate Change;
- identification of key categories of greenhouse gas emission sources and removals;
- recalculation of greenhouse gas emissions and removals in cases of improvement of methodology, emission factors or activity data, inclusion of new categories of sources and sinks, or application of coordination/adjustment methods;
- calculation of greenhouse gas emissions or removal from mandatory and selected activities in the sector of land use, land-use change and forestry;
- reporting on issuance, holding, transfer, acquisition, cancellation and retirement of emission reduction units, certified emission reduction units, assigned amount units and removal units, and carry-over, into the next commitment period, of emission reduction units, certified emission reduction units and assigned amount units, from the Registry in line with the effective decisions and guidelines of the Convention and supporting international treaties;
- implementation of and reporting on quality control procedures in line with the quality control and quality assurance plan;
- preparation of the greenhouse gas inventory report, including also all additional requirements in line with the Convention and supporting international treaties and decisions;

- cooperation with the Secretariat's ERTs for the purpose of technical review and assessment/evaluation of the inventory submissions.

EKONERG – Energy Research and Environmental Protection Institute was selected as Authorised Institution for preparation of inventory submission for present three year period.

Process of inventory preparation encompasses several steps starting with activity data collection on the basis of the Program of data collection and followed by emissions estimation and recalculations in accordance with the IPCC methodology and recommendations for improvements provided by the ERT, compilation of inventory including the NIR and the Common Reporting Format (CRF) tables and in parallel implementation of general and source category specific quality control procedures. Activity data sources for inventory preparation are presented in the Table 1-6.

Table 1-6: Data sources for GHG inventory preparation

CRF Sector/ Sub-sector	Type of data	Source of data
Energy	Energy balance	- Ministry of Environment and Energy with assistance of Energy Institute Hrvoje Požar
	Registered motor vehicles database	- Ministry of Interior
	Fuel consumption and fuel characteristic data for thermal power plants	- Pollution Emission Register CAEN - Verified reports of CO_2 emission - Voluntary survey of Power Utility Company
	Fuel characteristic data	- Voluntary survey of Oil and Gas Company
	Natural gas processed (scrubbed), CO_2 content before scrubbing and CO_2 emission	- Voluntary survey of Central Gas Station
Industrial Processes	Activity data on production/consumption of material for particular industrial process	- CBS, Department of Manufacturing and Mining - CAEN - 'Republic of Croatia *Informative Inventory Report for LRTAP Convention for the Year 2015* Submission to the Convention on Long-range Transboundary Air Pollution'
	Activity data on production/consumption of halogenated hydrocarbons (PFCs, HFCs) and sulphur hexafluoride (SF_6)	- MEE
	Data on consumption and composition of natural gas in ammonia production Data on cement and lime production	- Survey of ammonia manufacturer - Survey of cement and lime manufacturers - CAEN
Solvent and Other Product Use	Activity data on production for particular source category and number of inhabitants	- 'Republic of Croatia *Informative Inventory Report for LRTAP Convention for the Year 2015* Submission to the Convention on Long-range Transboundary Air Pollution'
Agriculture	Livestock number	- CBS - Croatian Agricultural Agency (CAA)
	Production of N-fixing crops and non N-fixing crops	- CBS
	Area of histosols	- Faculty of Agriculture
	Activity data on mineral fertilisers applied in Croatia	- Voluntary survey of Fertilizer Companies
	Activity data on sewage sludge applied	- Voluntary survey of Food Company
LULUCF	Activity data on areas of different land use categories, annual increment and annual harvest and wildfires Activity data on crop production	- Ministry of Agriculture with assistance of public company "Hrvatske šume" - CAEN - CBS
Waste	Activity data on municipal solid waste disposed to different types of SWDSs	- MEE - CAEN

	Activity data on wastewater treatment and discharge	- State company Croatian Water (Hrvatske vode)
	Activity data on waste incineration	- CAEN

1.4.2. National registry

Initially each EU member state had its own GHG register. Since June 2012, the GHG registries of the EU member states have been consolidated into one system - the EUCR (European Union Consolidated Registry), which is managed and maintained by the European Commission. The Union Registry is linked to the European Transaction Log (EUTL) and the International Transaction Log (ITL).

The Union Registry is a systematized and computerized database in which accounts of greenhouse gas emission trading participants are kept. It records and monitors compliance with the law on the obligations of the installation and aircraft operators, records the transactions and the amounts of the allocated free emission units. The registry ensures accuracy, transparency and public availability of data on the fulfilment of obligations. The functional requirements of the registry are determined by the European Commission through the Registry regulation and by the UNFCCC Secretariat through various COP/MOP decisions. All publicly available information from the Union Registry can be found on the European Transaction Log (EUTL) website. On 17.01.2013 the Croatian GHG register became part of the Union Registry, six months before Croatia became a full member of the EU. Within the unified Union Registry each member state has its own national part of the Registry and a national administrator. The National Administrator of the Croatian part of the Union Registry is Croatian Agency for the Environment and Nature, pursuant to Art. 101, para 2, of Air Protection law (OG 130/11, 47/14, 61/17). The Agency is responsible for managing the Croatian part of the Union Registry, which includes opening and managing ETS accounts, performing transactions on national Kyoto and ESD accounts, producing public reports and publishing information in accordance with international and national regulations.. Information on changes in the Registry, as defined in the NIR 2017, are shown in the table 1-7.

Table 1-7: Changes in Natioanl Registry

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(a) Change of name or contact	Addition of national administrator team member: Mr. Dino Križnjak Senior Adviser in Climate Change Unit, Croatian Agency for the environment and nature Radnička cesta 80, 10 000 Zagreb, Croatia Phone: +385 1 5581 676 Fax: +385 1 4886 850 E-mail: dino.kriznjak@azo.hr
15/CMP.1 annex II.E paragraph 32.(b) Change regarding cooperation arrangement	No change of cooperation arrangement occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(c) Change to database structure or the capacity of national registry	New tables were added to the CSEUR database for the implementation of the CP2 SEF functionality. Versions of the CSEUR released after 6.7.3 (the production version at the time of the last Chapter 14 submission) introduced other minor changes in the structure of the database. These changes were limited and only affected EU ETS functionality. No change was required to the database and application backup plan or to the disaster recovery plan. The database model, including the new tables, is provided in the document Annex A, available upon request due to the confidentiality of the data.

	No change to the capacity of the national registry occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(d) Change regarding conformance to technical standards	Changes introduced since version 6.7.3 of the national registry are listed in the document Annex B, available upon request due to the confidentiality of the data. Each release of the registry is subject to both regression testing and tests related to new functionality. These tests also include thorough testing against the DES and were successfully carried out prior to the relevant major release of the version to Production (see Annex B). Annex H testing was completed in January 2017 and the test report (document Annex H) is available upon request, due to the confidentiality of the data. No other change in the registry's conformance to the technical standards occurred for the reported period.
15/CMP.1 annex II.E paragraph 32.(e) Change to discrepancies procedures	No change of discrepancies procedures occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(f) Change regarding security	The mandatory use of hardware tokens for authentication and signature was introduced for registry administrators.
15/CMP.1 annex II.E paragraph 32.(g) Change to list of publicly available information	No change in the list of publicly available information with regards to confidentiality of information occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(h) Change of Internet address	No change of the registry internet address occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(i) Change regarding data integrity measures	No change of data integrity measures occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(j) Change regarding test results	Changes introduced since version 6.7.3 of the national registry are listed in the document Annex B, available upon request due to the confidentiality of the data. Both regression testing and tests on the new functionality were successfully carried out prior to release of the version to Production. The site acceptance test was carried out by quality assurance consultants on behalf of and assisted by the European Commission and the report (document Annex B) is available upon request due to the confidentiality of the data. Testing was carried out in January 2017 and the test report (document Annex H) is available upon request due to the confidentiality of the data.
1/CMP.8 paragraph 23 PPSR account	Previous period surplus reserve (PPSR) account will be stablished in the Consolidated System of European Registries (CSEUR).
The Annexes A, B and H are considered as confidential and are available upon request.	

2. QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGET

This section explains the EU 2020 emission reduction target under the UNFCCC and the target compliance architecture set up within the EU in order to meet that target, and gives an overview of the emission reduction targets of the Republic of Croatia in the context of the EU emission target.

In 2010, the EU submitted a pledge to reduce its GHG emissions by 2020 by 20 % compared to 1990 levels, in order to contribute to achieving the ultimate objective of the UNFCCC: 'to stabilise GHG concentrations at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system'[24], or, in other words, to limit the global temperature increase to less than 2°C compared to temperature levels before industrialization (FCCC/CP/2010/7/Add.1).

The definition of the Convention target for 2020 is documented in the revised note provided by the UNFCCC Secretariat on the 'Compilation of economy-wide emission reduction targets to be implemented by Parties included in Annex I to the Convention' (FCCC/SB/2011/INF.1/Rev.1 of 7 June 2011). In addition, the EU provided additional information relating to its quantified economy-wide emission reduction target in a submission as part of the process of clarifying the developed country Parties' targets in 2012 (FCCC/AWGLCA/2012/MISC.1).

The EU clarified that the accounting rules for the target under the UNFCCC are more ambitious than the current rules under the Kyoto Protocol, for example, including international aviation, adding an annual compliance cycle for emissions under the Effort Sharing Decision (ESD, Decision No 406/2009/EC on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020) or higher Clean Development Mechanism (CDM) quality standards under the EU Emissions Trading System (EU ETS) (FCCC/TP/2013/7). Accordingly, the following assumptions and conditions apply to the EU's 20 % target under the UNFCCC:

- The EU Convention pledge does not include emissions/removals from Land Use, Land-Use Change and Forestry, but it is estimated to be a net sink over the relevant period. EU inventories also include information on emissions and removals from LULUCF in accordance with relevant reporting commitments under the UNFCCC. Accounting for LULUCF activities only takes place under the Kyoto Protocol.
- The target refers to 1990 as a single base year for all gases and all Member States.
- Emissions from international aviation to the extent it is included in the EU ETS are included in the target[25].
- A limited number of CERs and ERUs units may be used to achieve the target: in the ETS, the use of international credits is capped. Quality standards also apply to the use of international

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[24] First steps to a safer future: Introducing the United Nations Framework Convention on Climate Change http://unfccc.int/essential/ background/convention/items/6036.php

[25] In the EU, emissions covered by category 'international aviation' go beyond the scope of the EU target, as emissions from international aviation are included in the EU Climate and Energy Package and the EU target under the UNFCCC to the extent to which aviation is part of the EU ETS. As such emissions cannot be separated in the EU inventory nor in the projections for the entire time series, emissions from international aviation have been considered in their entirety throughout the report. Over the period, total emissions from international aviation were between 1.2-2.9% of the annual total EU GHG emissions.

credits in the EU ETS, including a ban on credits from LULUCF projects and certain industrial gas projects. In the ESD sectors, the annual use of international credits is limited to up to 3 % of each Member State's ESD emissions in 2005, with a limited number of Member States being permitted to use an additional 1 % from projects in Least Developed Countries (LDCs) or Small Island Developing States (SIDS), subject to conditions.

- The Global Warming Potentials (GWPs) used to aggregate GHG emissions up to 2020 under EU legislation were those based on the Second Assessment Report of the IPCC when the target was submitted. In its submission to clarify the 2020 target from 20 March 2012, the EU announced that the implications of the CMP Decision to revise the GWPs to those from the IPCC Fourth Assessment Report (AR4) are under review. This review has been completed and revised GWPs from AR4 were adopted for the EU ETS. For the revision of ESD targets the revised GWPs were taken into account. For the implementation until 2020, GWPs from AR4 will be used consistently with the UNFCCC reporting guidelines for GHG inventories.
- The target covers the gases CO_2, CH_4, N_2O, HFCs, PFCs and SF_6.

Table 2-1*: Key facts of the Convention target of the EU-28*

Parameters	**Target**
Base Year	1990
Target Year	2020
Emission Reduction target	-20% in 2020 compared to 1990
Gases covered	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6
Global Warming Potential	AR4
Sectors Covered	All IPCC sources and sectors, as measured by the full annual inventory and international aviation to the extent it is included in the EU ETS.
Land Use, Land-Use Change, and Forests (LULUCF)	Accounted under KP, reported in EU inventories under the Convention. Assumed to produce net removals
Use of international credits (JI and CDM)	Possible subject to quantitative and qualitative limits.

As this target under the Convention has only been submitted by EU-28 and not by each of its Member States (MS), there are no specified convention targets for single MS. Due to this, Croatia as part of the EU-28, takes on a quantified economy-wide emission reduction target jointly with all Member States.

In 2009 the EU established internal rules under its “2020 climate and energy package”[26] - these underpin the EU implementation of the target under the Convention. The package introduced a clear approach to achieving the 20 % reduction of total GHG emissions from 1990 levels, which is equivalent to a 14 % reduction compared to 2005 levels. This 14 % reduction objective is divided between the ETS and ESD sectors. These two sub-targets are:

- a 21 % reduction target compared to 2005 for emissions covered by the ETS (including domestic and international aviation);
- a 10 % reduction target compared to 2005 for ESD sectors, shared between the 28 Member States (MS) through individual national GHG targets.

The distribution of the total target across the ETS and ESD is shown in the Figure 2.1.

[26] http://ec.europa.eu/clima/policies/package/index_en.htm

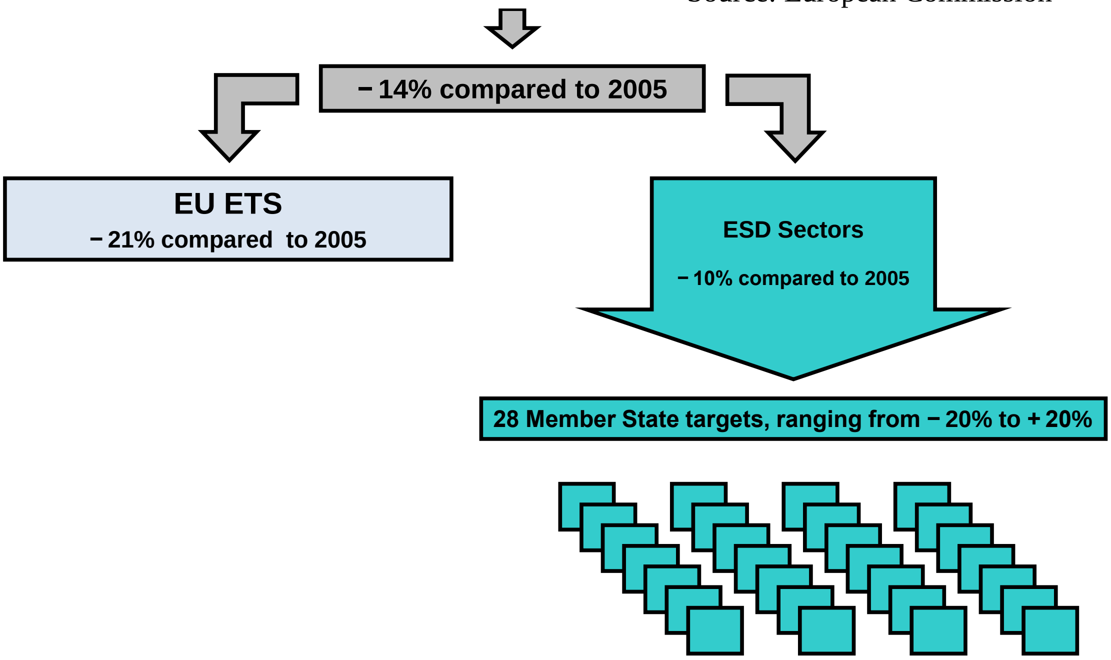
Under the revised EU ETS Directive (Directive 2009/29/EC), a single ETS cap covers the EU Member States and three participating non-EU countries (Norway, Iceland and Liechtenstein), i.e. there are no further individual caps by country. Allowances allocated in the EU ETS from 2013 to 2020 decrease by 1.74 % annually, starting from the average level of allowances issued by Member States for the second trading period (2008–2012).

The three non-EU countries participating in EU ETS (Norway, Iceland and Liechtenstein) are also subject to a similarly defined cap and the same annual decrease in allowance allocation.

The vast majority of emissions within the EU which fall outside the scope of the EU ETS are addressed under the Effort Sharing Decision (ESD) (Decision No 406/2009/EC). The ESD covers emissions from all sources outside the EU ETS, except for emissions from domestic and international aviation (which were included in the EU ETS from 1 January 2012), international maritime, and emissions and removals from land use, land-use change and forestry (LULUCF). It thus includes a

Figure 2.1.: GHG targets under the 2020 climate and energy package

Source: European Commission



diverse range of small-scale emitters in a wide range of sectors: transport (cars, trucks), buildings (in particular heating), services, small industrial installations, fugitive emissions from the energy sector, emissions of fluorinated gases from appliances and other sources, agriculture and waste. Such sources currently account for about 60 % of total GHG emissions in the EU. According to the Decision 529/2013/EU on accounting rules on GHG emissions and removals resulting from the activities relating to land use, land use change and forestry and on information concerning actions relating to those activities, Member States are obliged to provide information on their LULUCF actions to limit or reduce emissions and to maintain or increase removals.

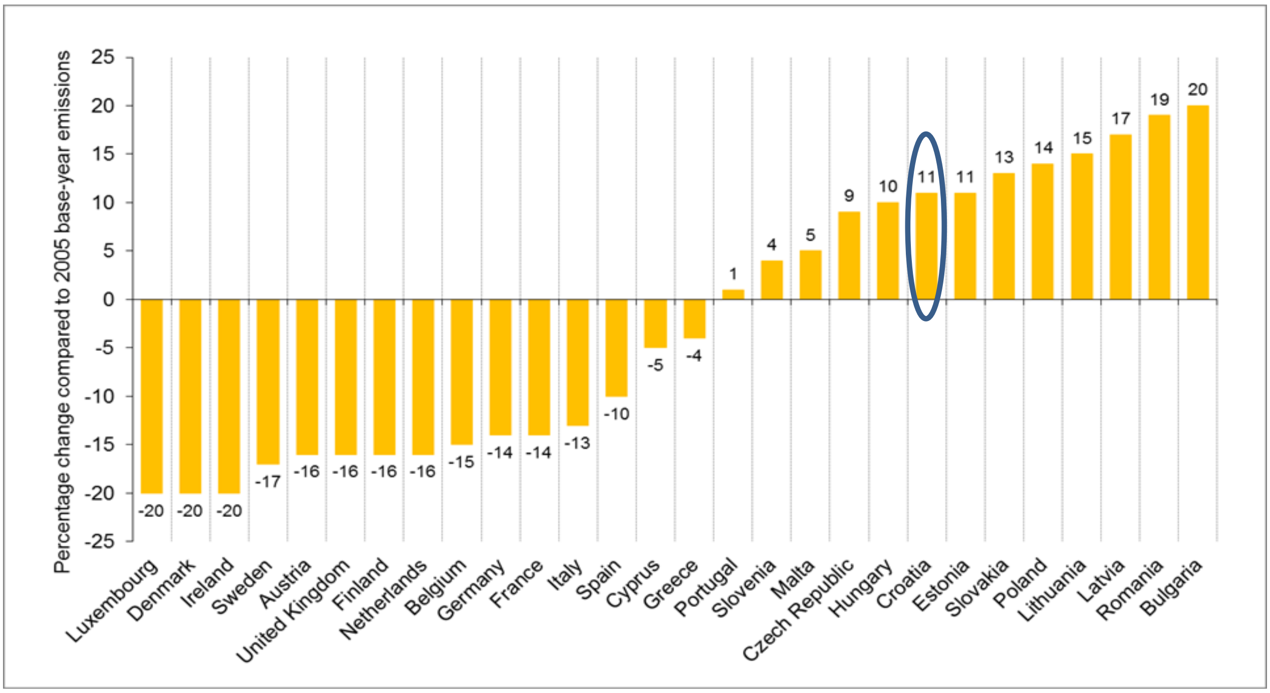


Figure 2-1*: National 2020 GHG emission limits under the ESD, relative to 2005 emissions levels*

Source*:* EU Decision No 406/2009/EC, Annex 2

While the EU ETS target is to be achieved by the EU as a whole, the ESD target was divided into national targets to be achieved individually by each Member State. Under the Effort Sharing Decision, national emission targets for 2020 are set, expressed as percentage changes from 2005 levels. These changes have been transferred into binding quantified annual reduction targets for the period from 2013 to 2020 (Commission Decisions 2013/162/EU and 2013/634/EU), denominated in Annual Emission Allocations (AEAs). At country level, 2020 targets under the ESD range from -20 % to +20 %, compared to 2005 levels. ESD targets for 2020 for each EU Member State are shown in the Figure 2-2. The target levels have been set on the basis of Member States' relative Gross Domestic Product per capita. In addition, different levels of development in the EU-28 are taken into account by the provision of several flexibility options.

Up to certain limitations, the ESD allows Member States (MS) to make use of flexibility provisions for meeting their annual targets: carry-over of over-achievements to subsequent years within each Member State up to 5%, transfers of AEAs between Member States and the use of international credits (credits from Joint Implementation and the Clean Development Mechanism) up to 3% according to the Decision No 406/2009/EC. Nevertheless, ESD targets are designed in a strict manner. The ESD and the Regulation No 525/2013 have introduced an annual compliance cycle requiring a review of Member States' greenhouse gas inventories to ensure compliance with their obligations under the ESD in the period 2013–2020. Monitoring, reporting and verification of the ESD targets mainly takes place through the submission of the national GHG inventories by Member States. Every year, once MS emissions are reviewed according to strict criteria (described in Chapter III of the Commission Implementing Regulation 749/2014), the European Commission issues an implementing decision on MS ESD emissions in the given year. MS exceeding their annual AEA, even after taking into account the flexibility provisions and the use of JI/CDM credits, will face inter alia a penalty – a deduction from their emission allocation of the following year (excess emissions, multiplied by 1.08).

National Annual Emission Allocations may be revised in late 2016 if the application of new UNFCCC methodologies to determine GHG inventories leads to a significant change of a Member State's past ESD emissions (Regulation No 525/2013 Article 27). In 2017 the allocations for the period 2017 to 2020 have been revised. The quantified annual reduction target for Croatia is decreasing from 20.9 million AEAs to 19.3 million AEAs in 2020. In the year 2015 verified emission of stationary installations covered under the EU-ETS in Croatia summed up to 8.386 Mt CO_2 equivalent.

Croatian Parliament passed the Law on the Ratification on Doha Amendment on 25 September 2015 (Official Gazette, International Treaties, No 06/15). Instrument of ratification has been deposited in December 2017.

Additional information is available in CTF tables 2(a)-(f).

For further information see the EU's second and third Biennial Report.

3. PROGRESS IN ACHIEVEMENT OF QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGETS AND RELEVANT INFORMATION

3.1. INTRODUCTION

3.1.1. General and development policy

In 2017, the Law on the System of Strategic Planning and Management of the Development of the Republic of Croatia (OG 123/17) was adopted. This Law regulates the system of strategic planning of the Republic of Croatia and the management of public policies, i.e. the preparation, development, implementation, reporting, monitoring of implementation and impacts and evaluation of strategic planning documents for the design and implementation of public policies which, in accordance with their competencies, authorities create.

The National Development Strategy is the highest hierarchical document. Subsequently, there are several sector and sector strategies, then plans and programs. It is currently drafting the first National Development Strategy of the Republic of Croatia until 2030, the plan is to be adopted by 2020 [4]. Currently, the strategic development of the Republic of Croatia is based on a series of multi-sectorial and sectorial strategies, plans and programs.

As an important current document defining development policy by 2020, the Government Program of the Republic of Croatia for the mandate of 2016-2020 [5] can be emphasized. The main goals are:

- achieving a stable and lasting economic growth;
- creation of new and quality jobs;
- stopping emigration of the population and demographic renewal;
- social justice and solidarity.

In the field of ecology, sustainable development and environmental protection, the following specific objectives are:

- protection of Croatian natural resources;
- integrated water management and protection of national water resources;
- adaptation to climatic change;
- efficient waste management.

In the area of energy, it is emphasized that new Energy Development Strategy is being developed, with specific objectives:

- improving the security of oil supply in Croatia and the EU;
- Improving the security of gas supply in Croatia and the EU.

3.1.2. Environmental protection policy in the context of climate change mitigation

The Ministry of Environment and Energy (MEE) is responsible for the overall national policy of environmental protection, including climate change and reporting on the implementation of policies and measures and on emission projections. The Croatian Agency for the Environment and Nature (CAEN) is responsible for organizing the preparation of the Inventory of greenhouse gas emissions, data collection, preparation of quality assurance and quality control plan and selection of an authorized institution for a three-year period. Update of the Report on the implementation of policies and measures to reduce emissions and enhance sinks of greenhouse gases and Report on projections of greenhouse gas emissions is organized in two-year cycles, according to Regulation (EU) No 525/2013.

With the Decision of the Government in accordance with the Air Protection Act (OG 130/11, 47/14, 61/17) in 2014 was established Committee for inter-sectorial coordination of policies and measures for mitigation and adaptation to climate change (OG 114/14). This Committee was in charge for monitoring and evaluation of the implementation and planning of policies and mitigation and adaptation measures for climate change in the Republic of Croatia. To this Committee were appointed representatives of competent state administration bodies and other relevant institutions, agencies and non-governmental organizations. The composition of the Committee, the tasks and the manner of the work of the Committee were determined by the above mentioned Government decision. The Committee consists of a Coordination Group and a Technical Working Group.
The Commission consists of a Coordination Group and a Technical Working Group, and the Coordination Group carries out the following tasks:

- evaluates and proposes to the Government of the Republic of Croatia the adoption of strategic documents related to the policies and measures to mitigate and adapt to climate change, taking into account long-term goals and feasibility with regard to technical, economic, sociological constraints, compliance with sectorial and local planning documents, and international obligations in all sectors;
- provide suggestions of the goals, policies and measures, and ways of monitoring the effects of policies and measures;
- provide suggestions and support in promoting effective interdisciplinary and synergistic activities, policies and measures.

Regarding to changes in the Government during 2017, in the beginning of 2018 Ministry of Environment and Energy started with reconstruction of this Committee.

It is possible to highlight the drafting of the Low Carbon Development Strategy of the Republic of Croatia by 2030 with a view to 2050 [2]. It is a multi-sectorial development strategy and a base for emission reduction by sectors in line with European strategic guidelines and UNFCCC commitments. Low-carbon Development Strategy should provide the basis for policy decisions and guidelines that all sectors will have to implement in order to significantly reduce greenhouse gas emissions. This Strategy should provide a transition towards a low-carbon and competitive economy whose growth is based on sustainable development. The Strategy has gone through public consultations but has not yet been adopted.

3.2. POLICIES AND MEASURES BY SECTORS

Policies and measures that are subject of this report are included in the ‘with existing measures’ and ‘with additional measures’ scenarios along with ‘without measures’ scenario in chapter 5 of the 7th National Communication of the Republic of Croatia.

Policies and measures to reduce emissions from sources and increase sinks of greenhouse gases are shown separately for the following sectors:

- energy
- transport
- industrial processes

- waste management
- agriculture
- land use, land use change and forestry (LULUCF)
- other (cross-cutting) policies and measures.

EU ETS, as a common EU, supranational, cross-cutting measure is listed with the other (cross-cutting) policies and measures.

The description of policies and measures by sectors is given in Chapter 4.2. in the 7th National Communication of the Republic of Croatia.

3.3. POLICIES AND MEASURES AND THEIR EFFECTS

Overview tables of policies and measures in each sector contain the code and title of the policy or measure, objective of implementation, identification of greenhouse gas affected by the policy or measure, type of policy instrument, status of implementation and implementing body.

The type of instrument was determined according to recommendations laid down in the Guidelines for the preparation of National Communications by parties included in Annex I to the Convention. The guidelines make a distinction between economic, fiscal, agreement, regulatory, information, research and other instruments.

The status of implementation that can be assigned to a policy or measure is: implemented, adopted or planned. Status "implemented" is assigned if national legislation is in force, voluntary agreements have been established, financial resources have been allocated or human resources have been mobilized. Status "adopted" is assigned to policies and measures for which an official government decision has been made and there is a clear commitment to proceed with implementation. For those policies and measures that are still under discussion and have a realistic chance of being adopted and implemented, status "planned" is chosen.

The overview is given in Section 4.3. of the 7th National Communication of the Republic of Croatia, as well as in the Annex II, CTF Table 3. Progress in achieving the goals is listed in CTF Table 4 and Chapter 4 of the Biennial Report as well as the information on the use of international flexible mechanisms.

3.4. ASSESSMENT OF THE ECONOMIC AND SOCIAL CONSEQUENCE OF RESPONSE MEASURES

According to Article 4, paragraphs 8 and 9 of the Convention Croatia strives to implement Kyoto commitments in a way which minimize adverse impact on developing countries. In continuation information on implementation of policies and measures that minimise adverse social, environmental and economic impacts on non-Annex I Parties is provided.

To ensure that all relevant possible impacts are taken into account, the EU has established processes that assess the economic and social consequences of climate policy measures.

For the development of new policy initiatives through legislative proposals by the European Commission, an impact assessment system has been established in which all proposals are examined before any legislation is passed. 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 (for details please refer to section 4.10 of the EU BR1 and EU BR3 as well as chapter 15 of the EU National Inventory Report 2017).

a) Market imperfections, fiscal incentives, tax and duty exemptions and subsidies

The ongoing liberalization of energy market is in line with EU policies and directives. No significant market distortions have been identified. Consumption taxes for electricity and fossil fuels were harmonized recently. The main instrument addressing externalities is the emission trading under the EU ETS.

b) Removing subsidies a ssociated with the use of environmentally unsound and unsafe technologies

In Republic of Croatia no subsidies for environmentally unsound and unsafe technologies have been identified.

c) Technological development of non-energy uses of fossil fuels

The Republic of Croatia has not participated actively in activities of this nature.

d) Carbon capture and storage technology development

The Republic of Croatia does not take part in any such activity.

e) Improvements in fossil fuel efficiencies

In 2017 The Draft of the Forth National Energy Efficiency Action Plan for the 2017- 2019 period has been drawn up in accordance with the template laid down by the European Commission, with which all EU Member States must comply. Measures for the period from 2017 to 2019 regarding energy efficiency are listed in the chapter 4.1.3. of the 7th National Communication of the Republic of Croatia and in the CTF Table 3.

4. PROJECTIONS

4.1. INTRODUCTION

This chapter presents the historical greenhouse gas emissions in the period from 1990 to 2014 and projections of greenhouse gas emissions for the period from 2015 to 2035. The emissions are presented as total emissions of greenhouse gases by sectors and by gases.

Since greenhouse gases have different irradiation properties and consequently different contribution to the greenhouse effect, emissions of each gas are multiplied by their Global Warming Potential (abb. GWP). In this case, the emission of greenhouse gases is presented as equivalent emission of carbon dioxide (CO_2 eq). In case of removing emissions of greenhouse gases, it refers to outflows (sinks) of greenhouse gas emissions and the amount is shown as negative value. The global warming potentials of individual gases that are used in the report are presented below.

GAS	**GWP**
Ugljikov dioksid (CO_2)	1
Metan (CH_4)	25
Didušikov oksid (N_2O)	298
HFC-23	14800
HFC-32	675
HFC-125	3500
HFC-134a	1430
HFC-143a	4470
HFC-152a	124
HFC-227ea	3220
HFC-236fa	9810
CF_4	7390
C_3F_8	8830
C_2F_6	12200
SF_6	22800

Source: 2006 IPCC Guidelines

Sectors are identified according to the Guidelines for the preparation of National Communications by Parties included in Annex I to the Convention (FCCC/CP/1999/7, Part II):

- energy, transport,
- industry,
- agriculture,
- waste management,
- LULUCF.

Particularly the emissions of certain greenhouse gases are presented:

- CO_2,
- CH_4,
- N_2O,
- HFCs and PFCs,
- SF_6.

According to the Guidelines for the preparation of National Communications by Parties included in Annex I to the Convention, projections are presented for three scenarios: ‘without measures’ scenario, ‘with existing measures’ scenario and ‘with additional measures’ scenario. Scenario ‘without measures’ assumes that implementation of adopted policies and measures as well as implementation of planned policies and measures will not happen. Scenario ‘with existing measures’ assumes a consistent application of policies and measures, which application is already in progress and application of adopted policies and measures, which application is likely, but still not begun. Scenario ’with additional measures’ is based on application of planned policies and measures.

Emission projections start from the inventory of greenhouse gas emissions (NIR 2017) which includes an inventory of emissions and sinks of greenhouse gases for the period 1990 – 2015. Reference year for projection is 2014.

4.2. PROJECTIONS OF GREENHOUSE GAS EMISSIONS

4.2.1. Projections of greenhouse gas emissions by sectors

Historical and projected trends in greenhouse gas emissions by sectors are presented in Figures 4-1 to 4-3. Emissions are presented for ‘without measures’ scenario, ‘with existing measures’ scenario and ‘with additional measures’ scenario for the period from 1990 to 2035.

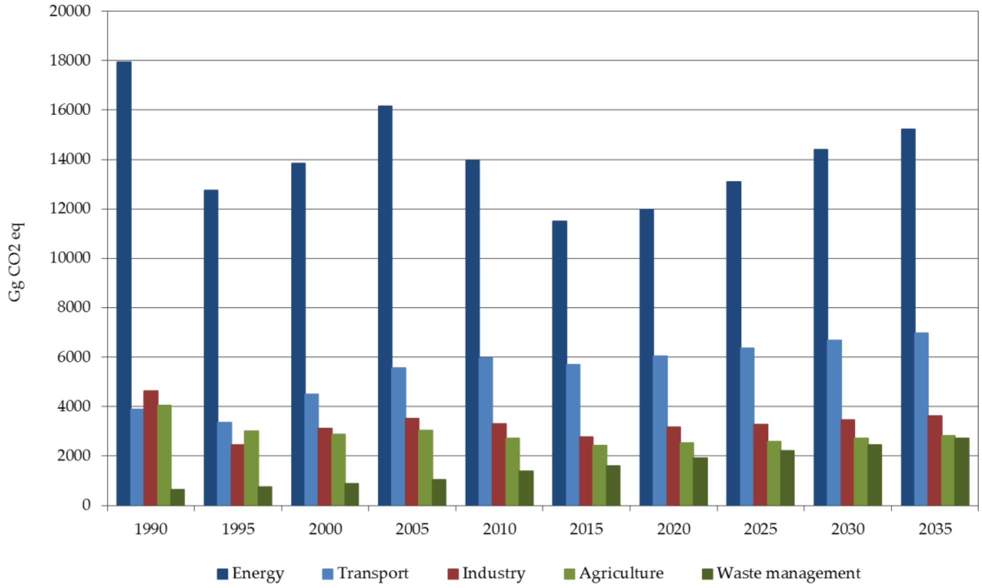


Figure 4-1: Historical and projected greenhouse emissions by sectors, 'without measures' scenario

Source: [3], [2]

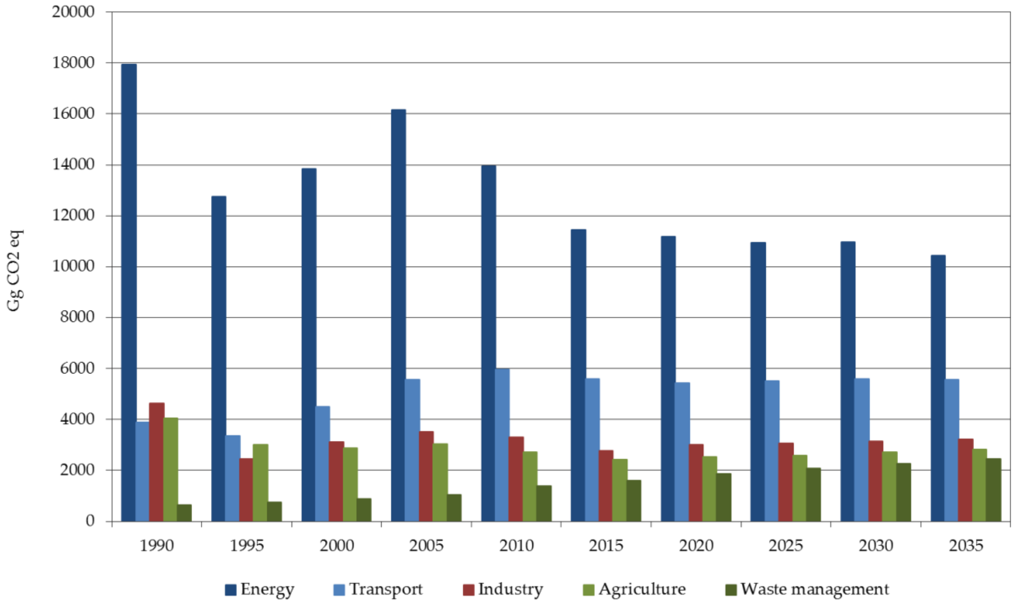


Figure 4-2: Historical and projected greenhouse emissions by sectors, 'with existing measures' scenario

Source: [12], [2],

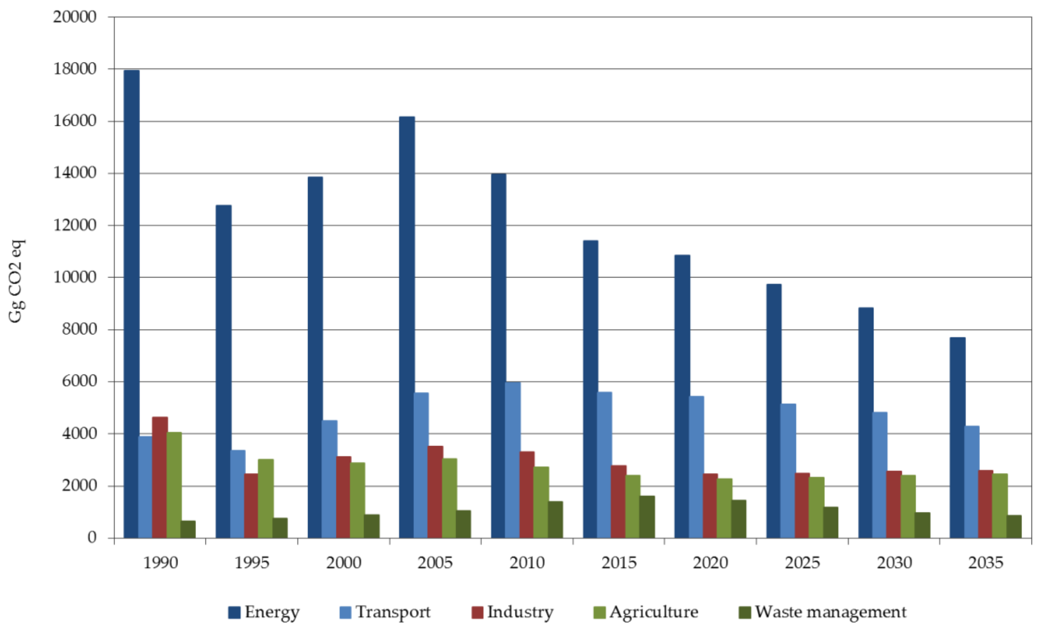


Figure 4-3: Historical and projected greenhouse emissions by sectors, 'with additional measures' scenario

Source: [3], [2],

The energy sector covers all activities that involve fuel combustion from stationary sources and fugitive emission from fuels. The emission from energy sector in 2014 amounted to 10,817 kt CO_2 and it is the main source of anthropogenic emission of greenhouse gases, it accounts approximately 46.9% of the total greenhouse gases emission in 2014. In scenario ‘without measures', i.e. without implementation of energy efficiency measures and renewable energy policy and with the increase in a number of fossil fuel power plants to reduce the import of electricity by 2030, projections show steady growth until 2035. In the ‘with existing measures’ scenario, projections show stagnation of emissions until 2020 as the growth of demand is mainly satisfied by the development of the renewable energy sources and energy efficiency. In the period from 2020 to 2035, this scenario shows a slight decrease due to expected development of the renewable energy sources even without the additional measures, only due to market competitiveness and impact of the EU ETS. Most measures to reduce emissions in the energy sector are defined by 2020, so it has not yet been determined which will be implemented after 2020. In scenario 'with additional measures', all measures planned in the energy sector were taken into account and projections show a steady trend of emission reduction.

The transport sector includes emissions from fuel combustion in road transportation, civil aviation, railways and navigation. The emission from transport sector in 2014 amounted to 5,642 kt CO_2-eq, which makes about 24.5 % of total Croatia’s greenhouse gases emission. In scenario ‘without measures', projections show a continuous trend of growth of emissions by 2035, primarily due to strong ties with expected increase in GDP and transport activity. In the ‘with existing measures’ scenario in the period from 2015 to 2035, projections indicate stagnation of emissions. Factors that encourage the growth of emissions are expected increase in economic activities and living standards, while the emission reductions are primarily affected by the measures to increase energy efficiency and use of renewable sources in transport. Most of the existing measures have defined duration by 2020 so in this scenario not many measures are simulated after 2020. In scenario 'with additional measures', projections show a continuous trend of reducing emissions by 2035, primarily due to expected measures to increase rail transport and development of electric vehicles, which will be the key condition for the strong reduction of emissions in transport sector in long term.

The industry sector includes the process emission from industrial processes and product use, while emission from fuel combustion in industry is included in the Energy sector. The emission from industry sector in 2014 amounted to 2 688 kt CO_2-eq, which makes about 11.7 % of total Croatia's greenhouse gases emission in 2014. The projections of emissions indicate an increase in 'without measures' and 'with existing measures' scenarios due to expected increase in production to the maximum utilization of existing productive capacity in the period until 2035. The differences between 'without measures' and 'with existing measures' scenarios relate to the degree of the implementation of process measures in 'with existing measures' scenario prescribed by the sectoral legislation. The projections of emissions indicate a decrease in 'with additional measures' scenario due to the implementation of cost-effective measures to reduce emissions.

The agriculture sector covers about 10.5 % of total greenhouse gas emissions in 2014 (emission is 2 427 kt CO_2-eq). The projections indicate an increase in emissions after 2015, implying a growth of emissions from the agricultural sector based on the assumed increase in livestock population and crop production (assumption based on expert judgement of University of Zagreb, Faculty of Agriculture experts) and normalization of agricultural production (trend analysis).

The waste management sector participates in the total emission of greenhouse gases with about 6.4% in 2014 (emission is 1 474 kt CO_2-eq). The projections of emissions indicate an increase in 'without measures' and 'with existing measures' scenarios due to expected increase of waste quantities in the period until 2035 as a result of higher living standards, despite the effects of measures undertaken to avoid/reduce and recycle waste. The differences between 'without measures' and 'with existing measures' scenarios relate to the degree of the implementation of measures in 'with existing measures' scenario prescribed by the sectoral legislation. The projections of emissions indicate a decrease in 'with additional measures' scenario due to the implementation of cost-effective measures to reduce emissions. The potential of CO_2 emission reduction, which can be achieved by implementing the measures included in the scenarios 'with existing measures' and 'with additional measures' is balanced in the Energy sector.

In the year 2014, removals by sink in the LULUCF sector were -6 591.28 kt CO_2-eq. Projections of removals up to 2035 amount -2 338.29 kt CO_2-eq sinks per year. These projections are made by sectorial sub-categories 'Forest land', 'Cropland', 'Grasslands', 'Wetlands', 'Settlements', 'Other land' and 'Harvested wood products' for the scenario with existing measures and their aggregated trend is shown in Figure 5- 4.

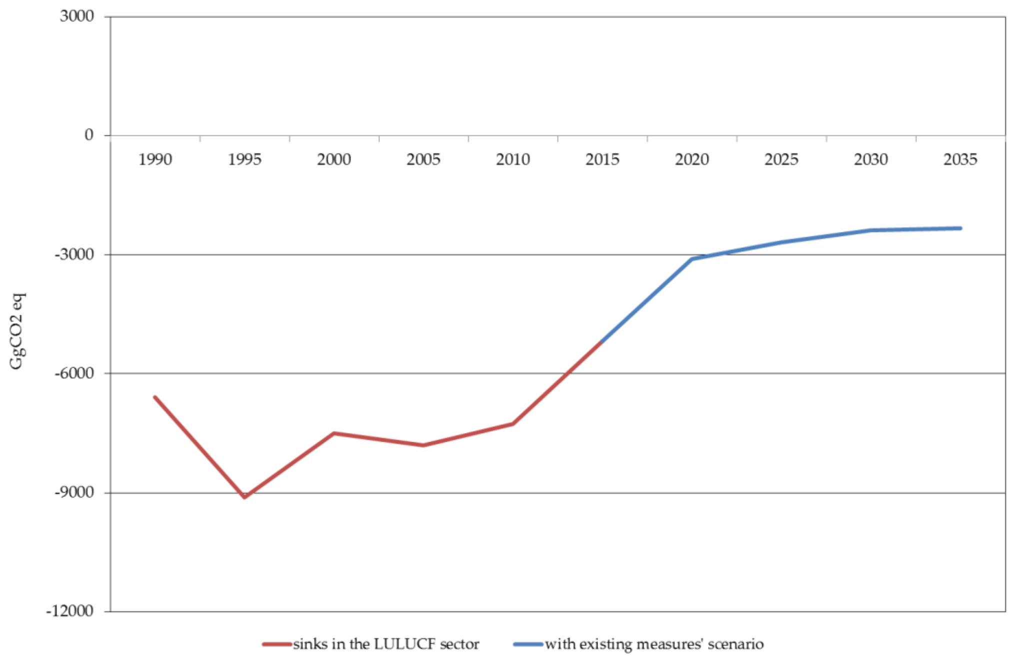


Figure 4-4: Historical and projected greenhouse removals in the LULUCF, 'with existing measures' scenario

Source: [3], [2]

4.2.2. Projections of greenhouse gas emissions by gases

Trends in emissions, by greenhouse gases (CO_2, CH_4, N_2O, HFCs and PFCs, SF_6), for all three scenarios, in the period from 1990 until 2035 are shown in Figure 5-5.

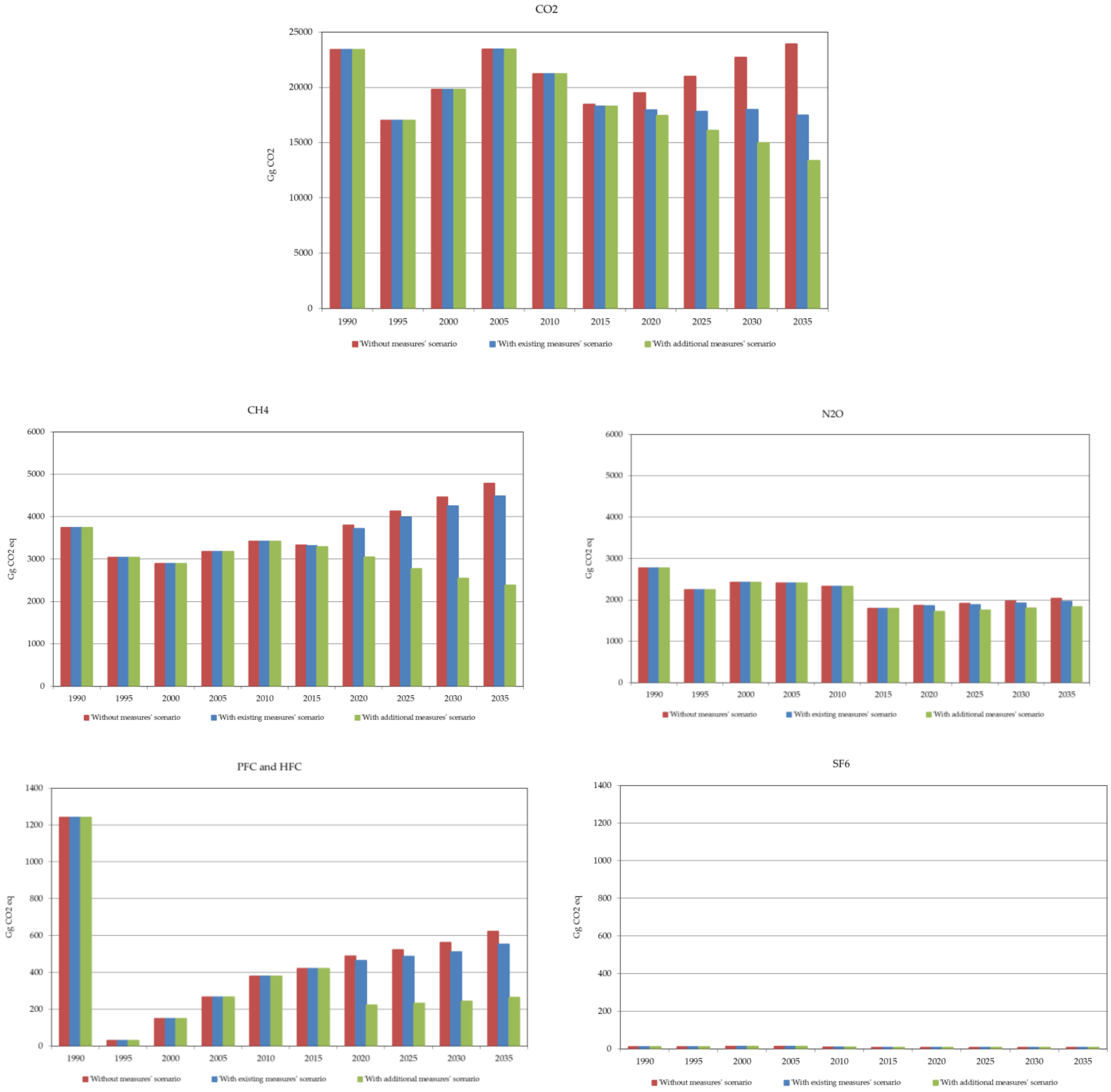


Figure 4-5: Projections of greenhouse gas emissions by gases

Source: [3], [2]

Historical emissions and projections of greenhouse gas emissions CO_2, CH_4, N_2O, HFCs and PFCs, SF_6, for all three scenarios, in the period from 1990 until 2035 are shown in Table 5-1.

Table 4-1: Historical emissions and projections of greenhouse gas emissions by gases, kt CO_2-eq

CO2	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
'Without measures' scenario	23,390.08	16,992.80	19,789.12	23,451.85	21,203.74	18,455.92	19,478.81	20,981.70	22,700.20	23,896.19
'With existing measures' scenario	23,390.08	16,992.80	19,789.12	23,451.85	21,203.74	18,295.74	17,937.49	17,826.15	17,990.49	17,481.24
'With additional measures' scenario	23,390.08	16,992.80	19,789.12	23,451.85	21,203.74	18,271.93	17,431.88	16,093.41	14,989.61	13,363.06
CH4	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
'Without measures' scenario	3,744.19	3,033.66	2,887.85	3,173.79	3,415.08	3,327.91	3,794.42	4,132.36	4,463.65	4,785.08
'With existing measures' scenario	3,744.19	3,033.66	2,887.85	3,173.79	3,415.08	3,313.14	3,713.89	3,985.90	4,248.31	4,487.82
'With additional measures' scenario	3,744.19	3,033.66	2,887.85	3,173.79	3,415.08	3,285.09	3,045.69	2,768.80	2,546.74	2,385.09
N2O	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
'Without measures' scenario	2,768.74	2,243.31	2,418.77	2,407.93	2,322.33	1,794.47	1,868.01	1,909.88	1,973.65	2,031.41
'With existing measures' scenario	2,768.74	2,243.31	2,418.77	2,407.93	2,322.33	1,794.47	1,854.15	1,878.63	1,920.88	1,957.93
'With additional measures' scenario	2,768.74	2,243.31	2,418.77	2,407.93	2,322.33	1,794.51	1,722.46	1,753.45	1,797.26	1,834.89
PFC and HFC	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
'Without measures' scenario	1,240.24	29.32	147.90	265.80	378.91	419.58	487.10	522.51	562.26	621.97
'With existing measures' scenario	1,240.24	29.32	147.90	265.80	378.91	419.58	463.90	486.06	511.15	552.86
'With additional measures' scenario	1,240.24	29.32	147.90	265.80	378.91	419.58	221.68	231.50	242.88	263.24
SF6	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
'Without measures' scenario	10.45	11.12	11.62	13.03	8.95	6.38	6.59	6.71	6.86	7.08
'With existing measures' scenario	10.45	11.12	11.62	13.03	8.95	6.38	6.59	6.71	6.86	7.08
'With additional measures' scenario	10.45	11.12	11.62	13.03	8.95	6.38	6.59	6.71	6.86	7.08
TOTAL	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
'Without measures' scenario	31,154	22,310	25,255	29,312	27,329	24,006	25,636	27,553	29,707	31,341
'With existing measures' scenario	31,154	22,310	25,255	29,312	27,329	23,830	23,977	24,182	24,677	24,488
'With additional measures' scenario	31,154	22,310	25,255	29,312	27,329	23,777	22,430	20,855	19,583	17,854

The energy sector has the most significant anthropogenic sources of CO_2 emissions, with maximum value from 21 218 kt CO_2 (for the ‘without measures’ scenario) to 11 182 kt CO_2 (for the 'with additional measures' scenario) in 2035.

The most important source of N_2O emissions is agriculture sector, which projections in 2035 have the maximum of 2 819 kt CO_2-eq for the ‘without measures’ scenario, or 2 459 kt CO_2-eq for the ‘with additional measures' scenario.

The sources of HFCs and PFCs and SF_6 emissions are in the industry sector. Although their emissions in absolute terms are not large, due to the large global warming potential (GWP), their contribution is significant. Projections in 2035 have the maximum value of 825 kt CO_2-eq for the ‘without measures’ scenario, 687 kt CO_2-eq eq for the ‘with existing measures’ scenario and 333 kt CO_2-eq for the ‘with additional measures' scenario.

4.2.3. Total projections of greenhouse gas emissions

Total projections of greenhouse gas emissions (without LULUCF) for all three scenarios, for the period until 2035 are shown in Figure 5-6 and Table 5-2.

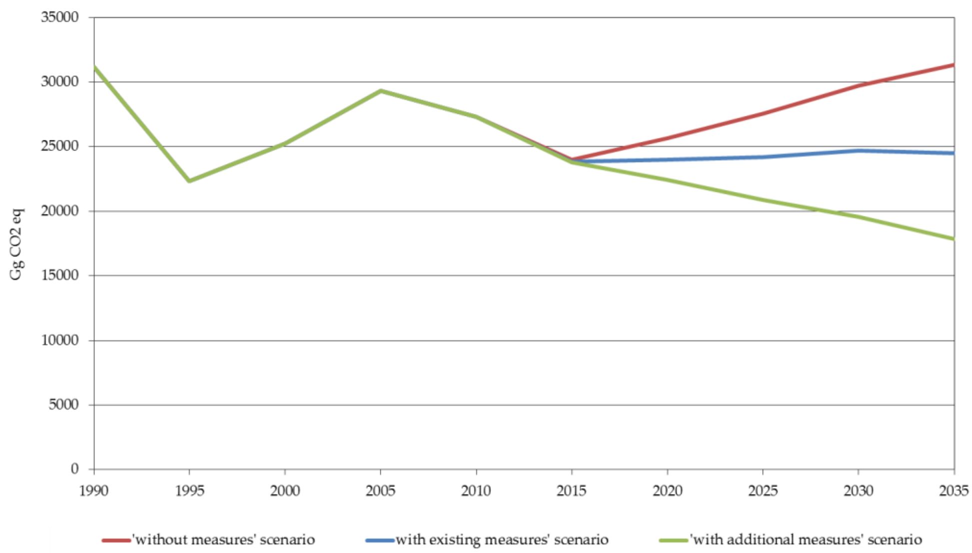


Figure 4-6: Total projections of greenhouse gas emissions (without LULUCF) for period until 2035

Source: [3], [2]

Table 4-2: Historical emissions and projections of greenhouse gas emissions by sectors, kt CO_2-eq

'Without measures' scenario	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Energy	17.951	12.754	13.851	16.169	13.952	11.496	11.975	13.098	14.395	15.215
Transport	3.881	3.368	4.499	5.561	5.952	5.703	6.050	6.373	6.692	6.973
Industry	4.629	2.441	3.128	3.508	3.315	2.781	3.157	3.287	3.457	3.626
Waste management	654	740	889	1.045	1.392	1.612	1.931	2.205	2.450	2.708
Agriculture	4.039	3.008	2.888	3.030	2.718	2.414	2.523	2.591	2.713	2.820
TOTAL	**31.154**	**22.310**	**25.255**	**29.312**	**27.329**	**24.006**	**25.636**	**27.553**	**29.707**	**31.341**

'With existing measures' scenario	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Energy	17.951	12.754	13.851	16.169	13.952	11.433	11.169	10.944	10.967	10.434
Transport	3.881	3.368	4.499	5.561	5.952	5.603	5.422	5.514	5.595	5.561
Industry	4.629	2.441	3.128	3.508	3.315	2.781	3.009	3.060	3.147	3.229
Waste management	654	740	889	1.045	1.392	1.599	1.854	2.072	2.256	2.444
Agriculture	4.039	3.008	2.888	3.030	2.718	2.414	2.523	2.591	2.713	2.820
TOTAL	**31.154**	**22.310**	**25.255**	**29.312**	**27.329**	**23.830**	**23.977**	**24.182**	**24.677**	**24.488**

'With additional measures' scenario	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Energy	17.951	12.754	13.851	16.169	13.952	11.412	10.847	9.741	8.840	7.677
Transport	3.881	3.368	4.499	5.561	5.952	5.599	5.421	5.128	4.827	4.286
Industry	4.629	2.441	3.128	3.508	3.315	2.781	2.447	2.484	2.547	2.586
Waste management	654	740	889	1.045	1.392	1.597	1.449	1.185	974	845
Agriculture	4.039	3.008	2.888	3.030	2.718	2.387	2.266	2.318	2.395	2.459
TOTAL	**31.154**	**22.310**	**25.255**	**29.312**	**27.329**	**23.777**	**22.430**	**20.855**	**19.583**	**17.854**

Projections show that compared to 1990, in 2035 the emission remains approximately the same as in 1990 in the 'without measures' scenario. In the ‘with existing measures’ scenario, in 2035 the emission is reduced by 21.4 % compared to 1990, while in the 'with additional measures' scenario emission is reduced by 42.7 % compared to 1990.

In the ‘with existing measures’ scenario, projections show stagnation of emissions until 2020. In the period from 2020 to 2035, this scenario shows a slight increase of emission.

In the 'with additional measures' scenario, projections show a steady downward trend of emissions.

In ‘with existing measures’ scenario, in relation to the 'without measures' in 2035, the greenhouse gas emissions will be reduced by 21.9 %, while in the scenario 'with additional measures' by 43 %.

In scenario 'with additional measures' in relation to the scenario ‘with existing measures’ in 2035, greenhouse gas emissions will be reduced by 27.1 %.

4.2.4. Total effects of policies and measures

Total effects of applied policies and measures to reduce greenhouse emissions are shown in Table 5-3.

Table 4-3: Total effects of policies and measures, kt CO_2-eq

	2015	**2020**	**2025**	**2030**	**2035**
'Without measures' scenario	24,006	25,636	27,553	29,707	31,341
‘With existing measures’ scenario	23,830	23,977	24,182	24,677	24,488
TOTAL	176	1,659	3,371	5,029	6,853

By comparing the 'without measures' scenario with scenario that includes the application of relevant policy and measures which implementation is already in progress, or application of policy and measures that have already been adopted (‘with existing measures’ scenario), total effects of applied policies and measures have been determined. Emission is reduced by 176 kt CO_2-eq in 2015 to 6 853 kt CO_2-eq in 2035 (Figure 5-7).

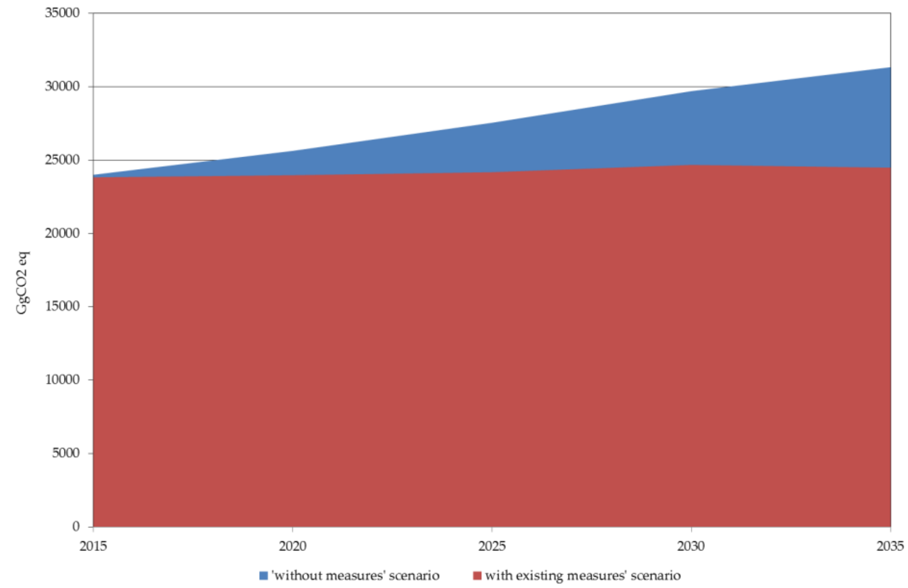


Figure 4-7: Total effects of policies and measures

4.2.5. Emissions of the ETS i ESD sectors

Historical emissions and projections of greenhouse gas emissions in ETS and ESD sectors for three scenarios are shown in Table 5-4.

Table 4-4: Historical emissions and projections of greenhouse gas emissions in ETS and ESD sectors, kt CO_2-eq

	2010	2015	2020	2025	2030	2035
'Without measures' scenario	27,329	24,006	25,636	27,553	29,707	31,341
ETS	8,710	8,772	9,452	10,546	11,881	12,693
ESD	18,587	15,201	16,142	16,963	17,774	18,594
‘With existing measures’ scenario	27,329	23,830	23,977	24,182	24,677	24,488
ETS	8,710	8,731	8,707	8,515	8,630	8,155
ESD	18,587	15,066	15,228	15,622	15,996	16,277
'With additional measures' scenario	27,329	23,777	22,430	20,855	19,583	17,854
ETS	8,710	8,712	8,098	7,342	6,848	6,024
ESD	18,587	15,033	14,290	13,469	12,686	11,780

Source: [3], [2]

Emissions within the ETS in 2010 encompassed 32 % of total emissions, amounting to 8,710 kt CO_2-eq. Projections indicate that in 2015 the ETS cover approximately 36.6 % of total emissions, while in 2035, according to the ‘with additional measures‘ scenario, 33.7 % of emissions will be included, 33.3 % of emissions will be included according to the ‘with existing measures’ scenario and 40.5 % of total emissions will be included in the 'without measures' scenario.

In the ‘without measures‘ scenario, compared to 2010, emission projections show an increase in emissions of 0.7% in 2015 up to 45.7 % in 2035. The reason of this increase is primarily due to no improvements in energy efficiency and production of electricity from fossil fuel plants as a result of the assumption of reduced dependency on electricity imports and assumption that all new electricity demands in this scenario will be covered by fossil fuel power plants. In the ‘with existing measures’ scenario, projections show stagnation of emissions until 2020. In the period from 2020 to 2035, this scenario shows a slight decrease of emission (by 6.4 % in 2035 compared to 2010). In the 'with additional measures' scenario, projections show a steady downward trend, primarily due to planned actions to promote usage of renewable energy sources and energy efficiency. Compared to 2010, emission projections show a decrease in emissions of 30.8 % in 2035.

In 2010, emissions within ESD sector amounted to 18,587 kt CO_2-eq, which represents 68 % of total emissions. In the ‘without measures‘ scenario, increase in emissions is expected in the whole observed period from 2015 to 2035, and it is expected that in 2035 the emission will be at the 2010 level. In the ‘with existing measures’ scenario, projections show a slight increase of emission in period from 2015 to 2035 (by 8 % in 2035 compared to 2015). Compared to 2010, emission projections show a decrease in emissions of 12.4 % in 2035. Compared to 2005, emission projections show a decrease in emissions of 12.6 % in 2035. In the 'with additional measures' scenario, further reduction of emissions is expected, by 36.6 % in 2035 compared to 2010.

5. PROVISION OF FINANCIAL, TECHNOLOGICAL AND CAPACITY BUILDING SUPPORT TO DEVELOPING COUNTRIES

The Law on Air Protection stipulates the use of revenues from the greenhouse gas emissions auctioning, including the financing of mitigation measures for climate change and adaptation in third countries. By the decision on the adoption of the Plan for the use of financial resources obtained from the sale of auctioning revenues in the Republic of Croatia by 2020 (OG 19/18), funds for financing projects in third countries are planned.

As an Annex I country, the Republic of Croatia has so far not pursued separate activities related to the financing of transfer of knowledge and technology in the field of environmental protection to developing countries. In accordance with the Plan for the use of auctioning revenues in the Republic of Croatia by 2020, the Bilateral Assistance Program for Third Countries in the Area of Climate Change for the period 2018-2020 is being drafted, whose adoption is planned during 2018 and the application since 2019.

It is important to note that as the most recent EU member state with recent experience in the transposition and implementation of EU environmental legislation, the Republic of Croatia is participating in the TAIEX assistance program, with which Croatia is involved in the transfer of knowledge and experience to potential candidate countries for membership in the EU, which are also non-Annex I states (e.g. Bosnia and Herzegovina, Montenegro, Serbia, Albania).

As part of the transfer of knowledge, the Republic of Croatia also participated in the project "Regional Network for Environment and Climate - ECRAN" (2013 - 2016). Given that the project's task was to continue working on linking and transferring knowledge and experience in the field of environment and climate between the countries in the region, experts from the Republic of Croatia were involved in the implementation of the project on "soft" technology transfer from the field of climate change.

Data for 2015 and 2016 are provided in CTF tables 7, 7(a) and 7(b). CTF Table 8 and Table 9 remain blank because Republic of Croatia has not contributed to any program specifically aimed at capacity building or technology transfer in developing countries.

ANNEX II. CTF TABLES FOR THE BIENNIAL REPORT (19/CP.18)

CTF Table 1: Emission trends (Summary)

GREENHOUSE GAS EMISSIONS	Base year[(1)]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
	CO_2 equivalent (kt)																											(%)
CO_2 emissions without net CO_2 from LULUCF	23390.08	23390.08	17268.91	16607.13	17081.23	16342.18	16992.80	17587.90	18666.47	19372.39	20215.65	19789.12	20943.11	22031.13	23355.22	23005.23	23451.85	23684.94	25017.37	23746.47	21965.64	21203.74	20759.40	19172.43	18525.44	17777.06	17918.75	-23.39
CO_2 emissions with net CO_2 from LULUCF	16762.70	16762.70	9392.03	8524.63	8600.43	7731.75	7837.63	8717.27	10310.21	11113.34	11525.62	12088.36	12888.54	13776.09	15727.45	15336.43	15572.30	16004.16	17866.04	16312.11	14495.10	13863.57	14402.24	13054.52	11924.95	11109.39	12826.69	-23.48
CH_4 emissions without CH_4 from LULUCF	3744.19	3744.19	3620.87	3230.74	3280.09	3072.18	3033.66	3027.57	2978.72	2947.27	2946.42	2887.85	2958.00	2960.11	3070.99	3211.38	3173.79	3266.73	3277.28	3310.66	3386.39	3415.08	3384.45	3311.17	3267.57	3226.54	3430.64	-8.37
CH_4 emissions with CH_4 from LULUCF	3745.42	3745.42	3624.05	3245.89	3314.48	3083.69	3041.21	3044.10	2996.34	2992.38	2952.33	2984.76	2976.99	2966.51	3110.54	3214.30	3176.52	3272.78	3309.04	3320.24	3391.48	3416.84	3403.08	3350.06	3269.50	3226.86	3444.61	-8.03
N_2O emissions without N_2O from LULUCF	2768.74	2768.74	2618.52	2673.46	2292.12	2322.05	2243.31	2248.42	2436.23	2083.13	2300.27	2418.77	2394.74	2294.31	2195.23	2454.11	2407.93	2348.67	2439.09	2479.93	2249.18	2322.33	2379.23	2231.85	1714.46	1624.92	1727.57	-37.60
N_2O emissions with N_2O from LULUCF	2805.47	2805.47	2656.02	2718.87	2349.70	2363.68	2281.66	2292.52	2480.51	2146.70	2335.90	2517.37	2446.30	2343.84	2275.03	2515.88	2476.66	2426.85	2534.99	2560.80	2326.92	2396.94	2467.00	2333.34	1791.21	1701.01	1813.95	-35.34
HFCs	NO	NO	NO	NO	NO	NO	29.32	49.77	71.93	101.88	122.08	147.90	161.46	185.34	212.23	240.33	265.80	292.57	326.74	338.04	341.35	378.87	396.20	397.28	408.91	413.60	419.89	100.00
PFCs	1240.24	1240.24	850.75	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.26	0.03	0.02	0.03	0.06	0.06	0.03	-100.00
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
SF_6	10.45	10.45	10.33	10.42	10.53	10.64	11.12	11.57	11.43	11.99	11.99	11.62	11.69	12.01	12.28	12.57	13.03	13.01	13.05	11.98	8.03	8.95	9.37	9.18	6.10	6.81	5.26	-49.62
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total (without LULUCF)	31153.70	31153.70	24369.39	22521.75	22663.97	21747.06	22310.22	22925.24	24164.77	24516.66	25596.42	25255.27	26469.00	27482.89	28845.96	28923.62	29312.39	29605.91	31073.53	29887.08	27950.84	27329.01	26928.66	25121.94	23922.55	23049.00	23502.15	-24.56
Total (with LULUCF)	24564.27	24564.27	16533.18	14499.81	14275.15	13189.76	13200.94	14115.24	15870.42	16366.29	16947.92	17750.01	18484.98	19283.78	21337.54	21319.49	21504.31	22009.37	24049.87	22543.17	20563.14	20065.22	20677.90	19144.40	17400.73	16457.73	18510.43	-24.64
Total (without LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
Total (with LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[(1)]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
																											CO_2 equivalent (kt)	(%)
1. Energy	21831.84	21831.84	16244.53	15409.17	16242.70	15214.87	16121.96	16768.29	17608.07	18421.08	18970.42	18350.77	19399.08	20514.22	21914.68	21371.30	21730.04	21815.23	23071.16	21878.99	20703.82	19903.86	19634.83	18187.43	17415.67	16459.83	16728.04	-23.38
2. Industrial processes and product use	4628.76	4628.76	3530.98	2925.73	2409.96	2687.06	2440.50	2438.65	2679.06	2430.82	2858.48	3127.50	3141.95	3083.99	3081.04	3444.02	3507.64	3667.54	3838.77	3761.03	3056.21	3315.26	3083.66	2809.20	2538.56	2688.00	2665.51	-42.41
3. Agriculture	4039.08	4039.08	3929.71	3508.90	3318.55	3128.24	3008.23	2966.37	3093.36	2860.10	2917.90	2887.95	3015.10	2926.78	2849.91	3054.24	3029.67	2976.48	2920.35	2909.42	2796.26	2717.50	2785.56	2704.64	2536.99	2427.05	2555.32	-36.74
4. Land use, land-use change and forestry[(5)]	-6589.43	-6589.43	-7836.21	-8021.94	-8388.82	-8557.29	-9109.28	-8810.00	-8294.35	-8150.37	-8648.50	-7505.25	-7984.01	-8199.11	-7508.42	-7604.13	-7808.08	-7596.53	-7023.66	-7343.92	-7387.70	-7263.79	-6250.76	-5977.54	-6521.81	-6591.28	-4991.72	-24.25
5. Waste	654.01	654.01	664.17	677.95	692.75	716.90	739.53	751.93	784.28	804.66	849.61	889.04	912.87	957.90	1000.33	1054.07	1045.05	1146.66	1243.25	1337.63	1394.54	1392.39	1424.61	1420.67	1431.33	1474.13	1553.28	137.50
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total (including LULUCF)[(5)]	24564.27	24564.27	16533.18	14499.81	14275.15	13189.76	13200.94	14115.24	15870.42	16366.29	16947.92	17750.01	18484.98	19283.78	21337.54	21319.49	21504.31	22009.37	24049.87	22543.17	20563.14	20065.22	20677.90	19144.40	17400.73	16457.73	18510.43	-24.64

[(1)] 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 COP. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[(2)] Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[(3)] In accordance with the UNFCCC reporting guidelines, for Parties that decide to report indirect CO2 the national totals shall be provided with and without indirect CO_2.

[(4)] In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is kt of CO_2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.

[(5)] Includes net CO_2, CH_4 and N_2O from LULUCF.

Table 1: Emission trends (CO_2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[(1)]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
	(kt)																											%
1. Energy	20758.79	20758.79	15252.77	14532.35	15321.31	14364.19	15263.42	15828.26	16704.89	17546.74	18065.30	17485.25	18495.16	19663.59	20998.81	20426.78	20811.67	20908.30	22159.97	20984.97	19811.20	18987.46	18764.79	17363.42	16609.97	15725.63	15924.56	-23.29
A. Fuel combustion (sectoral approach)	20078.93	20078.93	14586.28	13856.50	14434.43	13571.13	14331.09	14930.29	15858.22	16792.20	17327.30	16692.57	17634.30	18783.12	20162.49	19540.93	19942.81	20009.09	21290.36	20214.14	19104.53	18312.02	18084.55	16791.33	16066.05	15200.29	15597.65	-22.32
1. Energy industries	7071.41	7071.41	4738.14	5404.66	5929.31	4630.04	5226.83	5054.87	5557.44	6212.63	6439.06	5816.84	6381.66	7273.79	7946.52	6830.91	6853.44	6674.57	7868.62	6820.96	6403.19	5925.02	6297.13	5895.66	5274.69	4769.85	4771.67	-32.52
2. Manufacturing industries and construction	5501.67	5501.67	3919.00	3114.89	3031.80	3202.34	2954.66	2998.35	3026.43	3313.18	2980.25	3103.13	3196.99	3057.13	3136.78	3583.00	3723.73	3855.12	3853.05	3872.78	3157.36	3015.80	2779.55	2409.07	2380.65	2324.33	2222.70	-59.60
3. Transport	3786.94	3786.94	2866.87	2776.67	2925.04	3102.80	3292.78	3620.09	3965.98	4098.64	4329.03	4354.24	4419.92	4729.16	5126.60	5262.05	5467.52	5820.73	6241.46	6078.62	6089.63	5865.04	5726.02	5544.99	5631.06	5575.58	5883.52	55.36
4. Other sectors	3718.91	3718.91	3062.28	2560.29	2548.29	2635.95	2856.82	3256.98	3308.37	3167.75	3578.95	3418.37	3635.73	3723.03	3952.60	3864.98	3898.12	3658.66	3327.24	3441.78	3454.34	3506.16	3281.84	2941.62	2779.65	2530.53	2719.76	-26.87
5. Other	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	0.00
B. Fugitive emissions from fuels	679.85	679.85	666.49	675.85	886.88	793.06	932.34	897.98	846.67	754.55	738.00	792.67	860.87	880.47	836.32	885.85	868.86	899.21	869.60	770.84	706.67	675.43	680.24	572.09	543.92	525.34	326.91	-51.91
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Oil and natural gas and other emissions from energy production	679.85	679.85	666.49	675.85	886.88	793.06	932.34	897.98	846.67	754.55	738.00	792.67	860.87	880.47	836.32	885.85	868.86	899.21	869.60	770.84	706.67	675.43	680.24	572.09	543.92	525.34	326.91	-51.91
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Industrial processes	2580.73	2580.73	1964.66	2008.74	1707.24	1929.89	1682.55	1706.66	1891.37	1777.70	2095.48	2236.86	2349.17	2283.00	2283.82	2502.16	2554.55	2695.23	2767.42	2664.23	2077.31	2128.20	1889.39	1707.69	1840.82	1981.93	1924.80	-25.42
A. Mineral industry	1280.88	1280.88	863.47	938.79	804.89	976.59	759.97	844.58	954.10	1027.37	1284.91	1423.08	1643.76	1638.10	1619.95	1731.21	1785.37	1917.28	1948.84	1856.99	1460.61	1432.29	1220.06	1163.71	1275.91	1360.19	1313.14	2.52
B. Chemical industry	771.87	771.87	682.27	850.24	729.48	749.67	770.84	712.81	756.12	606.29	722.89	724.36	633.80	562.20	577.51	664.88	664.65	662.17	693.88	677.48	524.80	594.74	571.33	478.93	485.96	534.35	537.04	-30.42
C. Metal industry	338.56	338.56	273.84	118.53	58.10	80.11	38.37	19.30	40.11	28.85	26.86	26.78	6.56	5.86	9.88	15.36	11.81	13.85	13.10	24.15	11.56	27.55	29.45	2.02	16.88	28.58	13.63	-95.97
D. Non-energy products from fuels and solvent use	189.43	189.43	145.07	101.19	114.77	123.51	113.37	129.97	141.04	115.19	60.83	62.64	65.06	76.85	76.47	90.71	92.72	101.93	111.61	105.61	80.35	73.61	68.55	63.03	62.06	58.80	60.99	-67.80
E. Electronic industry																												
F. Product uses as ODS substitutes																												
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
3. Agriculture	50.02	50.02	50.95	65.51	52.14	47.57	46.29	52.44	68.39	44.25	50.49	60.87	92.09	80.76	71.79	75.94	85.46	80.67	89.32	96.60	76.96	88.04	105.18	101.23	74.61	69.47	69.34	38.63
A. Enteric fermentation																												
B. Manure management																												
C. Rice cultivation																												
D. Agricultural soils																												
E. Prescribed burning of savannas																												
F. Field burning of agricultural residues																												
G. Liming	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	14.49	17.48	16.60	20.78	11.92	21.46	21.32	14.38	14.23	19.99	12.09	100.00
H. Urea application	50.02	50.02	50.95	65.51	52.14	47.57	46.29	52.44	68.39	44.25	50.49	60.87	92.09	80.76	71.79	75.94	70.97	63.19	72.72	75.83	65.04	66.58	83.86	86.85	60.39	49.47	57.25	14.45
I. Other carbon-containing fertilizers	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land use, land-use change and forestry [(2)]	-6627.38	-6627.38	-7876.88	-8082.50	-8480.79	-8610.43	-9155.17	-8870.63	-8356.26	-8259.05	-8690.03	-7700.77	-8054.57	-8255.04	-7627.77	-7668.81	-7879.55	-7680.78	-7151.32	-7434.37	-7470.54	-7340.16	-6357.16	-6117.91	-6600.49	-6667.68	-5092.05	-23.17
A. Forest land	-6733.83	-6733.83	-8507.50	-8805.57	-8965.53	-8965.09	-9461.17	-9220.07	-8636.10	-8444.86	-8840.26	-7930.80	-8500.02	-8691.21	-8182.00	-8257.43	-8319.86	-8158.05	-7491.89	-7707.08	-7903.70	-7721.79	-6720.77	-6470.73	-6829.76	-6552.22	-5607.26	-16.73
B. Cropland	189.57	189.57	153.55	162.72	152.64	170.50	178.01	177.21	241.94	261.74	252.54	330.55	343.32	323.63	308.46	294.25	240.59	210.92	145.34	142.88	78.74	145.96	116.01	185.75	167.13	2.26	121.75	-35.77
C. Grassland	-76.65	-76.65	-3.06	-15.50	-24.02	-37.16	-48.63	-58.97	-117.03	-123.23	-124.00	-131.44	-195.10	-188.63	-182.17	-175.70	-127.64	-128.04	-81.43	-135.65	-83.23	-91.27	-65.42	-95.91	-55.38	-42.15	-78.78	2.79
D. Wetlands	86.39	86.39	74.57	71.22	67.86	64.51	61.16	57.80	54.45	51.09	47.74	44.39	40.15	36.54	32.94	29.33	25.73	22.13	18.17	14.47	10.76	7.06	6.71	6.36	6.01	5.66	5.31	-93.85
E. Settlements	208.68	208.68	183.17	180.09	177.02	173.23	171.06	168.06	163.31	161.37	159.65	156.59	363.55	425.95	485.96	545.38	601.08	658.18	544.08	546.96	591.89	557.31	565.94	566.81	572.52	576.84	593.11	184.22
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Harvested wood products	-301.54	-301.54	222.39	324.54	111.24	-16.42	-55.59	5.35	-62.82	-165.16	-185.70	-170.05	-106.47	-161.32	-90.96	-104.64	-299.45	-285.91	-285.59	-295.95	-165.01	-237.43	-259.63	-310.18	-461.02	-658.07	-126.19	-58.15
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
5. Waste	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	1.82	3.70	4.38	6.15	6.68	3.78	0.80	0.35	0.16	0.74	0.65	0.67	0.16	0.05	0.05	0.08	0.04	0.04	0.05	-91.49
A. Solid waste disposal	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00
B. Biological treatment of solid waste																												
C. Incineration and open burning of waste	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	1.82	3.70	4.38	6.15	6.68	3.78	0.80	0.35	0.16	0.74	0.65	0.67	0.16	0.05	0.05	0.08	0.04	0.04	0.05	-91.49
D. Waste water treatment and discharge																												
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Memo items:																												
International bunkers	643.85	643.85	94.29	72.29	182.30	403.81	348.25	314.02	310.14	336.44	311.54	258.78	291.47	262.60	251.70	284.43	337.55	325.65	353.05	384.96	292.16	315.09	387.14	330.03	366.52	368.10	359.45	-44.17
Aviation	496.62	496.62	94.29	72.29	182.30	264.02	245.16	223.16	235.74	254.59	245.16	201.16	201.16	188.59	182.30	210.59	257.74	264.02	276.60	317.46	270.31	295.46	311.17	330.03	366.52	368.10	354.08	-28.70
Navigation	147.23	147.23	NO	NO	NO	139.78	103.08	90.86	74.41	81.85	66.37	57.62	90.31	74.01	69.39	73.83	79.82	61.63	76.45	67.50	21.85	19.64	75.97	NO	NO	NO	5.37	-96.35
Multilateral operations	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	0.00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[(1)]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
	(kt)																											%
CO_2 emissions from biomass	5126.24	5126.24	5986.51	5219.31	5493.15	4929.23	5212.59	5801.38	5428.42	5442.75	5257.71	4694.77	5187.98	4975.57	5755.73	5660.22	5908.79	5497.41	5323.07	5298.85	5577.15	5940.99	5834.61	6017.15	5962.40	5249.83	6010.65	17.25
CO_2 captured	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Long-term storage of C in waste disposal sites	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
Indirect N_2O																												
Indirect CO_2 [(3)]	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00
Total CO_2 equivalent emissions without land use, land-use change and forestry	23390.08	23390.08	17268.91	16607.13	17081.23	16342.18	16992.80	17587.90	18666.47	19372.39	20215.65	19789.12	20943.11	22031.13	23355.22	23005.23	23451.85	23684.94	25017.37	23746.47	21965.64	21203.74	20759.40	19172.43	18525.44	17777.06	17918.75	-23.39
Total CO_2 equivalent emissions with land use, land-use change and forestry	16762.70	16762.70	9392.03	8524.63	8600.43	7731.75	7837.63	8717.27	10310.21	11113.34	11525.62	12088.36	12888.54	13776.09	15727.45	15336.43	15572.30	16004.16	17866.04	16312.11	14495.10	13863.57	14402.24	13054.52	11924.95	11109.39	12826.69	-23.48
Total CO_2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
Total CO_2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00

Table 1: Emission trends (CH_4)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[(1)]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
	(kt)																											%
1. Energy	33.71	33.71	31.70	27.90	29.11	26.49	27.16	28.41	27.08	26.58	25.63	23.65	25.29	24.94	26.97	26.44	27.22	26.69	26.60	26.06	26.24	27.25	25.94	24.43	23.86	21.46	23.80	-29.39
A. Fuel combustion (sectoral approach)	16.56	16.56	17.69	15.08	15.74	14.40	15.19	16.90	15.81	15.97	15.76	14.12	15.13	14.56	16.53	16.08	16.83	15.55	15.02	14.96	15.46	16.43	15.97	15.81	15.67	13.81	15.72	-5.07
1. Energy industries	0.22	0.22	0.16	0.18	0.20	0.13	0.16	0.16	0.18	0.21	0.22	0.16	0.18	0.20	0.23	0.19	0.18	0.19	0.22	0.19	0.19	0.17	0.20	0.20	0.17	0.13	0.17	-23.73
2. Manufacturing industries and construction	0.39	0.39	0.28	0.22	0.21	0.19	0.19	0.19	0.21	0.21	0.17	0.18	0.18	0.17	0.20	0.24	0.22	0.23	0.23	0.22	0.21	0.21	0.18	0.19	0.18	0.15	0.13	-65.72
3. Transport	1.64	1.64	1.24	1.11	1.09	1.18	1.24	1.33	1.41	1.45	1.48	1.43	1.22	1.19	1.14	1.07	0.98	0.97	0.93	0.87	0.81	0.73	0.67	0.56	0.56	0.51	0.50	-69.81
4. Other sectors	14.31	14.31	16.01	13.57	14.25	12.89	13.60	15.22	14.02	14.11	13.89	12.36	13.55	13.00	14.96	14.58	15.45	14.16	13.63	13.68	14.24	15.32	14.92	14.86	14.77	13.01	14.92	4.30
5. Other	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	0.00
B. Fugitive emissions from fuels	17.16	17.16	14.01	12.82	13.37	12.09	11.97	11.51	11.26	10.61	9.87	9.53	10.17	10.38	10.43	10.36	10.39	11.14	11.58	11.11	10.78	10.82	9.96	8.62	8.19	7.65	8.09	-52.86
1. Solid fuels	2.39	2.39	2.13	1.65	1.58	1.42	1.13	0.91	0.67	0.70	0.21	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
2. Oil and natural gas and other emissions from energy production	14.77	14.77	11.88	11.17	11.79	10.67	10.85	10.60	10.60	9.91	9.66	9.53	10.17	10.38	10.43	10.36	10.39	11.14	11.58	11.11	10.78	10.82	9.96	8.62	8.19	7.65	8.09	-45.25
C. CO_2 transport and storage																												
2. Industrial processes	0.38	0.38	0.36	0.31	0.26	0.27	0.24	0.21	0.23	0.20	0.21	0.14	0.15	0.14	0.13	0.16	0.16	0.15	0.14	0.14	0.12	0.12	0.08	0.01	0.01	0.01	0.01	-98.24
A. Mineral industry																												
B. Chemical industry	0.23	0.23	0.21	0.21	0.21	0.20	0.21	0.20	0.20	0.19	0.19	0.12	0.15	0.14	0.13	0.16	0.16	0.15	0.14	0.14	0.12	0.12	0.08	0.01	0.01	0.01	0.01	-97.02
C. Metal industry	0.16	0.16	0.15	0.10	0.04	0.07	0.03	0.01	0.03	0.02	0.02	0.02	0.00	0.00	0.00	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	
D. Non-energy products from fuels and solvent use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
E. Electronic industry																												
F. Product uses as ODS substitutes																												
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
3. Agriculture	92.22	92.22	88.77	76.47	76.70	70.14	67.27	65.17	63.32	61.77	61.12	59.21	59.62	58.31	58.88	62.81	61.00	61.33	58.06	56.21	56.85	56.90	55.79	54.60	53.01	52.04	54.75	-40.62
A. Enteric fermentation	79.10	79.10	75.38	64.67	64.20	57.68	55.07	52.83	50.89	49.21	47.78	46.20	46.21	44.86	44.86	47.75	46.78	45.83	43.33	42.19	42.11	42.28	41.63	40.97	39.84	38.99	40.97	-48.20
B. Manure management	13.11	13.11	13.39	11.80	12.50	12.45	12.20	12.34	12.43	12.57	13.33	13.01	13.40	13.45	14.02	15.06	14.22	15.50	14.73	14.02	14.73	14.61	14.16	13.63	13.17	13.05	13.78	5.09
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
D. Agricultural soils	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Liming																												
H. Urea application																												
I. Other carbon-containing fertilizers																												
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land use, land-use change and forestry	0.05	0.05	0.13	0.61	1.38	0.46	0.30	0.66	0.71	1.80	0.24	3.88	0.76	0.26	1.58	0.12	0.11	0.24	1.27	0.38	0.20	0.07	0.75	1.56	0.08	0.01	0.56	1034.90
A. Forest land	0.04	0.04	0.12	0.55	1.31	0.43	0.28	0.61	0.65	1.59	0.17	3.48	0.64	0.22	1.44	0.08	0.09	0.22	1.18	0.35	0.19	0.07	0.61	1.44	0.06	0.01	0.39	775.54
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.10	100.00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year(1)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
	(kt)																											%
C. Grassland	0.00	0.00	0.01	0.06	0.06	0.03	0.02	0.06	0.05	0.21	0.07	0.39	0.12	0.03	0.14	0.04	0.02	0.02	0.09	0.04	0.01	0.00	0.14	0.11	0.02	0.00	0.06	1340.52
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Harvested wood products																												
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
5. Waste	23.46	23.46	24.01	24.55	25.13	26.00	26.68	27.31	28.53	29.34	30.90	32.51	33.26	35.02	36.86	39.05	38.57	42.50	46.29	50.01	52.25	52.34	53.58	53.41	53.83	55.56	58.66	150.07
A. Solid waste disposal	13.94	13.94	14.51	15.07	15.67	16.35	17.18	18.10	19.16	20.26	21.54	22.81	24.32	26.05	27.98	29.85	29.41	33.09	36.58	40.40	43.91	43.94	45.26	45.61	45.69	47.14	50.15	259.67
B. Biological treatment of solid waste	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	0.04	0.04	0.04	0.04	0.04	0.07	0.11	0.11	0.25	100.00
C. Incineration and open burning of waste	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00
D. Waste water treatment and discharge	9.51	9.51	9.50	9.48	9.46	9.65	9.50	9.21	9.37	9.08	9.36	9.70	8.94	8.97	8.88	9.19	9.16	9.41	9.67	9.57	8.30	8.36	8.27	7.73	8.02	8.31	8.26	-13.14
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total CH_4 emissions without CH_4 from LULUCF	149.77	149.77	144.83	129.23	131.20	122.89	121.35	121.10	119.15	117.89	117.86	115.51	118.32	118.40	122.84	128.46	126.95	130.67	131.09	132.43	135.46	136.60	135.38	132.45	130.70	129.06	137.23	-8.37
Total CH_4 emissions with CH_4 from LULUCF	149.82	149.82	144.96	129.84	132.58	123.35	121.65	121.76	119.85	119.70	118.09	119.39	119.08	118.66	124.42	128.57	127.06	130.91	132.36	132.81	135.66	136.67	136.12	134.00	130.78	129.07	137.78	-8.03
Memo items:																												
International bunkers	0.03	0.03	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.02	0.03	0.03	-17.08
Aviation	0.02	0.02	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.03	34.45
Navigation	0.01	0.01	NO	NO	NO	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	NO	NO	NO	0.00	-96.28
Multilateral operations	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	0.00
CO_2 emissions from biomass																												
CO_2 captured																												
Long-term storage of C in waste disposal sites																												
Indirect N_2O																												
Indirect CO_2 (3)																												

Table 1: Emission trends (N_2O)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year(1)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
	(kt)																											%
1. Energy	0.77	0.77	0.67	0.60	0.65	0.63	0.60	0.77	0.76	0.70	0.89	0.92	0.91	0.76	0.81	0.95	0.80	0.80	0.83	0.81	0.79	0.79	0.74	0.72	0.70	0.66	0.70	-9.49
A. Fuel combustion (sectoral approach)	0.77	0.77	0.67	0.60	0.65	0.63	0.60	0.77	0.76	0.70	0.89	0.92	0.91	0.76	0.81	0.95	0.80	0.80	0.83	0.81	0.79	0.79	0.74	0.72	0.70	0.66	0.70	-9.30
1. Energy industries	0.06	0.06	0.04	0.05	0.06	0.04	0.04	0.04	0.05	0.06	0.06	0.06	0.07	0.08	0.09	0.08	0.08	0.08	0.09	0.08	0.07	0.07	0.08	0.07	0.07	0.06	0.07	12.18
2. Manufacturing industries and construction	0.06	0.06	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	-66.08
3. Transport	0.18	0.18	0.15	0.13	0.16	0.16	0.15	0.24	0.28	0.20	0.35	0.37	0.35	0.22	0.22	0.39	0.23	0.25	0.26	0.24	0.24	0.23	0.19	0.19	0.18	0.18	0.19	5.32
4. Other sectors	0.47	0.47	0.44	0.39	0.40	0.40	0.38	0.46	0.40	0.42	0.45	0.46	0.46	0.43	0.47	0.44	0.46	0.45	0.44	0.45	0.45	0.45	0.45	0.43	0.42	0.40	0.43	-10.35
5. Other	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	0.00
B. Fugitive emissions from fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-72.15
1. Solid fuels	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NA,NO	NA,NO	0.00
2. Oil and natural gas and other emissions from energy production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-72.15
C. CO_2 transport and storage																												
2. Industrial processes	2.64	2.64	2.34	3.02	2.30	2.48	2.39	2.23	2.34	1.79	2.09	2.44	2.07	2.01	1.91	2.30	2.25	2.22	2.44	2.49	2.10	2.67	2.64	2.33	0.95	0.96	1.06	-59.97
A. Mineral industry																												
B. Chemical industry	2.53	2.53	2.22	2.90	2.19	2.37	2.28	2.12	2.23	1.68	1.98	2.33	1.95	1.90	1.80	2.19	2.14	2.11	2.33	2.38	1.99	2.57	2.53	2.19	0.81	0.89	1.05	-58.70
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
D. Non-energy products from fuels and solvent use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
E. Electronic industry																												

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
	(kt)																											%
F. Product uses as ODS substitutes																												
G. Other product manufacture and use	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.11	0.14	0.14	0.06	0.01	-88.60
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
3. Agriculture	5.65	5.65	5.57	5.14	4.53	4.45	4.30	4.31	4.84	4.27	4.50	4.52	4.81	4.66	4.38	4.73	4.76	4.57	4.63	4.72	4.36	4.05	4.31	4.16	3.82	3.55	3.75	-33.65
A. Enteric fermentation																												
B. Manure management	1.09	1.09	1.04	0.85	0.86	0.80	0.75	0.72	0.69	0.67	0.68	0.64	0.64	0.62	0.62	0.66	0.61	0.63	0.58	0.55	0.55	0.54	0.50	0.49	0.47	0.46	0.49	-54.69
C. Rice cultivation																												
D. Agricultural soils	4.56	4.56	4.53	4.29	3.66	3.66	3.55	3.59	4.14	3.60	3.82	3.88	4.17	4.04	3.76	4.07	4.15	3.95	4.05	4.18	3.81	3.52	3.81	3.66	3.34	3.09	3.26	-28.64
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Liming																												
H. Urea application																												
I. Other carbon containing fertlizers																												
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land use, land-use change and forestry	0.12	0.12	0.13	0.15	0.19	0.14	0.13	0.15	0.15	0.21	0.12	0.33	0.17	0.17	0.27	0.21	0.23	0.26	0.32	0.27	0.26	0.25	0.29	0.34	0.26	0.26	0.29	135.20
A. Forest land	0.00	0.00	0.01	0.03	0.07	0.02	0.02	0.03	0.04	0.09	0.01	0.19	0.04	0.01	0.08	0.00	0.00	0.01	0.07	0.02	0.01	0.00	0.03	0.08	0.00	0.00	0.02	775.54
B. Cropland	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.03	99.48
C. Grassland	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.02	0.01	0.04	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	1340.52
D. Wetlands	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-93.51
E. Settlements	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.09	0.11	0.14	0.16	0.19	0.21	0.21	0.22	0.22	0.22	0.22	0.22	0.23	0.23	0.23	214.76
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Harvested wood products																												
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
5. Waste	0.22	0.22	0.21	0.21	0.21	0.22	0.24	0.23	0.23	0.23	0.24	0.24	0.25	0.26	0.26	0.26	0.27	0.28	0.29	0.29	0.30	0.28	0.29	0.29	0.29	0.29	0.29	29.32
A. Solid waste disposal																												
B. Biological treatment of solid waste	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	100.00
C. Incineration and open burning of waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA,NO,IE	NA,NO,IE	NA,NO,IE	NA,NO,IE	NA,NO,IE	NA,NO,IE	NA,NO,IE	
D. Waste water treatment and discharge	0.22	0.22	0.21	0.21	0.21	0.22	0.24	0.23	0.23	0.23	0.24	0.23	0.25	0.26	0.26	0.26	0.27	0.28	0.28	0.29	0.29	0.28	0.28	0.28	0.28	0.28	0.28	22.76
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total direct N_2O emissions without N_2O from LULUCF	9.29	9.29	8.79	8.97	7.69	7.79	7.53	7.55	8.18	6.99	7.72	8.12	8.04	7.70	7.37	8.24	8.08	7.88	8.18	8.32	7.55	7.79	7.98	7.49	5.75	5.45	5.80	-37.60
Total direct N_2O emissions with N_2O from LULUCF	9.41	9.41	8.91	9.12	7.88	7.93	7.66	7.69	8.32	7.20	7.84	8.45	8.21	7.87	7.63	8.44	8.31	8.14	8.51	8.59	7.81	8.04	8.28	7.83	6.01	5.71	6.09	-35.34
Memo items:																												
International bunkers	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-61.76
Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-29.68
Navigation	0.00	0.00	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NO	NO	NO	0.00	-96.28
Multilateral operations	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	0.00
CO_2 emissions from biomass																												
CO_2 captured																												
Long-term storage of C in waste disposal sites																												
Indirect N_2O	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00
Indirect CO_2 [3]																												

Table 1: Emission trends (HFC, PFC, SF_6, NF_3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
	(kt)																											%
Emissions of HFCs and PFCs - (kt CO_2 equivalent)																												
Emissions of HFCs - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	29.32	49.77	71.93	101.88	122.08	147.90	161.46	185.34	212.23	240.33	265.80	292.57	326.74	338.04	341.35	378.87	396.20	397.28	408.91	413.60	419.89	100.00
HFC-23	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	NO	0.00	0.00	0.00	100.00
HFC-32	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	100.00
HFC-41	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-43-10mee	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-125	NO	NO	NO	NO	NO	NO	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	100.00
HFC-134	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-134a	NO	NO	NO	NO	NO	NO	0.01	0.01	0.02	0.03	0.04	0.06	0.06	0.07	0.08	0.09	0.10	0.12	0.13	0.14	0.14	0.15	0.15	0.15	0.15	0.15	0.16	100.00
HFC-143	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-143a	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	100.00
HFC-152	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-152a	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	NO	0.00	0.04	NO	NO	NO	NO	NO	0.00
HFC-161	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-227ea	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-236cb	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-236ea	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-236fa	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	NO	NO	0.00	0.00	0.00	0.00	0.00	100.00
HFC-245ca	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-245fa	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Unspecified mix of HFCs[4] - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Emissions of PFCs - (kt CO_2 equivalent)	1240.24	1240.24	850.75	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.26	0.03	0.02	0.03	0.06	0.06	0.03	-100.00
CF_4	0.12	0.12	0.08	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	NO	NO	NO	NO	NO	
C_2F_6	0.03	0.03	0.02	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	-99.99
C_3F_8	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	NO	NO	NO	0.00
C_4F_{10}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
c-C_4F_8	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C_5F_{12}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C_6F_{14}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
$C_{10}F_{18}$	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
c-C_3F_6	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Unspecified mix of PFCs[4] - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Unspecified mix of HFCs and PFCs - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Emissions of SF_6 - (kt CO_2 equivalent)	10.45	10.45	10.33	10.42	10.53	10.64	11.12	11.57	11.43	11.99	11.99	11.62	11.69	12.01	12.28	12.57	13.03	13.01	13.05	11.98	8.03	8.95	9.37	9.18	6.10	6.81	5.26	-49.62
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-49.62
Emissions of NF_3 - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00

Table 1: Emission trends (CO2-eq)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
	(kt CO_2 eq)																											%
Total (net emissions)[2]	24564.27	24564.27	16533.18	14499.81	14275.15	13189.76	13200.94	14115.24	15870.42	16366.29	16947.92	17750.01	18484.98	19283.78	21337.54	21319.49	21504.31	22009.37	24049.87	22543.17	20563.14	20065.22	20677.90	19144.40	17400.73	16457.73	18510.43	-24.64
1. Energy	21831.84	21831.84	16244.53	15409.17	16242.70	15214.87	16121.96	16768.29	17608.07	18421.08	18970.42	18350.77	19399.08	20514.22	21914.68	21371.30	21730.04	21815.23	23071.16	21878.99	20703.82	19903.86	19634.83	18187.43	17415.67	16459.83	16728.04	-23.38
A. Fuel combustion (sectoral approach)	20722.40	20722.40	15227.28	14412.31	15021.06	14119.12	14889.86	15582.21	16479.44	17401.01	17985.23	17319.53	18283.76	19374.05	20817.29	20226.16	20601.08	20637.26	21911.77	20830.27	19727.33	18957.82	18705.28	17399.64	16666.85	15743.10	16198.77	-21.83
1. Energy industries	7094.31	7094.31	4754.11	5424.64	5951.31	4645.37	5243.22	5071.84	5577.04	6234.63	6461.94	5839.41	6407.08	7303.60	7978.29	6859.28	6880.91	6701.94	7901.30	6849.97	6428.97	5951.08	6325.15	5922.32	5299.77	4791.03	4795.41	-32.40
2. Manufacturing industries and construction	5529.04	5529.04	3938.65	3129.91	3046.18	3215.82	2967.87	3011.48	3040.54	3327.47	2992.21	3115.63	3209.43	3069.38	3150.65	3599.72	3739.05	3871.40	3869.36	3888.55	3171.98	3030.11	2792.12	2421.88	2392.78	2334.97	2232.02	-59.63
3. Transport	3881.11	3881.11	2941.55	2842.01	2998.59	3181.24	3367.95	3725.69	4084.47	4193.36	4469.57	4499.39	4555.15	4823.43	5221.98	5405.21	5561.06	5918.51	6342.65	6173.12	6182.36	5952.28	5799.55	5614.24	5699.55	5642.49	5951.83	53.35
4. Other sectors	4217.93	4217.93	3592.97	3015.75	3024.97	3076.69	3310.83	3773.20	3777.39	3645.55	4061.51	3865.11	4112.10	4177.63	4466.39	4361.95	4420.06	4145.40	3798.46	3918.63	3944.02	4024.35	3788.46	3441.19	3274.76	2974.62	3219.51	-23.67
5. Other	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	0.00
B. Fugitive emissions from fuels	1109.45	1109.45	1017.26	996.86	1221.65	1095.75	1232.10	1186.08	1128.63	1020.07	985.19	1031.23	1115.32	1140.17	1097.38	1145.14	1128.96	1177.98	1159.39	1048.73	976.50	946.04	929.55	787.79	748.82	716.73	529.27	-52.29
1. Solid fuels	59.64	59.64	53.15	41.30	39.52	35.44	28.23	22.77	16.65	17.44	5.25	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NA,NO	NA,NO	
2. Oil and natural gas and other emissions from energy production	1049.80	1049.80	964.10	955.56	1182.12	1060.31	1203.87	1163.31	1111.97	1002.62	979.93	1031.23	1115.32	1140.17	1097.38	1145.14	1128.96	1177.98	1159.39	1048.73	976.50	946.04	929.55	787.79	748.82	716.73	529.27	-49.58
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Industrial Processes	4628.76	4628.76	3530.98	2925.73	2409.96	2687.06	2440.50	2438.65	2679.06	2430.82	2858.48	3127.50	3141.95	3083.99	3081.04	3444.02	3507.64	3667.54	3838.77	3761.03	3056.21	3315.26	3083.66	2809.20	2538.56	2688.00	2665.51	-42.41
A. Mineral industry	1280.88	1280.88	863.47	938.79	804.89	976.59	759.97	844.58	954.10	1027.37	1284.91	1423.08	1643.76	1638.10	1619.95	1731.21	1785.37	1917.28	1948.84	1856.99	1460.61	1432.29	1220.06	1163.71	1275.91	1360.19	1313.14	2.52
B. Chemical industry	1531.93	1531.93	1350.41	1720.98	1387.20	1461.19	1454.19	1349.76	1426.34	1111.79	1318.01	1421.62	1220.03	1132.46	1116.83	1320.47	1305.53	1295.53	1392.06	1390.88	1121.23	1362.87	1327.43	1131.62	726.56	800.92	848.76	-44.60
C. Metal industry	1582.70	1582.70	1128.32	120.98	59.20	81.74	39.15	19.62	40.85	29.22	27.28	27.26	6.58	5.86	9.90	15.36	11.81	13.85	13.10	24.15	11.56	27.55	29.45	2.02	16.88	28.58	13.63	-99.14
D. Non-energy products from fuels and solvent use	189.43	189.43	145.07	101.19	114.77	123.51	113.37	129.97	141.04	115.19	60.83	62.64	65.06	76.85	76.47	90.71	92.72	101.93	111.61	105.61	80.35	73.61	68.55	63.03	62.06	58.80	60.99	-67.80
E. Electronic industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
F. Product uses as ODS substitutes	NO	NO	NO	NO	NO	NO	29.32	49.77	71.93	101.88	122.08	147.90	161.46	185.34	212.23	240.33	265.80	292.57	326.74	338.04	341.61	378.91	396.21	397.31	408.97	413.66	419.92	100.00
G. Other product manufacture and use	43.83	43.83	43.71	43.79	43.91	44.02	44.50	44.95	44.80	45.37	45.37	45.00	45.07	45.39	45.65	45.94	46.40	46.38	46.43	45.35	40.86	40.03	41.96	51.50	48.17	25.85	9.07	-79.31
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
3. Agriculture	4039.08	4039.08	3929.71	3508.90	3318.55	3128.24	3008.23	2966.37	3093.36	2860.10	2917.90	2887.95	3015.10	2926.78	2849.91	3054.24	3029.67	2976.48	2920.35	2909.42	2796.26	2717.50	2785.56	2704.64	2536.99	2427.05	2555.32	-36.74
A. Enteric fermentation	1977.59	1977.59	1884.45	1616.74	1605.03	1442.05	1376.67	1320.86	1272.13	1230.16	1194.57	1154.97	1155.36	1121.42	1121.58	1193.74	1169.47	1145.74	1083.29	1054.84	1052.77	1057.12	1040.66	1024.33	996.04	974.86	1024.36	-48.20
B. Manure management	651.63	651.63	644.92	549.42	570.18	548.66	528.39	522.50	517.80	514.12	534.97	515.71	525.97	520.03	535.57	573.04	538.43	574.06	541.24	513.28	531.54	524.79	504.36	486.97	469.60	462.90	491.19	-24.62
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
D. Agricultural soils	1359.84	1359.84	1349.39	1277.22	1091.20	1089.95	1056.88	1070.57	1235.05	1071.58	1137.88	1156.41	1241.67	1204.58	1120.96	1211.52	1236.30	1176.01	1206.50	1244.70	1134.99	1047.55	1135.37	1092.11	996.74	919.82	970.44	-28.64
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Liming	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	14.49	17.48	16.60	20.78	11.92	21.46	21.32	14.38	14.23	19.99	12.09	100.00
H. Urea application	50.02	50.02	50.95	65.51	52.14	47.57	46.29	52.44	68.39	44.25	50.49	60.87	92.09	80.76	71.79	75.94	70.97	63.19	72.72	75.83	65.04	66.58	83.86	86.85	60.39	49.47	57.25	14.45
I. Other carbon-containing fertilizers	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land use, land-use change and forestry[2]	-6589.43	-6589.43	-7836.21	-8021.94	-8388.82	-8557.29	-9109.28	-8810.00	-8294.35	-8150.37	-8648.50	-7505.25	-7984.01	-8199.11	-7508.42	-7604.13	-7808.08	-7596.53	-7023.66	-7343.92	-7387.70	-7263.79	-6250.76	-5977.54	-6521.81	-6591.28	-4991.72	-24.25
A. Forest land	-6731.97	-6731.97	-8502.52	-8782.93	-8911.09	-8947.37	-9449.51	-9194.94	-8609.10	-8378.78	-8833.20	-7786.25	-8473.43	-8681.89	-8122.35	-8254.20	-8316.27	-8148.99	-7442.79	-7692.74	-7895.61	-7719.07	-6695.55	-6410.84	-6827.34	-6551.85	-5590.96	-16.95
B. Cropland	193.47	193.47	157.72	167.17	157.36	175.50	183.28	182.75	247.76	267.84	258.91	337.19	350.24	330.83	315.93	302.00	248.61	219.22	153.58	151.05	86.89	153.77	123.48	192.87	173.90	8.80	132.11	-31.72
C. Grassland	-76.42	-76.42	-2.69	-12.35	-20.71	-35.44	-47.55	-56.07	-114.21	-112.19	-120.55	-110.98	-188.88	-187.01	-174.64	-173.69	-126.44	-126.79	-76.89	-133.68	-82.76	-91.03	-58.25	-90.08	-54.39	-42.10	-75.51	-1.19
D. Wetlands	96.19	96.19	83.94	80.16	76.38	72.59	68.81	65.03	61.25	57.46	53.68	49.90	45.20	41.14	37.07	33.01	28.94	24.88	20.45	16.27	12.10	7.92	7.52	7.13	6.73	6.34	5.95	-93.82
E. Settlements	230.85	230.85	204.95	201.48	198.01	193.84	191.28	187.89	182.77	180.46	178.35	174.92	389.33	459.15	526.53	593.39	656.52	721.06	607.58	611.13	656.69	622.04	631.67	633.57	640.30	645.61	662.89	187.16
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Harvested wood products	-301.54	-301.54	222.39	324.54	111.24	-16.42	-55.59	5.35	-62.82	-165.16	-185.70	-170.05	-106.47	-161.32	-90.96	-104.64	-299.45	-285.91	-285.59	-295.95	-165.01	-237.43	-259.63	-310.18	-461.02	-658.07	-126.19	-58.15
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
5. Waste	654.01	654.01	664.17	677.95	692.75	716.90	739.53	751.93	784.28	804.66	849.61	889.04	912.87	957.90	1000.33	1054.07	1045.05	1146.66	1243.25	1337.63	1394.54	1392.39	1424.61	1420.67	1431.33	1474.13	1553.28	137.50
A. Solid waste disposal	348.61	348.61	362.83	376.81	391.85	408.74	429.46	452.53	478.90	506.52	538.62	570.36	608.04	651.26	699.56	746.36	735.33	827.25	914.38	1010.07	1097.72	1098.53	1131.57	1140.22	1142.37	1178.42	1253.82	259.67
B. Biological treatment of solid waste	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	1.88	1.84	1.54	1.66	1.73	3.21	4.89	4.90	10.57	100.00
C. Incineration and open burning of waste	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	1.86	3.76	4.46	6.26	6.80	3.85	0.82	0.35	0.16	0.75	0.66	0.68	0.16	0.05	0.05	0.08	0.04	0.04	0.05	-91.61
D. Waste water treatment and discharge	304.86	304.86	300.80	300.60	300.36	307.62	309.53	298.86	303.53	294.38	306.54	312.42	298.03	302.79	299.95	307.35	309.55	318.65	326.33	325.05	295.12	292.15	291.26	277.17	284.03	290.76	288.85	-5.25
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Memo items:																												
International bunkers	647.10	647.10	94.63	72.55	182.95	406.16	350.16	315.74	311.73	338.18	313.09	260.08	293.10	264.02	253.04	285.92	339.28	327.21	354.80	386.76	293.34	316.34	389.01	331.20	367.80	369.73	361.08	-44.20

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
	(kt CO_2 eq)																											%
Aviation	498.38	498.38	94.63	72.55	182.95	264.96	246.04	223.96	236.57	255.50	246.04	201.88	201.88	189.26	182.95	211.34	258.65	264.96	277.58	318.58	271.27	296.50	312.28	331.20	367.80	369.73	355.65	-28.64
Navigation	148.72	148.72	NO	NO	NO	141.20	104.13	91.78	75.16	82.68	67.05	58.21	91.23	74.76	70.09	74.58	80.62	62.25	77.22	68.17	22.07	19.83	76.73	NO	NO	NO	5.42	-96.35
Multilateral operations	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	0.00
CO_2 emissions from biomass	5126.24	5126.24	5986.51	5219.31	5493.15	4929.23	5212.59	5801.38	5428.42	5442.75	5257.71	4694.77	5187.98	4975.57	5755.73	5660.22	5908.79	5497.41	5323.07	5298.85	5577.15	5940.99	5834.61	6017.15	5962.40	5249.83	6010.65	17.25
CO_2 captured	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Long-term storage of C in waste disposal sites	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
Indirect N_2O	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00
Indirect CO_2 [3]	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00
Total CO_2 equivalent emissions without land use, land-use change and forestry	31153.70	31153.70	24369.39	22521.75	22663.97	21747.06	22310.22	22925.24	24164.77	24516.66	25596.42	25255.27	26469.00	27482.89	28845.96	28923.62	29312.39	29605.91	31073.53	29887.08	27950.84	27329.01	26928.66	25121.94	23922.55	23049.00	23502.15	-24.56
Total CO_2 equivalent emissions with land use, land-use change and forestry	24564.27	24564.27	16533.18	14499.81	14275.15	13189.76	13200.94	14115.24	15870.42	16366.29	16947.92	17750.01	18484.98	19283.78	21337.54	21319.49	21504.31	22009.37	24049.87	22543.17	20563.14	20065.22	20677.90	19144.40	17400.73	16457.73	18510.43	-24.64
Total CO_2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
Total CO_2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00

Table 2(a): Description of quantified economy-wide emission reduction target: base year[a]

Party	*Croatia*	
Base year /base period	1990	
Emission reduction target	% of base year/base period 20.00	% of 1990 [b] 20.00
Period for reaching target	BY-2020	

[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.

Table 2(b): Description of quantified economy-wide emission reduction target: gases and sectors covered[a]

Gases covered		*Base year for each gas (year):*
CO_2		1990
CH_4		1990
N_2O		1990
HFCs		1990
PFCs		1990
SF_6		1990
NF_3		
Other Gases (specify)		
Sectors covered[b]	Energy	Yes
	Transport[f]	Yes
	Industrial processes[g]	Yes
	Agriculture	Yes
	LULUCF	No
	Waste	Yes
	Other Sectors (specify)	

Abbreviations: 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] 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.

Table 2(c): Description of quantified economy-wide emission reduction target: global warming potential values (GWP)[a]

Gases	*GWP values* [b]
CO_2	4th AR
CH_4	4th AR
N_2O	4th AR
HFCs	4th AR
PFCs	4th AR
SF_6	4th AR
NF_3	4th AR
Other Gases (specify)	

Abbreviations: GWP = global warming potential

[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] 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.

Table 2(d): Description of quantified economy-wide emission reduction target: approach to counting emissions and removals from the LULUCF[a]

Role of LULUCF	LULUCF in base year level and target	Excluded
	Contribution of LULUCF is calculated using	

Abbreviation: 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.

Table 2(e)I: Description of quantified economy-wide emission reduction target: market-based mechanisms under the Convention and other market-based mechanisms[a]

Market-based mechanisms under the Convention	*Possible scale of contributions (estimated kt CO_2 eq)*
Possible scale of contributions of market-based mechanisms under the convention	
CERs	
ERUs	.
AAUs[i]	
Carry-over units[j]	
Other mechanism units under the Convention (specify)[d]	

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.

[d] As indicated in paragraph 5(e) of the guidelines contained in annex I of decision 2/CP.17 .

[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 1/CMP.8.

Table 2(e)II: Description of quantified economy-wide emission reduction target: market-based mechanisms under the Convention and other market-based mechanisms[a]

Other market-based mechanisms	*Possible scale of contributions*
(Specify)	*(estimated kt CO_2 eq)*

[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.

Table 2(f): Description of quantified economy-wide emission reduction target: any other information[a,b]

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.

[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] 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.

Custom Footnotes

Legally binding target trajectories for the period 2013-2020 are enshrined in both the EU-ETS Directive (Directive 2003/87/EC andrespective amendments) and the Effort Sharing Decision (Decision No406/2009/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 targetpathway 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 tradingsystem (ETS), expressed as percentage changes from 2005 levels. In March 2013, the Commission formally adopted the national annual limits throughout theperiod 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 thesectors covered by the EU ETS will be 21% below 2005 emission levels.

CTF Table 3: Progress in achievement of the quantified economy-wide emission reduction target: information on mitigation actions and their effects

Name of mitigation action	Sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of impleme-ntation	Brief description	Start year of impleme-ntation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)			
									2020	2025	2030	2035
MEN-1: National Plan for the Increase of the Number of Nearly-Zero Energy Buildings	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO_2)	Efficiency improvements of buildings (Energy consumption)	Planning, Economic, Regulatory	Adopted	See 7th NC, Chapter 4.1.3., measure: MEN-1	2014	Government:Ministry of Construction and Physical Planning	NE	NE	NE	NE
MEN-2: Program for energy renovation of the apartment buildings[27]	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO_2)	Efficiency improvements of buildings (Energy consumption)	Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-2	2014	Government:Ministry of Construction and Physical Planning, Other:Environmental Protection and Energy Efficiency Fund	254	509	763	NE
MEN-3: Program for the increase of energy efficiency and use of renewable energy sources in commercial non-residential buildings	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO_2)	Efficiency improvements of buildings (Energy consumption), Efficiency improvement in services/ tertiary sector (Energy consumption), Efficiency improvement in industrial end-use sectors (Energy consumption), Demand management/reduction (Energy consumption)	Economic	Adopted	See 7th NC , chapter 4.1.3., measure: MEN-3	2017	Government:Ministry of Environment and Energy, Government:Ministry of Construction and Physical Planning, Other:Environmental Protection and Energy Efficiency Fund	NE	NE	NE	NE
MEN-4: Program for the Energy Renovation of the Family Houses	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO_2)	Efficiency improvements of buildings (Energy consumption), Demand management/reduction (Energy consumption)	Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-4	2014	Government:Ministry of Construction and Physical Planning, Government:Ministry for Regional Development and EU Funds, Other:Environmental Protection and Energy Efficiency Fund	NE	NE	NE	NE

[27] The estimated GHG emission reduction potential includes GHG emission reduction potential for renovation of all types of buildings.

Name of mitigation action	Sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of impleme-ntation	Brief description	Start year of impleme-ntation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)			
									2020	2025	2030	2035
MEN-5: Program for the energy renovation of public buildings	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO2)	Efficiency improvements of buildings (Energy consumption)	Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-5	2014	Government:Ministry of Construction and Physical Planning, Environmental Protection, Other:Energy Efficiency Fund, Other:Agency for Legal Affairs and Real Estate	NE	NE	NE	NE
MEN-6: Energy management in the public sector	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO2)	Demand management/reduction (Energy consumption), Efficiency improvement in services/ tertiary sector (Energy consumption)	Regulatory, Information	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-6	2014	Other:Agency for Legal Affairs and Real Estate, Other:National Energy Efficiency Authority	NE	NE	NE	NE
MEN-7: Measurement and informative calculation of energy consumption	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO2)	Demand management/reduction (Energy consumption)	Information	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-7	2014	Government:Ministry of Environment and Energy, Companies:Energy distributors	NE	NE	NE	NE
MEN-8: Labelling the energy efficiency of household appliances	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO2)	Efficiency improvement of appliances (Energy consumption)	Information	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-8	2014	Government:Ministry of Environment and Energy	NE	NE	NE	NE
MEN-9: Eco-design of energy-using products	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO2)	Efficiency improvement of appliances (Energy consumption)	Regulatory	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-9	2013	Government:Ministry of Environment and Energy	67	135	202	NE
MEN-10: Promotion of energy efficiency and implementation of measures through energy services model	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO2)	Efficiency improvements of buildings (Energy consumption), Efficiency improvement in services/ tertiary sector (Energy consumption), Efficiency improvement in industrial end-use sectors (Energy consumption)	Information, Voluntary/negotiated agreements	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-10	2007	Other:National Energy Efficiency Authority, Companies:ESCO companies	NE	NE	NE	NE

Name of mitigation action	Sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of impleme-ntation	Brief description	Start year of impleme-ntation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)			
									2020	2025	2030	2035
MEN-11: Program for the reduction of energy poverty	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO_2)	Demand management/reduction (Energy consumption)	Economic, Education	Planned	See 7th NC , chapter 4.1.3., measure: MEN-11	2017	Government:Ministry of Environment and Energy, Government:Ministry for Demography, Family, Youth and Social Policy, Other:Environmental Protection and Energy Efficiency Fund	NE	NE	NE	NE
MEN-12: Education in the area of energy efficiency	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO_2)	Efficiency improvements of buildings (Energy consumption)	Education	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-12	2012	Other:Croatian Employment Service, Other:Agency for Vocational Education and Adult Education	NE	NE	NE	NE
MEN-13: National Program for the Energy Efficiency in Public Lighting	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO_2)	Efficiency improvement in services/ tertiary sector (Energy consumption)	Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-13	2014	Government:Ministry of Environment and Energy, Other:National Energy Efficiency Authority, Other:Environmental Protection and Energy Efficiency Fund	37	75	112	NE
MEN-14: Green public procurement	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture), Energy supply (comprising extraction, transmission, distribution and storage of fuels as well as energy and electricity production)	Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O)	Increase in renewable energy (Energy supply), Switch to less carbon-intensive fuels (Energy supply), Demand management/reduction (Energy consumption), Efficiency improvement in services/ tertiary sector (Energy consumption)	Regulatory, Voluntary/negotiated agreements	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-14	2014	Government:Ministry of Environment and Energy, Government:Ministry of the Economy, Entrepreneurship and Crafts, Other:Public office for public procurement, Other:National Energy Efficiency Authority	NE	NE	NE	NE

Name of mitigation action	Sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of impleme-ntation	Brief description	Start year of impleme-ntation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)			
									2020	2025	2030	2035
MEN-15: Energy audits in industry	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO_2), Nitrous oxide (N_2O)	Efficiency improvement in industrial end-use sectors (Energy consumption), Efficiency improvement in services/ tertiary sector (Energy consumption)	Regulatory, Voluntary/negotiated agreements	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-15	2014	Government:Ministry of Environment and Energy, Government:Ministry of the Economy, Entrepreneurship and Crafts, Other:Environmental Protection and Energy Efficiency Fund	NE	NE	NE	NE
MEN-16: Industrial Energy Efficiency Network (MIEE)	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO_2)	Efficiency improvement in industrial end-use sectors (Energy consumption)	Voluntary/negotiated agreements	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-16	2008	Other:Croatian Chamber of Commerce, Other:National Energy Efficiency Authority, Other:Environmental Protection and Energy Efficiency Fund	NE	NE	NE	NE
MEN-17: Increase of the use of renewable energy sources and energy efficiency in industry sector	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO_2)	Efficiency improvement in industrial end-use sectors (Energy consumption)	Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-17	2017	Government:Ministry of Environment and Energy, Other:National Energy Efficiency Authority, Other:Environmental Protection and Energy Efficiency Fund	98	195	293	NE
MEN-18: Feed-in tariffs and premium system for the support of the use of renewable energy sources in electricity generation and for the efficient cogeneration	Energy supply (comprising extraction, transmission, distribution and storage of fuels as well as energy and electricity production)	Carbon dioxide (CO_2)	Increase in renewable energy (Energy supply)	Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-18	2007	Government:Ministry of Environment and Energy, Other:Croatian Energy Operator (HROTE)	524	1049	1573	NE
MEN-19: Program for the Energy Efficiency in Heating and Cooling	Energy supply (comprising extraction, transmission, distribution and storage of fuels as well as energy and electricity production)	Carbon dioxide (CO_2)	Switch to less carbon-intensive fuels (Energy supply), Increase in renewable energy (Energy supply), Efficiency improvement in the energy and transformation sector (Energy supply), Reduction of losses (Energy supply)	Regulatory, Economic, Information	Adopted	See 7th NC , chapter 4.1.3., measure: MEN-19	2016	Government:Ministry of Environment and Energy, Government:Ministry of Construction and Physical Planning	NE	NE	NE	NE

Name of mitigation action	Sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of impleme-ntation	Brief description	Start year of impleme-ntation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)			
									2020	2025	2030	2035
MEN-20: Promotion of the use of renewable energy sources and energy efficiency by HBOR-a (Croatian Bank for Reconstruction and Development)	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture), Energy supply (comprising extraction, transmission, distribution and storage of fuels as well as energy and electricity production)	Carbon dioxide (CO2)	Increase in renewable energy (Energy supply), Switch to less carbon-intensive fuels (Energy supply), Efficiency improvement in the energy and transformation sector (Energy supply), Efficiency improvement in industrial end-use sectors (Energy consumption), Efficiency improvements of buildings (Energy consumption), Efficiency improvement in services/ tertiary sector (Energy consumption)	Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-20	2009	Other:Croatian Bank for Reconstruction and Development (HBOR)	NE	NE	NE	NE
MEN-21: Promotion of the use of renewable energy sources and energy efficiency by FZOEU (The Environmental Protection and Energy Efficiency Fund) resources	Energy supply (comprising extraction, transmission, distribution and storage of fuels as well as energy and electricity production), Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture), Transport, Waste management/waste, Cross-cutting	Carbon dioxide (CO2), Methane (CH4), Nitrous oxide (N2O)	Increase in renewable energy (Energy supply), Efficiency improvements of buildings (Energy consumption), Efficiency improvement in services/ tertiary sector (Energy consumption), Efficiency improvement in industrial end-use sectors (Energy consumption), Demand management/reduction (Energy consumption), Modal shift to public transport or non-motorized transport (Transport), Improved behaviour (Transport), Low carbon fuels/electric cars (Transport), Demand management / reduction (Waste), Reduced landfilling (Waste), Enhanced recycling (Waste), Multi-sectoral policy (Cross-cutting)	Economic, Fiscal	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-21	2004	Government:Ministry of Environment and Energy, Other:Environmental Protection and Energy Efficiency Fund	NE	NE	NE	NE

Name of mitigation action	Sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of impleme-ntation	Brief description	Start year of impleme-ntation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)			
									2020	2025	2030	2035
MEN-22: CO2 emission tax on the non-ETS stationary sources	Energy supply (comprising extraction, transmission, distribution and storage of fuels as well as energy and electricity production), Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture)	Carbon dioxide (CO2)	Switch to less carbon-intensive fuels (Energy supply), Increase in renewable energy (Energy supply), Efficiency improvement in the energy and transformation sector (Energy supply), Efficiency improvement in industrial end-use sectors (Energy consumption)	Fiscal, Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-22	2013	Government:Ministry of Environment and Energy, Government:Ministry of Finances, Other:Environmental Protection and Energy Efficiency Fund	NE	NE	NE	NE
MEN-23: Revitalization and energy efficiency in existing thermal and hydro power plants	Energy supply (comprising extraction, transmission, distribution and storage of fuels as well as energy and electricity production)	Carbon dioxide (CO2)	Increase in renewable energy (Energy supply), Efficiency improvement in the energy and transformation sector (Energy supply)	Voluntary/negotiated agreements	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-23	2014	Companies:HEP-Proizvodnja Ltd.	NE	NE	NE	NE
MEN-24: Reconstruction and renovation of the heating and steam network	Energy supply (comprising extraction, transmission, distribution and storage of fuels as well as energy and electricity production)	Carbon dioxide (CO2)	Reduction of losses (Energy supply), Efficiency improvement in the energy and transformation sector (Energy supply)	Economic, Voluntary/negotiated agreements	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-24	2014	Government:Ministry of Environment and Energy, Companies:HEP-Toplinarstvo d.o.o.	NE	NE	NE	NE
MEN-25: Operation of power system and development of the transmission and distribution network	Energy supply (comprising extraction, transmission, distribution and storage of fuels as well as energy and electricity production)	Carbon dioxide (CO2)	Reduction of losses (Energy supply)	Economic, Voluntary/negotiated agreements	Implemented	See 7th NC , chapter 4.1.3., measure: MEN-25	2014	Government:Ministry of Environment and Energy, Companies:Croatian Transmission System Operator, Companies:HEP-Distribution System Operator	NE	NE	NE	NE
MTR-1: Providing information to consumers on fuel economy and CO2 emission of new passenger cars	Transport	Carbon dioxide (CO2)	Low carbon fuels/electric cars (Transport)	Information	Implemented	See 7th NC , chapter 4.1.3., measure: MTR-1	2007	Government:Ministry of Environment and Energy	NE	NE	NE	NE

Name of mitigation action	Sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of impleme-ntation	Brief description	Start year of impleme-ntation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)			
									2020	2025	2030	2035
MTR-2: Training for drivers of road vehicles for eco-driving	Transport	Carbon dioxide (CO_2)	Improved behaviour (Transport)	Education, Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MTR-2	2011	Government:Ministry of Interior Affairs, Government:Ministry of Environment and Energy, Other:Environmental Protection and Energy Efficiency Fund, Other:National Energy Efficiency Authority	NE	NE	NE	NE
MTR-3: Obligation for the use of biofuels in transport	Transport	Carbon dioxide (CO_2)	Low carbon fuels/electric cars (Transport)	Regulatory	Implemented	See 7th NC , chapter 4.1.3., measure: MTR-3	2010	Government:Ministry of Environment and Energy	39	59	118	NE
MTR-4: Special fee for environment on the motor vehicles	Transport	Carbon dioxide (CO_2)	Efficiency improvements of vehicles (Transport), Low carbon fuels/electric cars (Transport)	Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MTR-4	2014	Government:Ministry of Environment and Energy, Government:Ministry of Finances, Other:Environmental Protection and Energy Efficiency Fund	NE	NE	NE	NE
MTR-5: Special tax on motor vehicles	Transport	Carbon dioxide (CO_2)	Efficiency improvements of vehicles (Transport), Low carbon fuels/electric cars (Transport)	Fiscal	Implemented	See 7th NC , chapter 4.1.3., measure: MTR-5	2015	Government:Ministry of Environment and Energy, Government:Ministry of Finances	NE	NE	NE	NE
MTR-6: Financial incentives for the purchase of plug-in hybrid and electric vehicles	Transport	Carbon dioxide (CO_2)	Low carbon fuels/electric cars (Transport)	Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MTR-6	2014	Government:Ministry of Environment and Energy, Other:Environmental Protection and Energy Efficiency Fund	221	441	662	NE

Name of mitigation action	Sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of impleme-ntation	Brief description	Start year of impleme-ntation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)			
									2020	2025	2030	2035
MTR-7: Development of infrastructure for alternative fuels	Transport	Carbon dioxide (CO2)	Low carbon fuels/electric cars (Transport), Improved transport infrastructure (Transport)	Regulatory, Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MTR-7	2014	Government:Ministry of the Sea, Transport and Infrastructure, Government:Ministry of Environment and Energy,, Government:Ministry of Construction and Physical Planning, Government:Ministry of Finances, Government:Ministry of Interior, Local:Units of regional and local self-government, Other:Environmental Protection and Energy Efficiency Fund	NE	NE	NE	NE
MTR-8: Promotion of integrated and intelligent transport systems and alternatives fuels in urban areas	Transport	Carbon dioxide (CO2)	Modal shift to public transport or non-motorized transport (Transport), Low carbon fuels/electric cars (Transport), Improved behaviour (Transport), Demand management/reduction (Transport)	Voluntary/negotiated agreements, Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MTR-8	2014	Government:Ministry of Environment and Energy, Local:Units of regional and local self-government, Other:Environmental Protection and Energy Efficiency Fund	NE	NE	NE	NE
MTR-9: Monitoring, reporting and verification of greenhouse gas emissions in the lifetime of liquid fuels	Transport	Carbon dioxide (CO2)	Low carbon fuels/electric cars (Transport)	Information	Implemented	See 7th NC , chapter 4.1.3., measure: MTR-9	2012	Government:Ministry of Environment and Energy, Other:Croatian Agency for the Environment and Nature	NE	NE	NE	NE
MIP-1: Reducing emissions of volatile organic compounds in solvent use sector	Industrial processes (comprising industrial activities that chemically or physically transform materials leading to greenhouse gas emissions, use of greenhouse gases in products and non-energy uses of fossil fuel carbon)	Carbon dioxide (CO2)	Installation of abatement technologies (Industrial processes)	Economic, Regulatory	Implemented	See 7th NC , chapter 4.1.3., measure: MIP-1	2014	Government:Ministry of Environment and Energy	23	24	25	27

Name of mitigation action	Sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of impleme-ntation	Brief description	Start year of impleme-ntation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)			
									2020	2025	2030	2035
MIP-2: Handling of substances that deplete the ozone layer and fluorinated greenhouse gases	Industrial processes (comprising industrial activities that chemically or physically transform materials leading to greenhouse gas emissions, use of greenhouse gases in products and non-energy uses of fossil fuel carbon)	Hydrofluorocarbons (HFC), Perfluorocarbons (PFC), Sulphur hexafluoride (SF6)	Reduction of emissions of fluorinated gases (Industrial processes)	Regulatory	Implemented	See 7th NC , chapter 4.1.3., measure: MIP-2	2014	Government:Ministry of Environment and Energy	242	255	268	290
MIP-3 Technical and organizational measures for collection, reuse, recovery and destruction of controlled substances and fluorinated greenhouse gases	Industrial processes (comprising industrial activities that chemically or physically transform materials leading to greenhouse gas emissions, use of greenhouse gases in products and non-energy uses of fossil fuel carbon)	Hydrofluorocarbons (HFC), Perfluorocarbons (PFC), Sulphur hexafluoride (SF6)	Reduction of emissions of fluorinated gases (Industrial processes)	Regulatory	Implemented	See 7th NC , chapter 4.1.3., measure: MIP-3	2014	Government:Ministry of Environment and Energy	NE	NE	NE	NE
MIP-4: Capacity building and strengthening the knowledge of authorized repairers	Industrial processes (comprising industrial activities that chemically or physically transform materials leading to greenhouse gas emissions, use of greenhouse gases in products and non-energy uses of fossil fuel carbon)	Hydrofluorocarbons (HFC), Perfluorocarbons (PFC), Sulphur hexafluoride (SF6)	Reduction of emissions of fluorinated gases (Industrial processes)	Regulatory	Implemented	See 7th NC , chapter 4.1.3., measure: MIP-4	2014	Government:Ministry of Environment and Energy	NE	NE	NE	NE
MIP-5: Leakage detection of controlled substances and fluorinated greenhouse gases	Industrial processes (comprising industrial activities that chemically or physically transform materials leading to greenhouse gas emissions, use of greenhouse gases in products and non-energy uses of fossil fuel carbon)	Hydrofluorocarbons (HFC), Perfluorocarbons (PFC), Sulphur hexafluoride (SF6)	Reduction of emissions of fluorinated gases (Industrial processes)	Regulatory	Implemented	See 7th NC , chapter 4.1.3., measure: MIP-5	2014	Government:Ministry of Environment and Energy	NE	NE	NE	NE

Name of mitigation action	Sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of impleme-ntation	Brief description	Start year of impleme-ntation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)			
									2020	2025	2030	2035
MWM-1: Preventing the generation and reducing the amount of municipal waste	Waste management/waste	Methane (CH4)	Demand management / reduction (Waste), Reduced landfilling (Waste)	Regulatory, Economic, Education	Implemented	See 7th NC , chapter 4.1.3., measure: MWM-1	2013	Regional:Regional self-government units, Local:Local self-government units, Government:Ministry of Environment and Energy	405	888	1283	1599
MWM-2: Increasing the amount of separately collected and recycled municipal waste	Waste management/waste	Methane (CH4)	Demand management / reduction (Waste), Reduced landfilling (Waste), Improved treatment technologies (Waste)	Regulatory, Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MWM-2	2013	Regional:Regional self-government units, Local:Local self-government units, Government:Ministry of Environment and Energy	NE	NE	NE	NE
MWM-3: Methane flaring	Waste management/waste	Methane (CH4)	Enhanced CH4 collection and use (Waste)	Regulatory, Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MWM-3	2013	Regional:Regional self-government units, Local:Local self-government units, Government:Ministry of Environment and Energy	NE	NE	NE	NE
MWM-4: Reducing the amount of disposed biodegradable municipal waste	Waste management/waste	Methane (CH4)	Demand management / reduction (Waste), Enhanced recycling (Waste), Reduced landfilling (Waste)	Regulatory	Implemented	See 7th NC , chapter 4.1.3., measure: MWM-4	2013	Regional:Regional self-government units, Local:Local self-government units, Government:Ministry of Environment and Energy	NE	NE	NE	NE
MWM-5: Use of biogas for electricity and heat generation	Waste management/waste	Methane (CH4), Carbon dioxide (CO2)	Demand management / reduction (Waste), Enhanced recycling (Waste), Enhanced CH4 collection and use (Waste), Improved treatment technologies (Waste), Reduced landfilling (Waste)	Regulatory, Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MWM-5	2013	Regional:Regional self-government units, Local:Local self-government units, Government:Ministry of Environment and Energy	NE	NE	NE	NE
MAG-1: Change in diet of cattle and pigs and animal feed quality	Agriculture	Methane (CH4), Nitrous oxide (N2O)	Improved livestock management (Agriculture)	Economic	Planned	See 7th NC , chapter 4.1.3., measure: MAG-1	2018	Government:Ministry of Agriculture	NE	NE	17,8	NE

Name of mitigation action	Sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of impleme-ntation	Brief description	Start year of impleme-ntation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)			
									2020	2025	2030	2035
MAG-2: Anaerobic decomposition of manure and biogas production	Agriculture, Energy supply (comprising extraction, transmission, distribution and storage of fuels as well as energy and electricity production)	Methane (CH_4), Nitrous oxide (N_2O)	Improved animal waste management systems (Agriculture)	Economic	Planned	See 7th NC , chapter 4.1.3., measure: MAG-2	2018	Government:Ministry of Agriculture, Government:Advisory services	NE	NE	NE	NE
MAG-3: Improving cattle facilities and systems of animal waste management	Agriculture	Methane (CH_4)	Improved animal waste management systems (Agriculture)	Economic	Planned	See 7th NC , chapter 4.1.3., measure: MAG-3	2018	Government:Ministry of Agriculture, Government:Advisory services	NE	NE	6,5	NE
MAG-4: Improvement of mineral fertilizer application methods	Agriculture	Nitrous oxide (N_2O)	Reduction of fertilizer/manure use on cropland (Agriculture)	Economic, Information, Research	Planned	See 7th NC , chapter 4.1.3., measure: MAG-4	2020	Government:Ministry of Agriculture, Government:Advisory services	NE	NE	68,7	NE
MAG-5: Hydromeliorative interventions and systems of protection against natural disasters	Agriculture	Nitrous oxide (N_2O)	Reduction of fertilizer/manure use on cropland (Agriculture)	Economic	Planned	See 7th NC , chapter 4.1.3., measure: MAG-5	2018	Government:Ministry of Agriculture, Government:Advisory services	NE	NE	25,2	NE
MAG-6: Introduction of new cultivars, varieties and cultures	Agriculture	Nitrous oxide (N_2O)	Reduction of fertilizer/manure use on cropland (Agriculture)	Information, Research	Planned	See 7th NC , chapter 4.1.3., measure: MAG-6	2020	Government:Ministry of Agriculture	NE	NE	12,6	NE
MAG-7: Rural Development Programme of the Republic of Croatia for the Period 2014-2020	Agriculture	Methane (CH_4), Nitrous oxide (N_2O)	Reduction of fertilizer/manure use on cropland (Agriculture), Improved livestock management (Agriculture), Activities improving grazing land or grassland management (Agriculture)	Economic, Regulatory	Adopted	See 7th NC , chapter 4.1.3., measure: MAG-7	2018	Government:Ministry of Agriculture, Other:Agency for paying in Agriculture	NE	NE	NE	NE
MLF-1: Improving the reporting in LULUCF sector	Land use, land-use change and forestry	Carbon dioxide (CO_2)	Afforestation and reforestation (LULUCF), Conservation of carbon in existing forests (LULUCF), Enhanced forest management (LULUCF), Strengthening protection against natural disturbances (LULUCF)	Regulatory	Implemented	See 7th NC , chapter 4.1.3., measure: MLF-1	2015	Government:Ministry of environment and energy	NE	NE	NE	NE

Name of mitigation action	Sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of impleme-ntation	Brief description	Start year of impleme-ntation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)			
									2020	2025	2030	2035
MLF-2: Preparation of cost-benefit analysis of afforestation on new areas and natural regeneration of forests as a measure of increasing the sinks in LULUCF sector	Land use, land-use change and forestry	Carbon dioxide (CO_2)	Afforestation and reforestation (LULUCF)	Research	Planned	See 7th NC , chapter 4.1.3., measure: MLF-2	2017	Government:Ministry of Environment and Energy, Government:Ministry of Agriculture	NE	NE	NE	NE
MLF-3: Implementation of Action plan for LULUCF sector	Land use, land-use change and forestry	Carbon dioxide (CO_2)	Afforestation and reforestation (LULUCF), Enhancing production in existing forests (LULUCF), Conservation of carbon in existing forests (LULUCF), Enhanced forest management (LULUCF), Prevention of deforestation (LULUCF)	Regulatory	Implemented	See 7th NC , chapter 4.1.3., measure: MLF-3	2015	Government:Ministry of Environment and Energy, Government:Ministry of Agriculture	NE	NE	NE	NE
MCC-1: Committee for cross-sectoral coordination of policies and measures for mitigation and adaptation to climate change	Cross-cutting	Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFC), Perfluorocarbons (PFC), Sulphur hexafluoride (SF_6)	Multi-sectoral policy (Cross-cutting)	Regulatory	Implemented	See 7th NC , chapter 4.1.3., measure: MCC-1	2014	Government:Ministry of Environment and Energy, Government:Competent Ministries	NE	NE	NE	NE

Name of mitigation action	Sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of impleme-ntation	Brief description	Start year of impleme-ntation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)			
									2020	2025	2030	2035
MCC-2: System for the Measurement and Verification of Energy Savings	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture), Transport	Carbon dioxide (CO2)	Efficiency improvements of buildings (Energy consumption), Efficiency improvement of appliances (Energy consumption), Efficiency improvement in services/ tertiary sector (Energy consumption), Efficiency improvement in industrial end-use sectors (Energy consumption), Demand management/reduction (Energy consumption), Efficiency improvements of vehicles (Transport), Modal shift to public transport or non-motorized transport (Transport), Low carbon fuels/electric cars (Transport), Demand management/reduction (Transport), Improved behaviour (Transport)	Information	Implemented	See 7th NC , chapter 4.1.3., measure: MCC-2	2015	Other:National Energy Efficiency Authority	NE	NE	NE	NE
MCC-3: Promotion of the use of innovative information and communication technologies (ICT) to reduce greenhouse gas emissions	Cross-cutting	Carbon dioxide (CO2), Methane (CH4), Nitrous oxide (N2O), Hydrofluorocarbons (HFC), Perfluorocarbons (PFC), Sulphur hexafluoride (SF6)	Multi-sectoral policy (Cross-cutting)	Voluntary/negotiated agreements	Implemented	See 7th NC , chapter 4.1.3., measure: MCC-3	2014	Government:Ministry of Environment and Energy, Government:Ministry of Economy, Enterpreneurship and Crafts, Government:Ministry of Construction and Physical Planning, Other:Croatian Agency for the Environment and Nature	NE	NE	NE	NE

Name of mitigation action	Sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of impleme-ntation	Brief description	Start year of impleme-ntation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)			
									2020	2025	2030	2035
MCC-4: Emissions Trading System	Energy supply (comprising extraction, transmission, distribution and storage of fuels as well as energy and electricity production), Transport, Industrial processes (comprising industrial activities that chemically or physically transform materials leading to greenhouse gas emissions, use of greenhouse gases in products and non-energy uses of fossil fuel carbon)	Carbon dioxide (CO2), Nitrous oxide (N2O)	Increase in renewable energy (Energy supply), Switch to less carbon-intensive fuels (Energy supply), Efficiency improvement in the energy and transformation sector (Energy supply), Carbon capture and storage (Energy supply), Installation of abatement technologies (Industrial processes), Emission reduction in air transport ()	Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MCC-4	2013	Other:European Comission, Government:Ministry of Environment and Energy, Other:Croatian Agency for the Environment and Nature	NE	NE	NE	NE
MCC-5: Use of funds obtained from the sales of EU ETS emission allowances through auctions for the GHG emission reduction measures	Cross-cutting	Carbon dioxide (CO2), Methane (CH4), Nitrous oxide (N2O), Hydrofluorocarbons (HFC), Perfluorocarbons (PFC), Sulphur hexafluoride (SF6)	Framework policy (Cross-cutting)	Economic	Implemented	See 7th NC , chapter 4.1.3., measure: MCC-5	2013	Government:Ministry of Environment and Energy, Government:Goverment of the Republic of Croatia	NE	NE	NE	NE
MCC-6: Implementation of interdisciplinary research on the potential of geological storage of CO_2 in the Republic of Croatia	Energy supply (comprising extraction, transmission, distribution and storage of fuels as well as energy and electricity production)	Carbon dioxide (CO2)	Carbon capture and storage (Energy supply)	Research	Planned	See 7th NC , chapter 4.1.3., measure: MCC-6	2018	Government:Ministry of Environment and Energy	NE	NE	NE	NE

Name of mitigation action	Sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of impleme-ntation	Brief description	Start year of impleme-ntation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)			
									2020	2025	2030	2035
MCC-7: Energy efficiency obligation scheme	Energy consumption (comprising consumption of fuels and electricity by end users such as households, services, industry and agriculture), Transport	Carbon dioxide (CO2)	Efficiency improvements of buildings (Energy consumption), Efficiency improvement in services/ tertiary sector (Energy consumption), Efficiency improvement in industrial end-use sectors (Energy consumption), Demand management/reduction (Energy consumption), Efficiency improvement of appliances (Energy consumption), Efficiency improvements of vehicles (Transport), Modal shift to public transport or non-motorized transport (Transport), Demand management/reduction (Transport), Low carbon fuels/electric cars (Transport), Improved behaviour (Transport)	Economic	Planned	See 7th NC , chapter 4.1.3., measure: MCC-7	2018	Government:Ministry of Environment and Energy, Other:National Energy Efficiency Authority	NE	NE	NE	NE
MIP-6: A fee to cover the costs of collection, reuse, recovery and destruction of controlled substances and fluorinated greenhouse gases	Industrial processes (comprising industrial activities that chemically or physically transform materials leading to greenhouse gas emissions, use of greenhouse gases in products and non-energy uses of fossil fuel carbon)	Hydrofluorocarbons (HFC), Perfluorocarbons (PFC), Sulphur hexafluoride (SF6)	Reduction of emissions of fluorinated gases (Industrial processes)	Economic, Regulatory	Implemented	See 7th NC , chapter 4.1.3., measure: MIP-6	2014	Government:Ministry of Environment and Energy, Government:Environmental Protection and Energy Efficiency Fund	NE	NE	NE	NE

Table 4: Reporting on progress[a,b]

	Total emissions excluding LULUCF	*Contribution from LULUCF[d]*	*Quantity of units from market based mechanisms under the Convention*		*Quantity of units from other market based mechanisms*	
Year[c]	*(kt CO_2 eq)*	*(kt CO_2 eq)*	*(number of units)*	*(kt CO_2 eq)*	*(number of units)*	*(kt CO_2 eq)*
(1990)	31153.70	NA	NO	NO	NA	NA
2010	27329.01	NA	NO	NO	NA	NA
2011	26928.66	NA	NO	NO	NA	NA
2012	25121.94	NA	NO	NO	NA	NA
2013	23922.55	NA	NO	NO	NA	NA
2014	23049.00	NA	NO	NO	NA	NA
2015	23502.15	NA	NO	NO	NA	NA

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] Parties may add additional rows for years other than those specified below.

[d] 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.

Since the LULUCF is excluded from the economy-wide emission reduction target of the Republic of Croatia, following optional tables are not needed:

- Table 4(a): Progress in achieving the quantified economy-wide emission reduction targets –- further information on mitigation actions relevant to the contribution of the land use, land-use change and forestry sector in 2015 and
- Table 4(a): 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[a,b]

Table 4(b): Reporting on progress[a,b,c]

Units of market based mechanisms			*Year*	
			2014	*2015*
Kyoto Protocol units[d]	*Kyoto Protocol units*	*(number of units)*		
		(kt CO_2 eq)		
	AAUs	*(number of units)*		
		(kt CO2 eq)		
	ERUs	*(number of units)*		
		(kt CO2 eq)		
	CERs	*(number of units)*		
		(kt CO2 eq)		
	tCERs	*(number of units)*		
		(kt CO2 eq)		
	lCERs	*(number of units)*		
		(kt CO2 eq)		
Other units [d,e]	*Units from market-based mechanisms under the Convention*	*(number of units)*		
		(kt CO_2 eq)		
	Units from other market-based mechanisms	*(number of units)*		
		(kt CO_2 eq)		
Total		*(number of units)*		
		(kt CO_2 eq)		

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.

Table 5: Summary of key variables and assumptions used in the projections analysis[a]

Key underlying assumptions		*Historical[b]*						Projected					Data source
Assumption	*Unit*	*1990*	*1995*	2000	2005	2010	2014	2015	2020	2025	2030	2035	
Population	*thousands*	4,778.00	4,659.00	4,497.00	4,311.00	4,303.00	4,238.00	4,229.00	4,193.70	4,139.60	4,081.00	4,017.60	*Croatian bureauof statistics, EC recommendations 2017*
GDP growth rate	%	NE	NE	3.80	4.20	-1.70	-0.4	1.6	1.8	1.2	1.3	1.9	Croatian bureauof statistics, EC recommendations 2017
Gross domestic product (GDP):-Constant prices	EUR million (c14)	NE	NE	NE	NE	NE	43,096.00	43,786.00	48,817.00	51,818.00	55,274.00	60,729.00	Croatian bureauof statistics, EC recommendations 2017
Gross value added (GVA) total industry	EUR million (c14)	NE	NE	NE	NE	NE	9,711.00	10,202.00	11,326.00	11,918.00	12,713.00	13,785.00	Croatian bureauof statistics, EC recommendations 2017
International (wholesale) fuel import prices:-Electricity Coal	EUR/GJ	NE	NE	NE	NE	NE	2.5	2.2	2.2	2.6	3.2	3.4	EC recommendations 2017
International (wholesale) fuel import prices:-Crude Oil	EUR/GJ	NE	NE	NE	NE	NE	8.1	7.8	11.6	13.2	14.5	15.1	EC recommendations 2017
International (wholesale) fuel import prices:-Natural gas	EUR/GJ	NE	NE	NE	NE	NE	6.5	6.7	7.5	8.1	8.8	9.4	EC recommendations 2017
EU ETS carbon price	*EUR/EUA*	NA	NA	NA	NE	NE	7	7	15	22.5	33.5	42	EC recommendations 2017

[a] Parties should include key underlying assumptions as appropriate.

[b] Parties should include historical data used to develop the greenhouse gas projections reported.

Table 6(a): Information on updated greenhouse gas projections under a ‘with measures’ scenario[a]

	GHG emissions and removals[b] (*kt CO_2 eq*)							GHG emission projections (kt CO_2 eq)	
	Base year (1990)	1990	1995	2000	2005	2010	2015	2020	2030
Sector[d,e]									
Energy	17.950,74	17.950,74	12.754,01	13.851,38	16.168,98	13.951,59	10.776,21	11.169,34	10.966,89
Transport	3.881,11	3.881,11	3.367,95	4.499,39	5.561,06	5.952,28	5.951,83	5.421,69	5.594,87
Industry/industrial processes	4.628,76	4.628,76	2.440,50	3.127,50	3.507,64	3.315,26	2.665,51	3.008,86	3.146,54
Agriculture	4.039,08	4.039,08	3.008,23	2.887,95	3.029,67	2.717,50	2.555,32	2.523,06	2.712,66
Forestry/LULUCF	-6.589,43	-6.589,43	-9.109,28	-7.505,25	-7.808,08	-7.263,79	-4.991,72	-3.098,18	-2.375,06
Waste management/waste	654,01	654,01	739,53	889,04	1.045,05	1.392,39	1.553,28	1.853,64	2.256,33
Other (specify)									
Gas									
CO_2 emissions including net CO_2 from LULUCF	16.762,70	16.762,70	7.837,63	12.088,36	15.572,30	13.863,57	12.826,69	14.737,37	15.504,39
CO_2 emissions excluding net CO_2 from LULUCF	23.390,08	23.390,08	16.992,80	19.789,12	23.451,85	21.203,74	17.918,75	17.937,49	17.990,50
CH_4 emissions including CH_4 from LULUCF	3.745,42	3.745,42	3.041,21	2.984,76	3.176,52	3.416,84	3.444,61	3.725,46	4.260,04
CH_4 emissions excluding CH_4 from LULUCF	3.744,19	3.744,19	3.033,66	2.887,85	3.173,79	3.415,08	3.430,64	3.713,71	4.248,29
N_2O emissions including N_2O from LULUCF	2.805,47	2.805,47	2.281,66	2.517,37	2.476,66	2.396,94	1.813,95	1.945,10	2.019,81
N_2O emissions excluding N_2O from LULUCF	2.768,74	2.768,74	2.243,31	2.418,77	2.407,93	2.322,33	1.727,57	1.854,90	1.920,50
HFCs	NO	NO	29,32	147,90	265,80	378,87	419,89	463,90	511,15
PFCs	1.240,24	1.240,24	NO	NO	NO	0,03	0,03	0,00	0,00
SF_6	10,45	10,45	11,12	11,62	13,03	8,95	5,26	6,59	6,86
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total with LULUCF[f]	24.564,27	24.564,27	13.200,94	17.750,01	21.504,31	20.065,22	18.510,43	20.878,41	22.302,24
Total without LULUCF	31.153,70	31.153,70	22.310,22	25.255,27	29.312,39	27.329,01	23.502,15	23.976,59	24.677,30

Abbreviations: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] In accordance with the “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications”, at a minimum Parties shall report a ‘with measures’ scenario, and may report ‘without measures’ and ‘with additional measures’ scenarios. If a Party chooses to report ‘without measures’ and/or ‘with additional measures’ scenarios they are to use tables 6(b) and/or 6(c), respectively. If a Party does not choose to report ‘without measures’ or ‘with additional measures’ scenarios then it should not include tables 6(b) or 6(c) in the biennial report.
[b] Emissions and removals reported in these columns should be as reported in the latest GHG inventory and consistent with the emissions and removals reported in the table on GHG emissions and trends provided in this biennial report. Where the sectoral breakdown differs from that reported in the GHG inventory Parties should explain in their biennial report how the inventory sectors relate to the sectors reported in this table.
[c] 20XX is the reporting due-date year (i.e. 2014 for the first biennial report).

[d] In accordance with paragraph 34 of the “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications”, projections shall be presented on a sectoral basis, to the extent possible, using the same sectoral categories used in the policies and measures section. This table should follow, to the extent possible, the same sectoral categories as those listed in paragraph 17 of those guidelines, namely, to the extent appropriate, the following sectors should be considered: energy, transport, industry, agriculture, forestry and waste management.
[e] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors (i.e. cross-cutting), as appropriate.
[f] Parties may choose to report total emissions with or without LULUCF, as appropriate.

Table 6(b): Information on updated greenhouse gas projections under a ‘without measures’ scenario[a]

	GHG emissions and removals[b]							GHG emission projections	
	(kt CO_2 eq)							(kt CO_2 eq)	
	Base year (1990)	1990	1995	2000	2005	2010	2015	2020	2030
Sector[d,e]									
Energy	17.950,74	17.950,74	12.754,01	13.851,38	16.168,98	13.951,59	10.776,21	11.974,53	14.395,39
Transport	3.881,11	3.881,11	3.367,95	4.499,39	5.561,06	5.952,28	5.951,83	6.049,94	6.692,09
Industry/industrial processes	4.628,76	4.628,76	2.440,50	3.127,50	3.507,64	3.315,26	2.665,51	3.157,20	3.456,52
Agriculture	4.039,08	4.039,08	3.008,23	2.887,95	3.029,67	2.717,50	2.555,32	2.523,06	2.712,66
Forestry/LULUCF	-6.589,43	-6.589,43	-9.109,28	-7.505,25	-7.808,08	-7.263,79	-4.991,72	NA	NA
Waste management/waste	654,01	654,01	739,53	889,04	1.045,05	1.392,39	1.553,28	1.931,21	2.450,05
Other (specify)									
Gas									
CO_2 emissions including net CO_2 from LULUCF	16.762,70	16.762,70	7.837,63	12.088,36	15.572,30	13.863,57	12.826,69	NA	NA
CO_2 emissions excluding net CO_2 from LULUCF	23.390,08	23.390,08	16.992,80	19.789,12	23.451,85	21.203,74	17.918,75	19.478,82	22.700,20
CH_4 emissions including CH_4 from LULUCF	3.745,42	3.745,42	3.041,21	2.984,76	3.176,52	3.416,84	3.444,61	NA	NA
CH_4 emissions excluding CH_4 from LULUCF	3.744,19	3.744,19	3.033,66	2.887,85	3.173,79	3.415,08	3.430,64	3.794,23	4.463,74
N_2O emissions including N_2O from LULUCF	2.805,47	2.805,47	2.281,66	2.517,37	2.476,66	2.396,94	1.813,95	NA	NA
N_2O emissions excluding N_2O from LULUCF	2.768,74	2.768,74	2.243,31	2.418,77	2.407,93	2.322,33	1.727,57	1.869,22	1.973,66
HFCs	NO	NO	29,32	147,90	265,80	378,87	419,89	487,10	562,26
PFCs	1.240,24	1.240,24	NO	NO	NO	0,03	0,03	0,00	0,00
SF_6	10,45	10,45	11,12	11,62	13,03	8,95	5,26	6,59	6,86
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total with LULUCF[f]	24.564,27	24.564,27	13.200,94	17.750,01	21.504,31	20.065,22	18.510,43	NE	NE
Total without LULUCF	31.153,70	31.153,70	22.310,22	25.255,27	29.312,39	27.329,01	23.502,15	25.635,95	29.706,71

Abbreviations: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] In accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", at a minimum Parties shall report a 'with measures' scenario, and may report 'without measures' and 'with additional measures' scenarios. If a Party chooses to report 'without measures' and/or 'with additional measures' scenarios they are to use tables 6(b) and/or 6(c), respectively. If a Party does not choose to report 'without measures' or 'with additional measures' scenarios then it should not include tables 6(b) or 6(c) in the biennial report.
[b] Emissions and removals reported in these columns should be as reported in the latest GHG inventory and consistent with the emissions and removals reported in the table on GHG emissions and trends provided in this biennial report. Where the sectoral breakdown differs from that reported in the GHG inventory Parties should explain in their biennial report how the inventory sectors relate to the sectors reported in this table.
[c] 20XX is the reporting due-date year (i.e. 2014 for the first biennial report).

[d] In accordance with paragraph 34 of the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", projections shall be presented on a sectoral basis, to the extent possible, using the same sectoral categories used in the policies and measures section. This table should follow, to the extent possible, the same sectoral categories as those listed in paragraph 17 of those guidelines, namely, to the extent appropriate, the following sectors should be considered: energy, transport, industry, agriculture, forestry and waste management.
[e] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors (i.e. cross-cutting), as appropriate.
[f] Parties may choose to report total emissions with or without LULUCF, as appropriate.

Table 6(c): Information on updated greenhouse gas projections under a ‘with additional measures’ scenario

	GHG emissions and removals[b]							GHG emission projections	
	(kt CO_2 eq)							(kt CO_2 eq)	
	Base year (1990)	1990	1995	2000	2005	2010	2015	2020	2030
Sector[d,e]									
Energy	17.950,74	17.950,74	12.754,01	13.851,38	16.168,98	13.951,59	10.776,21	10.846,61	8.839,77
Transport	3.881,11	3.881,11	3.367,95	4.499,39	5.561,06	5.952,28	5.951,83	5.421,06	4.827,37
Industry/industrial processes	4.628,76	4.628,76	2.440,50	3.127,50	3.507,64	3.315,26	2.665,51	2.447,39	2.546,63
Agriculture	4.039,08	4.039,08	3.008,23	2.887,95	3.029,67	2.717,50	2.555,32	2.266,09	2.395,22
Forestry/LULUCF	-6.589,43	-6.589,43	-9.109,28	-7.505,25	-7.808,08	-7.263,79	-4.991,72	NA	NA
Waste management/waste	654,01	654,01	739,53	889,04	1.045,05	1.392,39	1.553,28	1.448,50	973,73
Other (specify)									
Gas									
CO_2 emissions including net CO_2 from LULUCF	16.762,70	16.762,70	7.837,63	12.088,36	15.572,30	13.863,57	12.826,69	NA	NA
CO_2 emissions excluding net CO_2 from LULUCF	23.390,08	23.390,08	16.992,80	19.789,12	23.451,85	21.203,74	17.918,75	17.431,88	14.989,61
CH_4 emissions including CH_4 from LULUCF	3.745,42	3.745,42	3.041,21	2.984,76	3.176,52	3.416,84	3.444,61	NA	NA
CH_4 emissions excluding CH_4 from LULUCF	3.744,19	3.744,19	3.033,66	2.887,85	3.173,79	3.415,08	3.430,64	3.045,55	2.546,88
N_2O emissions including N_2O from LULUCF	2.805,47	2.805,47	2.281,66	2.517,37	2.476,66	2.396,94	1.813,95	NA	NA
N_2O emissions excluding N_2O from LULUCF	2.768,74	2.768,74	2.243,31	2.418,77	2.407,93	2.322,33	1.727,57	1.723,96	1.796,49
HFCs	NO	NO	29,32	147,90	265,80	378,87	419,89	221,68	242,88
PFCs	1.240,24	1.240,24	NO	NO	NO	0,03	0,03	0,00	0,00
SF_6	10,45	10,45	11,12	11,62	13,03	8,95	5,26	6,59	6,86
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total with LULUCF[f]	24.564,27	24.564,27	13.200,94	17.750,01	21.504,31	20.065,22	18.510,43	NE	NE
Total without LULUCF	31.153,70	31.153,70	22.310,22	25.255,27	29.312,39	27.329,01	23.502,15	22.429,66	19.582,72

Abbreviations: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] In accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", at a minimum Parties shall report a 'with measures' scenario, and may report 'without measures' and 'with additional measures' scenarios. If a Party chooses to report 'without measures' and/or 'with additional measures' scenarios they are to use tables 6(b) and/or 6(c), respectively. If a Party does not choose to report 'without measures' or 'with additional measures' scenarios then it should not include tables 6(b) or 6(c) in the biennial report.

[b] Emissions and removals reported in these columns should be as reported in the latest GHG inventory and consistent with the emissions and removals reported in the table on GHG emissions and trends provided in this biennial report. Where the sectoral breakdown differs from that reported in the GHG inventory Parties should explain in their biennial report how the inventory sectors relate to the sectors reported in this table.

[c] 20XX is the reporting due-date year (i.e. 2014 for the first biennial report).

[d] In accordance with paragraph 34 of the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", projections shall be presented on a sectoral basis, to the extent possible, using the same sectoral categories used in the policies and measures section. This table should follow, to the extent possible, the same sectoral categories as those listed in paragraph 17 of those guidelines, namely, to the extent appropriate, the following sectors should be considered: energy, transport, industry, agriculture, forestry and waste management.

[e] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors (i.e. cross-cutting), as appropriate.

[f] Parties may choose to report total emissions with or without LULUCF, as appropriate.

Table 7: Provision of public financial support: summary information in 2015-2016

Allocation channels	*Year 2015*									
	European euro - EUR					*USD*[b]				
	Core/ general[c]	*Climate-specific*[d]				*Core/ general*[c]	*Climate-specific*[d]			
		Mitigation	*Adaptation*	*Cross-cutting*[e]	*Other*[f]		*Mitigation*	*Adaptation*	*Cross-cutting*[e]	*Other*[f]
2015										
Total contributions through multilateral channels:	33,018.00									
Multilateral climate change funds[g]										
Other multilateral climate change funds[h]										
Multilateral financial institutions, including regional development banks										
Specialized United Nations bodies	33,018.00									
Total contributions through bilateral, regional and other channels										
Total	33,018.00									
2016										
Total contributions through multilateral channels:	37,442.00									
Multilateral climate change funds[g]										
Other multilateral climate change funds[h]										
Multilateral financial institutions, including regional development banks										
Specialized United Nations bodies	37,442.00									
Total contributions through bilateral, regional and other channels										
Total	37,442.00									

Table 7(a): Provision of public financial support: contribution through multilateral channels in 2015-2016

	Total Amount								
	Core/general		Climate-specific						
Donor funding	**Domestic Currency**	**USD**	**Domestic Currency**	**USD**	**Status**	**Funding source**	**Financial instrument**	**Type of support**	**Sector**
2015									
Total contributions through multilateral channels									
Multilateral climate change funds									
1. Global Environment Facility									
2. Least Developed Countries Fund									
3. Special Climate Change Fund									
4. Adaptation Fund									
5. Green Climate Fund									
6. UNFCCC Trust Fund for Supplementary Activities									
7. Other multilateral climate change funds									
Multilateral financial institutions, including regional development banks									
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. Other									
Specialized United Nations bodies									
1. United Nations Development Programme									
2. United Nations Environment Programme									
3. Other									
Contribution to the core budget (EUR)	33.018,00				Disbursed	Other		Other	Not applicable
2016									
Total contributions through multilateral channels									
Multilateral climate change funds									
1. Global Environment Facility									
2. Least Developed Countries Fund									
3. Special Climate Change Fund									
4. Adaptation Fund									

5. Green Climate Fund									
6. UNFCCC Trust Fund for Supplementary Activities									
7. Other multilateral climate change funds									
Multilateral financial institutions, including regional development banks									
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. Other									
Specialized United Nations bodies									
1. United Nations Development Programme									
2. United Nations Environment Programme									
3. Other									
Contribution to the core budget (EUR)	37.442,00				Disbursed	Other		Other	Not applicable

Table 7(b): Provision of public financial support: contribution through bi-lateral, regional and other channels in 2015-2016

	Total Amount								
	Climate-specific								
Project/programme/activity	**Domestic Currency**	**USD**	**Status**	**Funding source**	**Financial instrument**	**Type of support**	**Sector**	**Recipient country or region**	**Additional Information**
2015									
Total contributions through bilateral, regional and other channels									
2016									
Total contributions through bilateral, regional and other channels									

Table 8: Provision of technology development and transfer support

Recipient country and/or region	Targeted area	Measures and activities related to technology transfer	Sector	Source of the funding for technology transfer	Activities undertaken by	Status	Additional information

Table 9: Provision of capacity-building support

Recipient country / region	Targeted area	Programme or project title	Description of programme or project

ANNEX III. OTHER

1. SUMMARY OF EMISSION TABLES 1990-2015

Year 1990 (Base year)	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**20758.79**	**842.81**	**230.24**	**NA**	**21831.84**	**70.1%**
A. Fuel combustion (sectoral approach)	20078.93	413.91	229.55	NA	20722.40	66.5%
1. Energy industries	7071.41	5.42	17.49	NA	7094.31	22.8%
2. Manufacturing industries and construction	5501.67	9.73	17.64	NA	5529.04	17.7%
3. Transport	3786.94	41.10	53.07	NA	3881.11	12.5%
4. Other sectors	3718.91	357.67	141.35	NA	4217.93	13.5%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	679.85	428.90	0.69	NA	1109.45	3.6%
1. Solid fuels	NO	59.64	NO,NA	NA	59.64	0.2%
2. Oil and natural gas	679.85	369.26	0.69	NA	1049.80	3.4%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**2580.73**	**9.53**	**787.80**	**1250.69**	**4628.76**	**14.9%**
A. Mineral industry	1280.88	NA	NA	NA	1280.88	4.1%
B. Chemical industry	771.87	5.63	754.43	NA	1531.93	4.9%
C. Metal industry	338.56	3.90	NO	1240.24	1582.70	5.1%
D. Non-energy products from fuels and solvent	189.43	NA	NA	NA	189.43	0.6%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	NA	NO	NO
G. Other product manufacture and use	NO	NO	33.38	10.45	43.83	0.1%
3. Agriculture	**50.02**	**2305.38**	**1683.69**	**NA**	**4039.08**	**13.0%**
A. Enteric fermentation	NA	1977.59	NA	NA	1977.59	6.3%
B. Manure management	NA	327.78	323.85	NA	651.63	2.1%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1359.84	NA	1359.84	4.4%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	NO	NA	NA	NA	NO	NO
H. Urea application	50.02	NA	NA	NA	50.02	0.2%
4. Land use, land-use change and forestry	**-6627.38**	**1.23**	**36.72**	**NA**	**-6589.43**	**-21.2%**
A. Forest land	-6733.83	1.12	0.74	NA	-6731.97	-21.6%
B. Cropland	189.57	NO	3.90	NA	193.47	0.6%
C. Grassland	-76.65	0.11	0.12	NA	-76.42	-0.2%
D. Wetlands	86.39	NO	9.80	NA	96.19	0.3%
E. Settlements	208.68	NO	22.17	NA	230.85	0.7%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-301.54	NA	NA	NA	-301.54	-1.0%
5. Waste	**0.54**	**586.47**	**67.01**	**NA**	**654.01**	**2.1%**
A. Solid waste disposal	NA,NO	348.61	NA	NA	348.61	1.1%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	0.54	NA,NO	0.01	NA	0.54	0.0%
D. Waste water treatment and discharge	NA	237.86	67.00	NA	304.86	1.0%
Total with LULUCF	**16762.70**	**3745.42**	**2805.47**	**1250.69**	**24564.27**	**78.8%**
Total without LULUCF	**23390.08**	**3744.19**	**2768.74**	**1250.69**	**31153.70**	**100.0%**
Shares in total with LULUCF	68.2%	15.2%	11.4%	5.1%	100.0%	
Shares in total without LULUCF	75.1%	12.0%	8.9%	4.0%	100.0%	
Memo items:						
International bunkers	643.85	0.86	2.40	NA	647.10	2.1%
Aviation	496.62	0.52	1.24	NA	498.38	1.6%
Navigation	147.23	0.34	1.15	NA	148.72	0.5%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5126.24	NA	NA	NA	5126.24	16.5%

Year 1991	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**15252.77**	**792.47**	**199.29**	**NA**	**16244.53**	**66.7%**
A. Fuel combustion (sectoral approach)	14586.28	442.21	198.78	NA	15227.28	62.5%
1. Energy industries	4738.14	3.97	12.00	NA	4754.11	19.5%
2. Manufacturing industries and construction	3919.00	7.08	12.57	NA	3938.65	16.2%
3. Transport	2866.87	31.02	43.67	NA	2941.55	12.1%
4. Other sectors	3062.28	400.14	130.55	NA	3592.97	14.7%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	666.49	350.26	0.50	NA	1017.26	4.2%
1. Solid fuels	NO	53.15	NO,NA	NA	53.15	0.2%
2. Oil and natural gas	666.49	297.11	0.50	NA	964.10	4.0%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**1964.66**	**8.91**	**696.33**	**861.08**	**3530.98**	**14.5%**
A. Mineral industry	863.47	NA	NA	NA	863.47	3.5%
B. Chemical industry	682.27	5.18	662.95	NA	1350.41	5.5%
C. Metal industry	273.84	3.73	NO	850.75	1128.32	4.6%
D. Non-energy products from fuels and solvent	145.07	NA	NA	NA	145.07	0.6%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	NA	NO	NO
G. Other product manufacture and use	NO	NO	33.38	10.33	43.71	0.2%
3. Agriculture	**50.95**	**2219.25**	**1659.51**	**NA**	**3929.71**	**16.1%**
A. Enteric fermentation	NA	1884.45	NA	NA	1884.45	7.7%
B. Manure management	NA	334.80	310.12	NA	644.92	2.6%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1349.39	NA	1349.39	5.5%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	NO	NA	NA	NA	NO	NO
H. Urea application	50.95	NA	NA	NA	50.95	0.2%
4. Land use, land-use change and forestry	**-7876.88**	**3.18**	**37.49**	**NA**	**-7836.21**	**-32.2%**
A. Forest land	-8507.50	3.00	1.98	NA	-8502.52	-34.9%
B. Cropland	153.55	NO	4.17	NA	157.72	0.6%
C. Grassland	-3.06	0.18	0.19	NA	-2.69	0.0%
D. Wetlands	74.57	NO	9.37	NA	83.94	0.3%
E. Settlements	183.17	NO	21.78	NA	204.95	0.8%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	222.39	NA	NA	NA	222.39	0.9%
5. Waste	**0.54**	**600.24**	**63.40**	**NA**	**664.17**	**2.7%**
A. Solid waste disposal	NA,NO	362.83	NA	NA	362.83	1.5%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	0.54	NA,NO	0.01	NA	0.54	0.0%
D. Waste water treatment and discharge	NA	237.41	63.39	NA	300.80	1.2%
Total with LULUCF	**9392.03**	**3624.05**	**2656.02**	**861.08**	**16533.18**	**67.8%**
Total without LULUCF	**17268.91**	**3620.87**	**2618.52**	**861.08**	**24369.39**	**100.0%**
Shares in total with LULUCF	56.8%	21.9%	16.1%	5.2%	100.0%	
Shares in total without LULUCF	70.9%	14.9%	10.7%	3.5%	100.0%	
Memo items:						
International bunkers	94.29	0.10	0.24	NA	94.63	0.4%
Aviation	94.29	0.10	0.24	NA	94.63	0.4%
Navigation	NO	NO	NO	NA	NO	NO
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5986.51	NA	NA	NA	5986.51	24.6%

Year 1992	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**14532.35**	**697.58**	**179.24**	**NA**	**15409.17**	**68.4%**
A. Fuel combustion (sectoral approach)	13856.50	377.02	178.79	NA	14412.31	64.0%
1. Energy industries	5404.66	4.57	15.42	NA	5424.64	24.1%
2. Manufacturing industries and construction	3114.89	5.44	9.58	NA	3129.91	13.9%
3. Transport	2776.67	27.67	37.68	NA	2842.01	12.6%
4. Other sectors	2560.29	339.34	116.12	NA	3015.75	13.4%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	675.85	320.55	0.46	NA	996.86	4.4%
1. Solid fuels	NO	41.30	NO,NA	NA	41.30	0.2%
2. Oil and natural gas	675.85	279.26	0.46	NA	955.56	4.2%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**2008.74**	**7.77**	**898.81**	**10.42**	**2925.73**	**13.0%**
A. Mineral industry	938.79	NA	NA	NA	938.79	4.2%
B. Chemical industry	850.24	5.32	865.43	NA	1720.98	7.6%
C. Metal industry	118.53	2.45	NO	NA	120.98	0.5%
D. Non-energy products from fuels and solvent	101.19	NA	NA	NA	101.19	0.4%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	NA	NO	NO
G. Other product manufacture and use	NO	NO	33.38	10.42	43.79	0.2%
3. Agriculture	**65.51**	**1911.63**	**1531.76**	**NA**	**3508.90**	**15.6%**
A. Enteric fermentation	NA	1616.74	NA	NA	1616.74	7.2%
B. Manure management	NA	294.89	254.54	NA	549.42	2.4%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1277.22	NA	1277.22	5.7%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	NO	NA	NA	NA	NO	NO
H. Urea application	65.51	NA	NA	NA	65.51	0.3%
4. Land use, land-use change and forestry	**-8082.50**	**15.15**	**45.41**	**NA**	**-8021.94**	**-35.6%**
A. Forest land	-8805.57	13.64	9.00	NA	-8782.93	-39.0%
B. Cropland	162.72	NO	4.45	NA	167.17	0.7%
C. Grassland	-15.50	1.51	1.64	NA	-12.35	-0.1%
D. Wetlands	71.22	NO	8.94	NA	80.16	0.4%
E. Settlements	180.09	NO	21.38	NA	201.48	0.9%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	324.54	NA	NA	NA	324.54	1.4%
5. Waste	**0.54**	**613.76**	**63.65**	**NA**	**677.95**	**3.0%**
A. Solid waste disposal	NA,NO	376.81	NA	NA	376.81	1.7%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	0.54	NA,NO	0.01	NA	0.54	0.0%
D. Waste water treatment and discharge	NA	236.95	63.64	NA	300.60	1.3%
Total with LULUCF	**8524.63**	**3245.89**	**2718.87**	**10.42**	**14499.81**	**64.4%**
Total without LULUCF	**16607.13**	**3230.74**	**2673.46**	**10.42**	**22521.75**	**100.0%**
Shares in total with LULUCF	58.8%	22.4%	18.8%	0.1%	100.0%	
Shares in total without LULUCF	73.7%	14.3%	11.9%	0.0%	100.0%	
Memo items:						
International bunkers	72.29	0.08	0.18	NA	72.55	0.3%
Aviation	72.29	0.08	0.18	NA	72.55	0.3%
Navigation	NO	NO	NO	NA	NO	NO
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5219.31	NA	NA	NA	5219.31	23.2%

Year 1993	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**15321.31**	**727.77**	**193.62**	**NA**	**16242.70**	**71.7%**
A. Fuel combustion (sectoral approach)	14434.43	393.46	193.16	NA	15021.06	66.3%
1. Energy industries	5929.31	4.88	17.13	NA	5951.31	26.3%
2. Manufacturing industries and construction	3031.80	5.21	9.17	NA	3046.18	13.4%
3. Transport	2925.04	27.16	46.40	NA	2998.59	13.2%
4. Other sectors	2548.29	356.21	120.46	NA	3024.97	13.3%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	886.88	334.31	0.46	NA	1221.65	5.4%
1. Solid fuels	NO	39.52	NO,NA	NA	39.52	0.2%
2. Oil and natural gas	886.88	294.79	0.46	NA	1182.12	5.2%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**1707.24**	**6.42**	**685.77**	**10.53**	**2409.96**	**10.6%**
A. Mineral industry	804.89	NA	NA	NA	804.89	3.6%
B. Chemical industry	729.48	5.32	652.39	NA	1387.20	6.1%
C. Metal industry	58.10	1.10	NO	NA	59.20	0.3%
D. Non-energy products from fuels and solvent	114.77	NA	NA	NA	114.77	0.5%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	NA	NO	NO
G. Other product manufacture and use	NO	NO	33.38	10.53	43.91	0.2%
3. Agriculture	**52.14**	**1917.55**	**1348.87**	**NA**	**3318.55**	**14.6%**
A. Enteric fermentation	NA	1605.03	NA	NA	1605.03	7.1%
B. Manure management	NA	312.52	257.67	NA	570.18	2.5%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1091.20	NA	1091.20	4.8%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	NO	NA	NA	NA	NO	NO
H. Urea application	52.14	NA	NA	NA	52.14	0.2%
4. Land use, land-use change and forestry	**-8480.79**	**34.39**	**57.58**	**NA**	**-8388.82**	**-37.0%**
A. Forest land	-8965.53	32.81	21.64	NA	-8911.09	-39.3%
B. Cropland	152.64	NO	4.72	NA	157.36	0.7%
C. Grassland	-24.02	1.58	1.72	NA	-20.71	-0.1%
D. Wetlands	67.86	NO	8.51	NA	76.38	0.3%
E. Settlements	177.02	NO	20.99	NA	198.01	0.9%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	111.24	NA	NA	NA	111.24	0.5%
5. Waste	**0.54**	**628.35**	**63.86**	**NA**	**692.75**	**3.1%**
A. Solid waste disposal	NA,NO	391.85	NA	NA	391.85	1.7%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	0.54	NA,NO	0.01	NA	0.54	0.0%
D. Waste water treatment and discharge	NA	236.50	63.86	NA	300.36	1.3%
Total with LULUCF	**8600.43**	**3314.48**	**2349.70**	**10.53**	**14275.15**	**63.0%**
Total without LULUCF	**17081.23**	**3280.09**	**2292.12**	**10.53**	**22663.97**	**100.0%**
Shares in total with LULUCF	60.2%	23.2%	16.5%	0.1%	100.0%	
Shares in total without LULUCF	75.4%	14.5%	10.1%	0.0%	100.0%	
Memo items:						
International bunkers	182.30	0.19	0.46	NA	182.95	0.8%
Aviation	182.30	0.19	0.46	NA	182.95	0.8%
Navigation	NO	NO	NO	NA	NO	NO
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5493.15	NA	NA	NA	5493.15	24.2%

Year 1994	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**14364.19**	**662.15**	**188.53**	**NA**	**15214.87**	**70.0%**
A. Fuel combustion (sectoral approach)	13571.13	359.88	188.11	NA	14119.12	64.9%
1. Energy industries	4630.04	3.27	12.05	NA	4645.37	21.4%
2. Manufacturing industries and construction	3202.34	4.85	8.64	NA	3215.82	14.8%
3. Transport	3102.80	29.54	48.89	NA	3181.24	14.6%
4. Other sectors	2635.95	322.22	118.52	NA	3076.69	14.1%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	793.06	302.27	0.42	NA	1095.75	5.0%
1. Solid fuels	NO	35.44	NO,NA	NA	35.44	0.2%
2. Oil and natural gas	793.06	266.83	0.42	NA	1060.31	4.9%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**1929.89**	**6.71**	**739.82**	**10.64**	**2687.06**	**12.4%**
A. Mineral industry	976.59	NA	NA	NA	976.59	4.5%
B. Chemical industry	749.67	5.08	706.44	NA	1461.19	6.7%
C. Metal industry	80.11	1.63	NO	NA	81.74	0.4%
D. Non-energy products from fuels and solvent	123.51	NA	NA	NA	123.51	0.6%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	NA	NO	NO
G. Other product manufacture and use	NO	NO	33.38	10.64	44.02	0.2%
3. Agriculture	**47.57**	**1753.38**	**1327.28**	**NA**	**3128.24**	**14.4%**
A. Enteric fermentation	NA	1442.05	NA	NA	1442.05	6.6%
B. Manure management	NA	311.33	237.33	NA	548.66	2.5%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1089.95	NA	1089.95	5.0%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	NO	NA	NA	NA	NO	NO
H. Urea application	47.57	NA	NA	NA	47.57	0.2%
4. Land use, land-use change and forestry	**-8610.43**	**11.51**	**41.63**	**NA**	**-8557.29**	**-39.3%**
A. Forest land	-8965.09	10.68	7.04	NA	-8947.37	-41.1%
B. Cropland	170.50	NO	5.00	NA	175.50	0.8%
C. Grassland	-37.16	0.82	0.90	NA	-35.44	-0.2%
D. Wetlands	64.51	NO	8.08	NA	72.59	0.3%
E. Settlements	173.23	NO	20.61	NA	193.84	0.9%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-16.42	NA	NA	NA	-16.42	-0.1%
5. Waste	**0.54**	**649.94**	**66.42**	**NA**	**716.90**	**3.3%**
A. Solid waste disposal	NA,NO	408.74	NA	NA	408.74	1.9%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	0.54	NA,NO	0.01	NA	0.54	0.0%
D. Waste water treatment and discharge	NA	241.20	66.41	NA	307.62	1.4%
Total with LULUCF	**7731.75**	**3083.69**	**2363.68**	**10.64**	**13189.76**	**60.7%**
Total without LULUCF	**16342.18**	**3072.18**	**2322.05**	**10.64**	**21747.06**	**100.0%**
Shares in total with LULUCF	58.6%	23.4%	17.9%	0.1%	100.0%	
Shares in total without LULUCF	75.1%	14.1%	10.7%	0.0%	100.0%	
Memo items:						
International bunkers	403.81	0.60	1.75	NA	406.16	1.9%
Aviation	264.02	0.28	0.66	NA	264.96	1.2%
Navigation	139.78	0.32	1.09	NA	141.20	0.6%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	4929.23	NA	NA	NA	4929.23	22.7%

Year 1995	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**15263.42**	**679.03**	**179.50**	**NA**	**16121.96**	**72.3%**
A. Fuel combustion (sectoral approach)	14331.09	379.67	179.10	NA	14889.86	66.7%
1. Energy industries	5226.83	4.04	12.35	NA	5243.22	23.5%
2. Manufacturing industries and construction	2954.66	4.74	8.46	NA	2967.87	13.3%
3. Transport	3292.78	30.88	44.29	NA	3367.95	15.1%
4. Other sectors	2856.82	340.01	114.00	NA	3310.83	14.8%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	932.34	299.36	0.40	NA	1232.10	5.5%
1. Solid fuels	NO	28.23	NO,NA	NA	28.23	0.1%
2. Oil and natural gas	932.34	271.14	0.40	NA	1203.87	5.4%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**1682.55**	**6.06**	**711.45**	**40.44**	**2440.50**	**10.9%**
A. Mineral industry	759.97	NA	NA	NA	759.97	3.4%
B. Chemical industry	770.84	5.28	678.08	NA	1454.19	6.5%
C. Metal industry	38.37	0.78	NO	NA	39.15	0.2%
D. Non-energy products from fuels and solvent	113.37	NA	NA	NA	113.37	0.5%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	29.32	29.32	0.1%
G. Other product manufacture and use	NO	NO	33.38	11.12	44.50	0.2%
3. Agriculture	**46.29**	**1681.65**	**1280.29**	**NA**	**3008.23**	**13.5%**
A. Enteric fermentation	NA	1376.67	NA	NA	1376.67	6.2%
B. Manure management	NA	304.97	223.41	NA	528.39	2.4%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1056.88	NA	1056.88	4.7%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	NO	NA	NA	NA	NO	NO
H. Urea application	46.29	NA	NA	NA	46.29	0.2%
4. Land use, land-use change and forestry	**-9155.17**	**7.54**	**38.34**	**NA**	**-9109.28**	**-40.8%**
A. Forest land	-9461.17	7.03	4.63	NA	-9449.51	-42.4%
B. Cropland	178.01	NO	5.27	NA	183.28	0.8%
C. Grassland	-48.63	0.52	0.56	NA	-47.55	-0.2%
D. Wetlands	61.16	NO	7.66	NA	68.81	0.3%
E. Settlements	171.06	NO	20.22	NA	191.28	0.9%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-55.59	NA	NA	NA	-55.59	-0.2%
5. Waste	**0.54**	**666.93**	**72.07**	**NA**	**739.53**	**3.3%**
A. Solid waste disposal	NA,NO	429.46	NA	NA	429.46	1.9%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	0.54	NA,NO	0.01	NA	0.54	0.0%
D. Waste water treatment and discharge	NA	237.46	72.06	NA	309.53	1.4%
Total with LULUCF	**7837.63**	**3041.21**	**2281.66**	**40.44**	**13200.94**	**59.2%**
Total without LULUCF	**16992.80**	**3033.66**	**2243.31**	**40.44**	**22310.22**	**100.0%**
Shares in total with LULUCF	59.4%	23.0%	17.3%	0.3%	100.0%	
Shares in total without LULUCF	76.2%	13.6%	10.1%	0.2%	100.0%	
Memo items:						
International bunkers	348.25	0.49	1.42	NA	350.16	1.6%
Aviation	245.16	0.26	0.61	NA	246.04	1.1%
Navigation	103.08	0.24	0.81	NA	104.13	0.5%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5212.59	NA	NA	NA	5212.59	23.4%

Year 1996	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**15828.26**	**710.25**	**229.77**	**NA**	**16768.29**	**73.1%**
A. Fuel combustion (sectoral approach)	14930.29	422.54	229.39	NA	15582.21	68.0%
1. Energy industries	5054.87	4.06	12.92	NA	5071.84	22.1%
2. Manufacturing industries and construction	2998.35	4.71	8.41	NA	3011.48	13.1%
3. Transport	3620.09	33.32	72.27	NA	3725.69	16.3%
4. Other sectors	3256.98	380.45	135.78	NA	3773.20	16.5%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	897.98	287.71	0.39	NA	1186.08	5.2%
1. Solid fuels	NO	22.77	NO,NA	NA	22.77	0.1%
2. Oil and natural gas	897.98	264.95	0.39	NA	1163.31	5.1%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**1706.66**	**5.36**	**665.28**	**61.34**	**2438.65**	**10.6%**
A. Mineral industry	844.58	NA	NA	NA	844.58	3.7%
B. Chemical industry	712.81	5.04	631.91	NA	1349.76	5.9%
C. Metal industry	19.30	0.32	NO	NA	19.62	0.1%
D. Non-energy products from fuels and solvent	129.97	NA	NA	NA	129.97	0.6%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	49.77	49.77	0.2%
G. Other product manufacture and use	NO	NO	33.38	11.57	44.95	0.2%
3. Agriculture	**52.44**	**1629.29**	**1284.64**	**NA**	**2966.37**	**12.9%**
A. Enteric fermentation	NA	1320.86	NA	NA	1320.86	5.8%
B. Manure management	NA	308.43	214.07	NA	522.50	2.3%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1070.57	NA	1070.57	4.7%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	NO	NA	NA	NA	NO	NO
H. Urea application	52.44	NA	NA	NA	52.44	0.2%
4. Land use, land-use change and forestry	**-8870.63**	**16.53**	**44.10**	**NA**	**-8810.00**	**-38.4%**
A. Forest land	-9220.07	15.14	9.99	NA	-9194.94	-40.1%
B. Cropland	177.21	NO	5.55	NA	182.75	0.8%
C. Grassland	-58.97	1.39	1.51	NA	-56.07	-0.2%
D. Wetlands	57.80	NO	7.23	NA	65.03	0.3%
E. Settlements	168.06	NO	19.83	NA	187.89	0.8%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	5.35	NA	NA	NA	5.35	0.0%
5. Waste	**0.54**	**682.67**	**68.72**	**NA**	**751.93**	**3.3%**
A. Solid waste disposal	NA,NO	452.53	NA	NA	452.53	2.0%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	0.54	NA,NO	0.01	NA	0.54	0.0%
D. Waste water treatment and discharge	NA	230.14	68.72	NA	298.86	1.3%
Total with LULUCF	**8717.27**	**3044.10**	**2292.52**	**61.34**	**14115.24**	**61.6%**
Total without LULUCF	**17587.90**	**3027.57**	**2248.42**	**61.34**	**22925.24**	**100.0%**
Shares in total with LULUCF	61.8%	21.6%	16.2%	0.4%	100.0%	
Shares in total without LULUCF	76.7%	13.2%	9.8%	0.3%	100.0%	
Memo items:						
International bunkers	314.02	0.44	1.27	NA	315.74	1.4%
Aviation	223.16	0.23	0.56	NA	223.96	1.0%
Navigation	90.86	0.21	0.71	NA	91.78	0.4%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5801.38	NA	NA	NA	5801.38	25.3%

Year 1997	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**16704.89**	**676.89**	**226.29**	**NA**	**17608.07**	**72.9%**
A. Fuel combustion (sectoral approach)	15858.22	395.32	225.90	NA	16479.44	68.2%
1. Energy industries	5557.44	4.47	15.14	NA	5577.04	23.1%
2. Manufacturing industries and construction	3026.43	5.13	8.98	NA	3040.54	12.6%
3. Transport	3965.98	35.31	83.18	NA	4084.47	16.9%
4. Other sectors	3308.37	350.42	118.60	NA	3777.39	15.6%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	846.67	281.56	0.39	NA	1128.63	4.7%
1. Solid fuels	NO	16.65	NO,NA	NA	16.65	0.1%
2. Oil and natural gas	846.67	264.91	0.39	NA	1111.97	4.6%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**1891.37**	**5.70**	**698.63**	**83.36**	**2679.06**	**11.1%**
A. Mineral industry	954.10	NA	NA	NA	954.10	3.9%
B. Chemical industry	756.12	4.96	665.26	NA	1426.34	5.9%
C. Metal industry	40.11	0.74	NO	NA	40.85	0.2%
D. Non-energy products from fuels and solvent	141.04	NA	NA	NA	141.04	0.6%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	71.93	71.93	0.3%
G. Other product manufacture and use	NO	NO	33.38	11.43	44.80	0.2%
3. Agriculture	**68.39**	**1582.96**	**1442.02**	**NA**	**3093.36**	**12.8%**
A. Enteric fermentation	NA	1272.13	NA	NA	1272.13	5.3%
B. Manure management	NA	310.83	206.97	NA	517.80	2.1%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1235.05	NA	1235.05	5.1%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	NO	NA	NA	NA	NO	NO
H. Urea application	68.39	NA	NA	NA	68.39	0.3%
4. Land use, land-use change and forestry	**-8356.26**	**17.63**	**44.28**	**NA**	**-8294.35**	**-34.3%**
A. Forest land	-8636.10	16.28	10.73	NA	-8609.10	-35.6%
B. Cropland	241.94	NO	5.82	NA	247.76	1.0%
C. Grassland	-117.03	1.35	1.47	NA	-114.21	-0.5%
D. Wetlands	54.45	NO	6.80	NA	61.25	0.3%
E. Settlements	163.31	NO	19.45	NA	182.77	0.8%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-62.82	NA	NA	NA	-62.82	-0.3%
5. Waste	**1.82**	**713.17**	**69.29**	**NA**	**784.28**	**3.2%**
A. Solid waste disposal	NA,NO	478.90	NA	NA	478.90	2.0%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	1.82	NA,NO	0.03	NA	1.86	0.0%
D. Waste water treatment and discharge	NA	234.27	69.26	NA	303.53	1.3%
Total with LULUCF	**10310.21**	**2996.34**	**2480.51**	**83.36**	**15870.42**	**65.7%**
Total without LULUCF	**18666.47**	**2978.72**	**2436.23**	**83.36**	**24164.77**	**100.0%**
Shares in total with LULUCF	65.0%	18.9%	15.6%	0.5%	100.0%	
Shares in total without LULUCF	77.2%	12.3%	10.1%	0.3%	100.0%	
Memo items:						
International bunkers	310.14	0.42	1.17	NA	311.73	1.3%
Aviation	235.74	0.25	0.59	NA	236.57	1.0%
Navigation	74.41	0.17	0.58	NA	75.16	0.3%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5428.42	NA	NA	NA	5428.42	22.5%

Year 1998	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**17546.74**	**664.38**	**209.96**	**NA**	**18421.08**	**75.1%**
A. Fuel combustion (sectoral approach)	16792.20	399.23	209.59	NA	17401.01	71.0%
1. Energy industries	6212.63	5.18	16.82	NA	6234.63	25.4%
2. Manufacturing industries and construction	3313.18	5.14	9.16	NA	3327.47	13.6%
3. Transport	4098.64	36.21	58.51	NA	4193.36	17.1%
4. Other sectors	3167.75	352.70	125.11	NA	3645.55	14.9%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	754.55	265.15	0.37	NA	1020.07	4.2%
1. Solid fuels	NO	17.44	NO,NA	NA	17.44	0.1%
2. Oil and natural gas	754.55	247.71	0.37	NA	1002.62	4.1%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**1777.70**	**5.05**	**534.20**	**113.87**	**2430.82**	**9.9%**
A. Mineral industry	1027.37	NA	NA	NA	1027.37	4.2%
B. Chemical industry	606.29	4.67	500.83	NA	1111.79	4.5%
C. Metal industry	28.85	0.38	NO	NA	29.22	0.1%
D. Non-energy products from fuels and solvent use	115.19	NA	NA	NA	115.19	0.5%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	101.88	101.88	0.4%
G. Other product manufacture and use	NO	NO	33.38	11.99	45.37	0.2%
3. Agriculture	**44.25**	**1544.37**	**1271.48**	**NA**	**2860.10**	**11.7%**
A. Enteric fermentation	NA	1230.16	NA	NA	1230.16	5.0%
B. Manure management	NA	314.21	199.90	NA	514.12	2.1%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1071.58	NA	1071.58	4.4%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	NO	NA	NA	NA	NO	NO
H. Urea application	44.25	NA	NA	NA	44.25	0.2%
4. Land use, land-use change and forestry	**-8259.05**	**45.11**	**63.57**	**NA**	**-8150.37**	**-33.2%**
A. Forest land	-8444.86	39.83	26.26	NA	-8378.78	-34.2%
B. Cropland	261.74	NO	6.10	NA	267.84	1.1%
C. Grassland	-123.23	5.29	5.75	NA	-112.19	-0.5%
D. Wetlands	51.09	NO	6.37	NA	57.46	0.2%
E. Settlements	161.37	NO	19.09	NA	180.46	0.7%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-165.16	NA	NA	NA	-165.16	-0.7%
5. Waste	**3.70**	**733.47**	**67.49**	**NA**	**804.66**	**3.3%**
A. Solid waste disposal	NA,NO	506.52	NA	NA	506.52	2.1%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	3.70	NA,NO	0.06	NA	3.76	0.0%
D. Waste water treatment and discharge	NA	226.95	67.42	NA	294.38	1.2%
Total with LULUCF	**11113.34**	**2992.38**	**2146.70**	**113.87**	**16366.29**	**66.8%**
Total without LULUCF	**19372.39**	**2947.27**	**2083.13**	**113.87**	**24516.66**	**100.0%**
Shares in total with LULUCF	67.9%	18.3%	13.1%	0.7%	100.0%	
Shares in total without LULUCF	79.0%	12.0%	8.5%	0.5%	100.0%	
Memo items:						
International bunkers	336.44	0.46	1.28	NA	338.18	1.4%
Aviation	254.59	0.27	0.64	NA	255.50	1.0%
Navigation	81.85	0.19	0.64	NA	82.68	0.3%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5442.75	NA	NA	NA	5442.75	22.2%

Year 1999	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO2 equivalent (kt)					(%)
1. Energy	**18065.30**	**640.80**	**264.32**	**NA**	**18970.42**	**74.1%**
A. Fuel combustion (sectoral approach)	17327.30	393.95	263.98	NA	17985.23	70.3%
1. Energy industries	6439.06	5.45	17.42	NA	6461.94	25.2%
2. Manufacturing industries and construction	2980.25	4.26	7.69	NA	2992.21	11.7%
3. Transport	4329.03	36.91	103.63	NA	4469.57	17.5%
4. Other sectors	3578.95	347.33	135.23	NA	4061.51	15.9%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	738.00	246.85	0.34	NA	985.19	3.8%
1. Solid fuels	NO	5.25	NO,NA	NA	5.25	0.0%
2. Oil and natural gas	738.00	241.59	0.34	NA	979.93	3.8%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**2095.48**	**5.14**	**623.78**	**134.07**	**2858.48**	**11.2%**
A. Mineral industry	1284.91	NA	NA	NA	1284.91	5.0%
B. Chemical industry	722.89	4.71	590.41	NA	1318.01	5.1%
C. Metal industry	26.86	0.42	NO	NA	27.28	0.1%
D. Non-energy products from fuels and solvent	60.83	NA	NA	NA	60.83	0.2%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	122.08	122.08	0.5%
G. Other product manufacture and use	NO	NO	33.38	11.99	45.37	0.2%
3. Agriculture	**50.49**	**1527.90**	**1339.52**	**NA**	**2917.90**	**11.4%**
A. Enteric fermentation	NA	1194.57	NA	NA	1194.57	4.7%
B. Manure management	NA	333.33	201.64	NA	534.97	2.1%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1137.88	NA	1137.88	4.4%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	NO	NA	NA	NA	NO	NO
H. Urea application	50.49	NA	NA	NA	50.49	0.2%
4. Land use, land-use change and forestry	**-8690.03**	**5.91**	**35.62**	**NA**	**-8648.50**	**-33.8%**
A. Forest land	-8840.26	4.26	2.81	NA	-8833.20	-34.5%
B. Cropland	252.54	NO	6.37	NA	258.91	1.0%
C. Grassland	-124.00	1.65	1.80	NA	-120.55	-0.5%
D. Wetlands	47.74	NO	5.94	NA	53.68	0.2%
E. Settlements	159.65	NO	18.70	NA	178.35	0.7%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-185.70	NA	NA	NA	-185.70	-0.7%
5. Waste	**4.38**	**772.58**	**72.65**	**NA**	**849.61**	**3.3%**
A. Solid waste disposal	NA,NO	538.62	NA	NA	538.62	2.1%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	4.38	NA,NO	0.08	NA	4.46	0.0%
D. Waste water treatment and discharge	NA	233.96	72.58	NA	306.54	1.2%
Total with LULUCF	**11525.62**	**2952.33**	**2335.90**	**134.07**	**16947.92**	**66.2%**
Total without LULUCF	**20215.65**	**2946.42**	**2300.27**	**134.07**	**25596.42**	**100.0%**
Shares in total with LULUCF	68.0%	17.4%	13.8%	0.8%	100.0%	
Shares in total without LULUCF	79.0%	11.5%	9.0%	0.5%	100.0%	
Memo items:						
International bunkers	311.54	0.41	1.14	NA	313.09	1.2%
Aviation	245.16	0.26	0.61	NA	246.04	1.0%
Navigation	66.37	0.15	0.53	NA	67.05	0.3%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5257.71	NA	NA	NA	5257.71	20.5%

Year 2000	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**17485.25**	**591.18**	**274.34**	**NA**	**18350.77**	**72.7%**
A. Fuel combustion (sectoral approach)	16692.57	352.94	274.02	NA	17319.53	68.6%
1. Energy industries	5816.84	3.94	18.63	NA	5839.41	23.1%
2. Manufacturing industries and construction	3103.13	4.44	8.05	NA	3115.63	12.3%
3. Transport	4354.24	35.65	109.50	NA	4499.39	17.8%
4. Other sectors	3418.37	308.91	137.84	NA	3865.11	15.3%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	792.67	238.23	0.32	NA	1031.23	4.1%
1. Solid fuels	NO	NO	NO,NA	NA	NO,NA	NO,NA
2. Oil and natural gas	792.67	238.23	0.32	NA	1031.23	4.1%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**2236.86**	**3.60**	**727.52**	**159.52**	**3127.50**	**12.4%**
A. Mineral industry	1423.08	NA	NA	NA	1423.08	5.6%
B. Chemical industry	724.36	3.12	694.15	NA	1421.62	5.6%
C. Metal industry	26.78	0.48	NO	NA	27.26	0.1%
D. Non-energy products from fuels and solvent	62.64	NA	NA	NA	62.64	0.2%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	147.90	147.90	0.6%
G. Other product manufacture and use	NO	NO	33.38	11.62	45.00	0.2%
3. Agriculture	**60.87**	**1480.22**	**1346.87**	**NA**	**2887.95**	**11.4%**
A. Enteric fermentation	NA	1154.97	NA	NA	1154.97	4.6%
B. Manure management	NA	325.24	190.46	NA	515.71	2.0%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1156.41	NA	1156.41	4.6%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	NO	NA	NA	NA	NO	NO
H. Urea application	60.87	NA	NA	NA	60.87	0.2%
4. Land use, land-use change and forestry	**-7700.77**	**96.91**	**98.60**	**NA**	**-7505.25**	**-29.7%**
A. Forest land	-7930.80	87.11	57.44	NA	-7786.25	-30.8%
B. Cropland	330.55	NO	6.65	NA	337.19	1.3%
C. Grassland	-131.44	9.80	10.67	NA	-110.98	-0.4%
D. Wetlands	44.39	NO	5.51	NA	49.90	0.2%
E. Settlements	156.59	NO	18.34	NA	174.92	0.7%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-170.05	NA	NA	NA	-170.05	-0.7%
5. Waste	**6.15**	**812.86**	**70.03**	**NA**	**889.04**	**3.5%**
A. Solid waste disposal	NA,NO	570.36	NA	NA	570.36	2.3%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	6.15	NA,NO	0.11	NA	6.26	0.0%
D. Waste water treatment and discharge	NA	242.50	69.92	NA	312.42	1.2%
Total with LULUCF	**12088.36**	**2984.76**	**2517.37**	**159.52**	**17750.01**	**70.3%**
Total without LULUCF	**19789.12**	**2887.85**	**2418.77**	**159.52**	**25255.27**	**100.0%**
Shares in total with LULUCF	68.1%	16.8%	14.2%	0.9%	100.0%	
Shares in total without LULUCF	78.4%	11.4%	9.6%	0.6%	100.0%	
Memo items:						
International bunkers	258.78	0.34	0.95	NA	260.08	1.0%
Aviation	201.16	0.21	0.50	NA	201.88	0.8%
Navigation	57.62	0.13	0.45	NA	58.21	0.2%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	4694.77	NA	NA	NA	4694.77	18.6%

Year 2001	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**18495.16**	**632.36**	**271.56**	**NA**	**19399.08**	**73.3%**
A. Fuel combustion (sectoral approach)	17634.30	378.20	271.25	NA	18283.76	69.1%
1. Energy industries	6381.66	4.46	20.96	NA	6407.08	24.2%
2. Manufacturing industries and construction	3196.99	4.39	8.06	NA	3209.43	12.1%
3. Transport	4419.92	30.61	104.62	NA	4555.15	17.2%
4. Other sectors	3635.73	338.75	137.61	NA	4112.10	15.5%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	860.87	254.15	0.31	NA	1115.32	4.2%
1. Solid fuels	NO	NO	NO,NA	NA	NO,NA	NO,NA
2. Oil and natural gas	860.87	254.15	0.31	NA	1115.32	4.2%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**2349.17**	**3.69**	**615.94**	**173.15**	**3141.95**	**11.9%**
A. Mineral industry	1643.76	NA	NA	NA	1643.76	6.2%
B. Chemical industry	633.80	3.67	582.57	NA	1220.03	4.6%
C. Metal industry	6.56	0.02	NO	NA	6.58	0.0%
D. Non-energy products from fuels and solvent	65.06	NA	NA	NA	65.06	0.2%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	161.46	161.46	0.6%
G. Other product manufacture and use	NO	NO	33.38	11.69	45.07	0.2%
3. Agriculture	**92.09**	**1490.38**	**1432.63**	**NA**	**3015.10**	**11.4%**
A. Enteric fermentation	NA	1155.36	NA	NA	1155.36	4.4%
B. Manure management	NA	335.02	190.95	NA	525.97	2.0%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1241.67	NA	1241.67	4.7%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	NO	NA	NA	NA	NO	NO
H. Urea application	92.09	NA	NA	NA	92.09	0.3%
4. Land use, land-use change and forestry	**-8054.57**	**19.00**	**51.56**	**NA**	**-7984.01**	**-30.2%**
A. Forest land	-8500.02	16.02	10.56	NA	-8473.43	-32.0%
B. Cropland	343.32	NO	6.92	NA	350.24	1.3%
C. Grassland	-195.10	2.98	3.24	NA	-188.88	-0.7%
D. Wetlands	40.15	NO	5.05	NA	45.20	0.2%
E. Settlements	363.55	NO	25.78	NA	389.33	1.5%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-106.47	NA	NA	NA	-106.47	-0.4%
5. Waste	**6.68**	**831.58**	**74.61**	**NA**	**912.87**	**3.4%**
A. Solid waste disposal	NA,NO	608.04	NA	NA	608.04	2.3%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	6.68	NA,NO	0.12	NA	6.80	0.0%
D. Waste water treatment and discharge	NA	223.54	74.49	NA	298.03	1.1%
Total with LULUCF	**12888.54**	**2976.99**	**2446.30**	**173.15**	**18484.98**	**69.8%**
Total without LULUCF	**20943.11**	**2958.00**	**2394.74**	**173.15**	**26469.00**	**100.0%**
Shares in total with LULUCF	69.7%	16.1%	13.2%	0.9%	100.0%	
Shares in total without LULUCF	79.1%	11.2%	9.0%	0.7%	100.0%	
Memo items:						
International bunkers	291.47	0.42	1.21	NA	293.10	1.1%
Aviation	201.16	0.21	0.50	NA	201.88	0.8%
Navigation	90.31	0.21	0.71	NA	91.23	0.3%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5187.98	NA	NA	NA	5187.98	19.6%

Year 2002	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**19663.59**	**623.39**	**227.25**	**NA**	**20514.22**	**74.6%**
A. Fuel combustion (sectoral approach)	18783.12	364.00	226.94	NA	19374.05	70.5%
1. Energy industries	7273.79	4.90	24.91	NA	7303.60	26.6%
2. Manufacturing industries and construction	3057.13	4.32	7.93	NA	3069.38	11.2%
3. Transport	4729.16	29.65	64.62	NA	4823.43	17.6%
4. Other sectors	3723.03	325.12	129.48	NA	4177.63	15.2%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	880.47	259.39	0.31	NA	1140.17	4.1%
1. Solid fuels	NO	NO	NO,NA	NA	NO,NA	NO,NA
2. Oil and natural gas	880.47	259.39	0.31	NA	1140.17	4.1%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**2283.00**	**3.42**	**600.22**	**197.35**	**3083.99**	**11.2%**
A. Mineral industry	1638.10	NA	NA	NA	1638.10	6.0%
B. Chemical industry	562.20	3.41	566.85	NA	1132.46	4.1%
C. Metal industry	5.86	0.01	NO	NA	5.86	0.0%
D. Non-energy products from fuels and solvent	76.85	NA	NA	NA	76.85	0.3%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	185.34	185.34	0.7%
G. Other product manufacture and use	NO	NO	33.38	12.01	45.39	0.2%
3. Agriculture	**80.76**	**1457.76**	**1388.27**	**NA**	**2926.78**	**10.6%**
A. Enteric fermentation	NA	1121.42	NA	NA	1121.42	4.1%
B. Manure management	NA	336.34	183.69	NA	520.03	1.9%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1204.58	NA	1204.58	4.4%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	NO	NA	NA	NA	NO	NO
H. Urea application	80.76	NA	NA	NA	80.76	0.3%
4. Land use, land-use change and forestry	**-8255.04**	**6.39**	**49.53**	**NA**	**-8199.11**	**-29.8%**
A. Forest land	-8691.21	5.62	3.70	NA	-8681.89	-31.6%
B. Cropland	323.63	NO	7.20	NA	330.83	1.2%
C. Grassland	-188.63	0.78	0.85	NA	-187.01	-0.7%
D. Wetlands	36.54	NO	4.59	NA	41.14	0.1%
E. Settlements	425.95	NO	33.19	NA	459.15	1.7%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-161.32	NA	NA	NA	-161.32	-0.6%
5. Waste	**3.78**	**875.55**	**78.57**	**NA**	**957.90**	**3.5%**
A. Solid waste disposal	NA,NO	651.26	NA	NA	651.26	2.4%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	3.78	NA,NO	0.07	NA	3.85	0.0%
D. Waste water treatment and discharge	NA	224.29	78.51	NA	302.79	1.1%
Total with LULUCF	**13776.09**	**2966.51**	**2343.84**	**197.35**	**19283.78**	**70.2%**
Total without LULUCF	**22031.13**	**2960.11**	**2294.31**	**197.35**	**27482.89**	**100.0%**
Shares in total with LULUCF	71.4%	15.4%	12.2%	1.0%	100.0%	
Shares in total without LULUCF	80.2%	10.8%	8.3%	0.7%	100.0%	
Memo items:						
International bunkers	262.60	0.37	1.05	NA	264.02	1.0%
Aviation	188.59	0.20	0.47	NA	189.26	0.7%
Navigation	74.01	0.17	0.58	NA	74.76	0.3%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	4975.57	NA	NA	NA	4975.57	18.1%

Year 2003	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**20998.81**	**674.14**	**241.73**	**NA**	**21914.68**	**76.0%**
A. Fuel combustion (sectoral approach)	20162.49	413.37	241.44	NA	20817.29	72.2%
1. Energy industries	7946.52	5.84	25.93	NA	7978.29	27.7%
2. Manufacturing industries and construction	3136.78	4.94	8.93	NA	3150.65	10.9%
3. Transport	5126.60	28.54	66.84	NA	5221.98	18.1%
4. Other sectors	3952.60	374.04	139.74	NA	4466.39	15.5%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	836.32	260.78	0.29	NA	1097.38	3.8%
1. Solid fuels	NO	NO	NO,NA	NA	NO,NA	NO,NA
2. Oil and natural gas	836.32	260.78	0.29	NA	1097.38	3.8%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**2283.82**	**3.29**	**569.43**	**224.51**	**3081.04**	**10.7%**
A. Mineral industry	1619.95	NA	NA	NA	1619.95	5.6%
B. Chemical industry	577.51	3.26	536.06	NA	1116.83	3.9%
C. Metal industry	9.88	0.02	NO	NA	9.90	0.0%
D. Non-energy products from fuels and solvent	76.47	NA	NA	NA	76.47	0.3%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	212.23	212.23	0.7%
G. Other product manufacture and use	NO	NO	33.38	12.28	45.65	0.2%
3. Agriculture	**71.79**	**1472.05**	**1306.06**	**NA**	**2849.91**	**9.9%**
A. Enteric fermentation	NA	1121.58	NA	NA	1121.58	3.9%
B. Manure management	NA	350.47	185.11	NA	535.57	1.9%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1120.96	NA	1120.96	3.9%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	NO	NA	NA	NA	NO	NO
H. Urea application	71.79	NA	NA	NA	71.79	0.2%
4. Land use, land-use change and forestry	**-7627.77**	**39.55**	**79.80**	**NA**	**-7508.42**	**-26.0%**
A. Forest land	-8182.00	35.95	23.70	NA	-8122.35	-28.2%
B. Cropland	308.46	NO	7.47	NA	315.93	1.1%
C. Grassland	-182.17	3.60	3.92	NA	-174.64	-0.6%
D. Wetlands	32.94	NO	4.13	NA	37.07	0.1%
E. Settlements	485.96	NO	40.57	NA	526.53	1.8%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-90.96	NA	NA	NA	-90.96	-0.3%
5. Waste	**0.80**	**921.52**	**78.01**	**NA**	**1000.33**	**3.5%**
A. Solid waste disposal	NA,NO	699.56	NA	NA	699.56	2.4%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	0.80	NA,NO	0.01	NA	0.82	0.0%
D. Waste water treatment and discharge	NA	221.96	78.00	NA	299.95	1.0%
Total with LULUCF	**15727.45**	**3110.54**	**2275.03**	**224.51**	**21337.54**	**74.0%**
Total without LULUCF	**23355.22**	**3070.99**	**2195.23**	**224.51**	**28845.96**	**100.0%**
Shares in total with LULUCF	73.7%	14.6%	10.7%	1.1%	100.0%	
Shares in total without LULUCF	81.0%	10.6%	7.6%	0.8%	100.0%	
Memo items:						
International bunkers	251.70	0.35	1.00	NA	253.04	0.9%
Aviation	182.30	0.19	0.46	NA	182.95	0.6%
Navigation	69.39	0.16	0.54	NA	70.09	0.2%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5755.73	NA	NA	NA	5755.73	20.0%

Year 2004	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**20426.78**	**661.10**	**283.42**	**NA**	**21371.30**	**73.9%**
A. Fuel combustion (sectoral approach)	19540.93	402.09	283.14	NA	20226.16	69.9%
1. Energy industries	6830.91	4.86	23.51	NA	6859.28	23.7%
2. Manufacturing industries and construction	3583.00	5.99	10.74	NA	3599.72	12.4%
3. Transport	5262.05	26.83	116.33	NA	5405.21	18.7%
4. Other sectors	3864.98	364.40	132.57	NA	4361.95	15.1%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	885.85	259.01	0.28	NA	1145.14	4.0%
1. Solid fuels	NO	NO	NO,NA	NA	NO,NA	NO,NA
2. Oil and natural gas	885.85	259.01	0.28	NA	1145.14	4.0%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**2502.16**	**3.93**	**685.03**	**252.89**	**3444.02**	**11.9%**
A. Mineral industry	1731.21	NA	NA	NA	1731.21	6.0%
B. Chemical industry	664.88	3.93	651.66	NA	1320.47	4.6%
C. Metal industry	15.36	NA,NO	NO	NA	15.36	0.1%
D. Non-energy products from fuels and solvent	90.71	NA	NA	NA	90.71	0.3%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	240.33	240.33	0.8%
G. Other product manufacture and use	NO	NO	33.38	12.57	45.94	0.2%
3. Agriculture	**75.94**	**1570.21**	**1408.08**	**NA**	**3054.24**	**10.6%**
A. Enteric fermentation	NA	1193.74	NA	NA	1193.74	4.1%
B. Manure management	NA	376.47	196.57	NA	573.04	2.0%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1211.52	NA	1211.52	4.2%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	NO	NA	NA	NA	NO	NO
H. Urea application	75.94	NA	NA	NA	75.94	0.3%
4. Land use, land-use change and forestry	**-7668.81**	**2.92**	**61.76**	**NA**	**-7604.13**	**-26.3%**
A. Forest land	-8257.43	1.95	1.29	NA	-8254.20	-28.5%
B. Cropland	294.25	NO	7.75	NA	302.00	1.0%
C. Grassland	-175.70	0.97	1.05	NA	-173.69	-0.6%
D. Wetlands	29.33	NO	3.67	NA	33.01	0.1%
E. Settlements	545.38	NO	48.00	NA	593.39	2.1%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-104.64	NA	NA	NA	-104.64	-0.4%
5. Waste	**0.35**	**976.14**	**77.58**	**NA**	**1054.07**	**3.6%**
A. Solid waste disposal	NA,NO	746.36	NA	NA	746.36	2.6%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	0.35	NA,NO	0.00	NA	0.35	0.0%
D. Waste water treatment and discharge	NA	229.78	77.57	NA	307.35	1.1%
Total with LULUCF	**15336.43**	**3214.30**	**2515.88**	**252.89**	**21319.49**	**73.7%**
Total without LULUCF	**23005.23**	**3211.38**	**2454.11**	**252.89**	**28923.62**	**100.0%**
Shares in total with LULUCF	71.9%	15.1%	11.8%	1.2%	100.0%	
Shares in total without LULUCF	79.5%	11.1%	8.5%	0.9%	100.0%	
Memo items:						
International bunkers	284.43	0.39	1.10	NA	285.92	1.0%
Aviation	210.59	0.22	0.53	NA	211.34	0.7%
Navigation	73.83	0.17	0.58	NA	74.58	0.3%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5660.22	NA	NA	NA	5660.22	19.6%

Year 2005	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**20811,67**	**680,46**	**237,90**	**NA**	**21730,04**	**74,1%**
A. Fuel combustion (sectoral approach)	19942.81	420.64	237.63	NA	20601.08	70.3%
1. Energy industries	6853.44	4.61	22.86	NA	6880.91	23.5%
2. Manufacturing industries and construction	3723.73	5.41	9.90	NA	3739.05	12.8%
3. Transport	5467.52	24.39	69.15	NA	5561.06	19.0%
4. Other sectors	3898.12	386.23	135.72	NA	4420.06	15.1%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	868.86	259.83	0.27	NA	1128.96	3.9%
1. Solid fuels	NO	NO	NO,NA	NA	NO,NA	NO,NA
2. Oil and natural gas	868.86	259.83	0.27	NA	1128.96	3.9%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**2554.55**	**3.96**	**670.31**	**278.83**	**3507.64**	**12.0%**
A. Mineral industry	1785.37	NA	NA	NA	1785.37	6.1%
B. Chemical industry	664.65	3.96	636.93	NA	1305.53	4.5%
C. Metal industry	11.81	NA,NO	NO	NA	11.81	0.0%
D. Non-energy products from fuels and solvent	92.72	NA	NA	NA	92.72	0.3%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	265.80	265.80	0.9%
G. Other product manufacture and use	NO	NO	33.38	13.03	46.40	0.2%
3. Agriculture	**85.46**	**1525.08**	**1419.13**	**NA**	**3029.67**	**10.3%**
A. Enteric fermentation	NA	1169.47	NA	NA	1169.47	4.0%
B. Manure management	NA	355.60	182.82	NA	538.43	1.8%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1236.30	NA	1236.30	4.2%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	14.49	NA	NA	NA	14.49	0.0%
H. Urea application	70.97	NA	NA	NA	70.97	0.2%
4. Land use, land-use change and forestry	**-7879.55**	**2.74**	**68.73**	**NA**	**-7808.08**	**-26.6%**
A. Forest land	-8319.86	2.16	1.43	NA	-8316.27	-28.4%
B. Cropland	240.59	NO	8.03	NA	248.61	0.8%
C. Grassland	-127.64	0.57	0.62	NA	-126.44	-0.4%
D. Wetlands	25.73	NO	3.21	NA	28.94	0.1%
E. Settlements	601.08	NO	55.44	NA	656.52	2.2%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-299.45	NA	NA	NA	-299.45	-1.0%
5. Waste	**0.16**	**964.29**	**80.60**	**NA**	**1045.05**	**3.6%**
A. Solid waste disposal	NA,NO	735.33	NA	NA	735.33	2.5%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	0.16	NA,NO	0.00	NA	0.16	0.0%
D. Waste water treatment and discharge	NA	228.96	80.60	NA	309.55	1.1%
Total with LULUCF	**15572.30**	**3176.52**	**2476.66**	**278.83**	**21504.31**	**73.4%**
Total without LULUCF	**23451.85**	**3173.79**	**2407.93**	**278.83**	**29312.39**	**100.0%**
Shares in total with LULUCF	72.4%	14.8%	11.5%	1.3%	100.0%	
Shares in total without LULUCF	80.0%	10.8%	8.2%	1.0%	100.0%	
Memo items:						
International bunkers	337.55	0.45	1.27	NA	339.28	1.2%
Aviation	257.74	0.27	0.64	NA	258.65	0.9%
Navigation	79.82	0.18	0.62	NA	80.62	0.3%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5908.79	NA	NA	NA	5908.79	20.2%

Year 2006	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**20908.30**	**667.30**	**239.63**	**NA**	**21815.23**	**73.7%**
A. Fuel combustion (sectoral approach)	20009.09	388.81	239.36	NA	20637.26	69.7%
1. Energy industries	6674.57	4.82	22.56	NA	6701.94	22.6%
2. Manufacturing industries and construction	3855.12	5.75	10.53	NA	3871.40	13.1%
3. Transport	5820.73	24.13	73.64	NA	5918.51	20.0%
4. Other sectors	3658.66	354.11	132.63	NA	4145.40	14.0%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	899.21	278.50	0.27	NA	1177.98	4.0%
1. Solid fuels	NO	NO	NO,NA	NA	NO,NA	NO,NA
2. Oil and natural gas	899.21	278.50	0.27	NA	1177.98	4.0%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**2695.23**	**3.85**	**662.88**	**305.58**	**3667.54**	**12.4%**
A. Mineral industry	1917.28	NA	NA	NA	1917.28	6.5%
B. Chemical industry	662.17	3.85	629.50	NA	1295.53	4.4%
C. Metal industry	13.85	NA,NO	NO	NA	13.85	0.0%
D. Non-energy products from fuels and solvent	101.93	NA	NA	NA	101.93	0.3%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	292.57	292.57	1.0%
G. Other product manufacture and use	NO	NO	33.38	13.01	46.38	0.2%
3. Agriculture	**80.67**	**1533.17**	**1362.64**	**NA**	**2976.48**	**10.1%**
A. Enteric fermentation	NA	1145.74	NA	NA	1145.74	3.9%
B. Manure management	NA	387.44	186.63	NA	574.06	1.9%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1176.01	NA	1176.01	4.0%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	17.48	NA	NA	NA	17.48	0.1%
H. Urea application	63.19	NA	NA	NA	63.19	0.2%
4. Land use, land-use change and forestry	**-7680.78**	**6.06**	**78.19**	**NA**	**-7596.53**	**-25.7%**
A. Forest land	-8158.05	5.46	3.60	NA	-8148.99	-27.5%
B. Cropland	210.92	NO	8.31	NA	219.22	0.7%
C. Grassland	-128.04	0.60	0.65	NA	-126.79	-0.4%
D. Wetlands	22.13	NO	2.75	NA	24.88	0.1%
E. Settlements	658.18	NO	62.88	NA	721.06	2.4%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-285.91	NA	NA	NA	-285.91	-1.0%
5. Waste	**0.74**	**1062.40**	**83.52**	**NA**	**1146.66**	**3.9%**
A. Solid waste disposal	NA,NO	827.25	NA	NA	827.25	2.8%
B. Biological treatment of solid waste	NA	NO,NE,IE	NO,NE,IE	NA	NO,NE,IE	NO,NE,IE
C. Incineration and open burning of waste	0.74	NA,NO	0.01	NA	0.75	0.0%
D. Waste water treatment and discharge	NA	235.15	83.51	NA	318.65	1.1%
Total with LULUCF	**16004.16**	**3272.78**	**2426.85**	**305.58**	**22009.37**	**74.3%**
Total without LULUCF	**23684.94**	**3266.73**	**2348.67**	**305.58**	**29605.91**	**100.0%**
Shares in total with LULUCF	72.7%	14.9%	11.0%	1.4%	100.0%	
Shares in total without LULUCF	80.0%	11.0%	7.9%	1.0%	100.0%	
Memo items:						
International bunkers	325.65	0.42	1.14	NA	327.21	1.1%
Aviation	264.02	0.28	0.66	NA	264.96	0.9%
Navigation	61.63	0.14	0.48	NA	62.25	0.2%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5497.41	NA	NA	NA	5497.41	18.6%

Year 2007	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Udio u ukupnoj emisiji bez LULUCF-a
	CO_2 equivalent (kt)					(%)
1. Energy	**22159.97**	**664.94**	**246.24**	**NA**	**23071.16**	**74.2%**
A. Fuel combustion (sectoral approach)	21290.36	375.42	245.98	NA	21911.77	70.5%
1. Energy industries	7868.62	5.57	27.11	NA	7901.30	25.4%
2. Manufacturing industries and construction	3853.05	5.80	10.51	NA	3869.36	12.5%
3. Transport	6241.46	23.33	77.86	NA	6342.65	20.4%
4. Other sectors	3327.24	340.71	130.51	NA	3798.46	12.2%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	869.60	289.52	0.26	NA	1159.39	3.7%
1. Solid fuels	NO	NO	NO,NA	NA	NO,NA	NO,NA
2. Oil and natural gas	869.60	289.52	0.26	NA	1159.39	3.7%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**2767.42**	**3.61**	**727.95**	**339.79**	**3838.77**	**12.4%**
A. Mineral industry	1948.84	NA	NA	NA	1948.84	6.3%
B. Chemical industry	693.88	3.61	694.57	NA	1392.06	4.5%
C. Metal industry	13.10	NA,NO	NO	NA	13.10	0.0%
D. Non-energy products from fuels and solvent use	111.61	NA	NA	NA	111.61	0.4%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	326.74	326.74	1.1%
G. Other product manufacture and use	NO	NO	33.38	13.05	46.43	0.1%
3. Agriculture	**89.32**	**1451.53**	**1379.50**	**NA**	**2920.35**	**9.4%**
A. Enteric fermentation	NA	1083.29	NA	NA	1083.29	3.5%
B. Manure management	NA	368.24	173.00	NA	541.24	1.7%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1206.50	NA	1206.50	3.9%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	16.60	NA	NA	NA	16.60	0.1%
H. Urea application	72.72	NA	NA	NA	72.72	0.2%
4. Land use, land-use change and forestry	**-7151.32**	**31.76**	**95.90**	**NA**	**-7023.66**	**-22.6%**
A. Forest land	-7491.89	29.59	19.51	NA	-7442.79	-24.0%
B. Cropland	145.34	NO	8.24	NA	153.58	0.5%
C. Grassland	-81.43	2.17	2.37	NA	-76.89	-0.2%
D. Wetlands	18.17	NO	2.28	NA	20.45	0.1%
E. Settlements	544.08	NO	63.50	NA	607.58	2.0%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-285.59	NA	NA	NA	-285.59	-0.9%
5. Waste	**0.65**	**1157.20**	**85.40**	**NA**	**1243.25**	**4.0%**
A. Solid waste disposal	NA,NO	914.38	NA	NA	914.38	2.9%
B. Biological treatment of solid waste	NA	1.10	0.78	NA	1.88	0.0%
C. Incineration and open burning of waste	0.65	NA,NO	0.01	NA	0.66	0.0%
D. Waste water treatment and discharge	NA	241.72	84.61	NA	326.33	1.1%
Total with LULUCF	**17866.04**	**3309.04**	**2534.99**	**339.79**	**24049.87**	**77.4%**
Total without LULUCF	**25017.37**	**3277.28**	**2439.09**	**339.79**	**31073.53**	**100.0%**
Shares in total with LULUCF	74.3%	13.8%	10.5%	1.4%	100.0%	
Shares in total without LULUCF	80.5%	10.5%	7.8%	1.1%	100.0%	
Memo items:						
International bunkers	353.05	0.46	1.29	NA	354.80	1.1%
Aviation	276.60	0.29	0.69	NA	277.58	0.9%
Navigation	76.45	0.17	0.59	NA	77.22	0.2%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5323.07	NA	NA	NA	5323.07	17.1%

Year 2008	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**20984.97**	**651.62**	**242.40**	**NA**	**21878.99**	**73.2%**
A. Fuel combustion (sectoral approach)	20214.14	373.98	242.15	NA	20830.27	69.7%
1. Energy industries	6820.96	4.79	24.21	NA	6849.97	22.9%
2. Manufacturing industries and construction	3872.78	5.59	10.17	NA	3888.55	13.0%
3. Transport	6078.62	21.64	72.87	NA	6173.12	20.7%
4. Other sectors	3441.78	341.95	134.90	NA	3918.63	13.1%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	770.84	277.64	0.25	NA	1048.73	3.5%
1. Solid fuels	NO	NO	NO,NA	NA	NO,NA	NO,NA
2. Oil and natural gas	770.84	277.64	0.25	NA	1048.73	3.5%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**2664.23**	**3.42**	**743.36**	**350.02**	**3761.03**	**12.6%**
A. Mineral industry	1856.99	NA	NA	NA	1856.99	6.2%
B. Chemical industry	677.48	3.42	709.98	NA	1390.88	4.7%
C. Metal industry	24.15	NA,NO	NO	NA	24.15	0.1%
D. Non-energy products from fuels and solvent use	105.61	NA	NA	NA	105.61	0.4%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	338.04	338.04	1.1%
G. Other product manufacture and use	NO	NO	33.38	11.98	45.35	0.2%
3. Agriculture	**96.60**	**1405.34**	**1407.48**	**NA**	**2909.42**	**9.7%**
A. Enteric fermentation	NA	1054.84	NA	NA	1054.84	3.5%
B. Manure management	NA	350.50	162.79	NA	513.28	1.7%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1244.70	NA	1244.70	4.2%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	20.78	NA	NA	NA	20.78	0.1%
H. Urea application	75.83	NA	NA	NA	75.83	0.3%
4. Land use, land-use change and forestry	**-7434.37**	**9.58**	**80.87**	**NA**	**-7343.92**	**-24.6%**
A. Forest land	-7707.08	8.64	5.70	NA	-7692.74	-25.7%
B. Cropland	142.88	NO	8.17	NA	151.05	0.5%
C. Grassland	-135.65	0.94	1.02	NA	-133.68	-0.4%
D. Wetlands	14.47	NO	1.81	NA	16.27	0.1%
E. Settlements	546.96	NO	64.17	NA	611.13	2.0%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-295.95	NA	NA	NA	-295.95	-1.0%
5. Waste	**0.67**	**1250.28**	**86.68**	**NA**	**1337.63**	**4.5%**
A. Solid waste disposal	NA,NO	1010.07	NA	NA	1010.07	3.4%
B. Biological treatment of solid waste	NA	1.07	0.77	NA	1.84	0.0%
C. Incineration and open burning of waste	0.67	NA,NO	0.01	NA	0.68	0.0%
D. Waste water treatment and discharge	NA	239.14	85.91	NA	325.05	1.1%
Total with LULUCF	**16312.11**	**3320.24**	**2560.80**	**350.02**	**22543.17**	**75.4%**
Total without LULUCF	**23746.47**	**3310.66**	**2479.93**	**350.02**	**29887.08**	**100.0%**
Shares in total with LULUCF	72.4%	14.7%	11.4%	1.6%	100.0%	
Shares in total without LULUCF	79.5%	11.1%	8.3%	1.2%	100.0%	
Memo items:						
International bunkers	384.96	0.49	1.31	NA	386.76	1.3%
Aviation	317.46	0.33	0.79	NA	318.58	1.1%
Navigation	67.50	0.15	0.52	NA	68.17	0.2%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5298.85	NA	NA	NA	5298.85	17.7%

Year 2009	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**19811.20**	**655.98**	**236.64**	**NA**	**20703.82**	**74.1%**
A. Fuel combustion (sectoral approach)	19104.53	386.39	236.41	NA	19727.33	70.6%
1. Energy industries	6403.19	4.77	21.01	NA	6428.97	23.0%
2. Manufacturing industries and construction	3157.36	5.28	9.34	NA	3171.98	11.3%
3. Transport	6089.63	20.34	72.38	NA	6182.36	22.1%
4. Other sectors	3454.34	356.00	133.68	NA	3944.02	14.1%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	706.67	269.59	0.23	NA	976.50	3.5%
1. Solid fuels	NO	NO	NO,NA	NA	NO,NA	NO,NA
2. Oil and natural gas	706.67	269.59	0.23	NA	976.50	3.5%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**2077.31**	**3.06**	**626.21**	**349.64**	**3056.21**	**10.9%**
A. Mineral industry	1460.61	NA	NA	NA	1460.61	5.2%
B. Chemical industry	524.80	3.06	593.37	NA	1121.23	4.0%
C. Metal industry	11.56	NA,NO	NO	NA	11.56	0.0%
D. Non-energy products from fuels and solvent	80.35	NA	NA	NA	80.35	0.3%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	341.61	341.61	1.2%
G. Other product manufacture and use	NO	NO	32.83	8.03	40.86	0.1%
3. Agriculture	**76.96**	**1421.13**	**1298.17**	**NA**	**2796.26**	**10.0%**
A. Enteric fermentation	NA	1052.77	NA	NA	1052.77	3.8%
B. Manure management	NA	368.36	163.18	NA	531.54	1.9%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1134.99	NA	1134.99	4.1%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	11.92	NA	NA	NA	11.92	0.0%
H. Urea application	65.04	NA	NA	NA	65.04	0.2%
4. Land use, land-use change and forestry	**-7470.54**	**5.10**	**77.74**	**NA**	**-7387.70**	**-26.4%**
A. Forest land	-7903.70	4.87	3.21	NA	-7895.61	-28.2%
B. Cropland	78.74	NO	8.15	NA	86.89	0.3%
C. Grassland	-83.23	0.22	0.24	NA	-82.76	-0.3%
D. Wetlands	10.76	NO	1.33	NA	12.10	0.0%
E. Settlements	591.89	NO	64.80	NA	656.69	2.3%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-165.01	NA	NA	NA	-165.01	-0.6%
5. Waste	**0.16**	**1306.22**	**88.16**	**NA**	**1394.54**	**5.0%**
A. Solid waste disposal	NA,NO	1097.72	NA	NA	1097.72	3.9%
B. Biological treatment of solid waste	NA	0.90	0.64	NA	1.54	0.0%
C. Incineration and open burning of waste	0.16	NA,NO	NA,NO,IE	NA	0.16	0.0%
D. Waste water treatment and discharge	NA	207.60	87.52	NA	295.12	1.1%
Total with LULUCF	**14495.10**	**3391.48**	**2326.92**	**349.64**	**20563.14**	**73.6%**
Total without LULUCF	**21965.64**	**3386.39**	**2249.18**	**349.64**	**27950.84**	**100.0%**
Shares in total with LULUCF	70.5%	16.5%	11.3%	1.7%	100.0%	
Shares in total without LULUCF	78.6%	12.1%	8.0%	1.3%	100.0%	
Memo items:						
International bunkers	292.16	0.33	0.85	NA	293.34	1.0%
Aviation	270.31	0.28	0.68	NA	271.27	1.0%
Navigation	21.85	0.05	0.17	NA	22.07	0.1%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5577.15	NA	NA	NA	5577.15	20.0%

Year 2010	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**18987.46**	**681.19**	**235.22**	**NA**	**19903.86**	**72.8%**
A. Fuel combustion (sectoral approach)	18312.02	410.80	235.00	NA	18957.82	69.4%
1. Energy industries	5925.02	4.34	21.72	NA	5951.08	21.8%
2. Manufacturing industries and construction	3015.80	5.21	9.09	NA	3030.11	11.1%
3. Transport	5865.04	18.26	68.97	NA	5952.28	21.8%
4. Other sectors	3506.16	382.98	135.21	NA	4024.35	14.7%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	675.43	270.39	0.22	NA	946.04	3.5%
1. Solid fuels	NO	NO	NO,NA	NA	NO,NA	NO,NA
2. Oil and natural gas	675.43	270.39	0.22	NA	946.04	3.5%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**2128.20**	**2.91**	**796.30**	**387.86**	**3315.26**	**12.1%**
A. Mineral industry	1432.29	NA	NA	NA	1432.29	5.2%
B. Chemical industry	594.74	2.91	765.22	NA	1362.87	5.0%
C. Metal industry	27.55	NA,NO	NO	NA	27.55	0.1%
D. Non-energy products from fuels and solvent	73.61	NA	NA	NA	73.61	0.3%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	378.91	378.91	1.4%
G. Other product manufacture and use	NO	NO	31.08	8.95	40.03	0.1%
3. Agriculture	**88.04**	**1422.38**	**1207.08**	**NA**	**2717.50**	**9.9%**
A. Enteric fermentation	NA	1057.12	NA	NA	1057.12	3.9%
B. Manure management	NA	365.26	159.53	NA	524.79	1.9%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1047.55	NA	1047.55	3.8%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	21.46	NA	NA	NA	21.46	0.1%
H. Urea application	66.58	NA	NA	NA	66.58	0.2%
4. Land use, land-use change and forestry	**-7340.16**	**1.76**	**74.61**	**NA**	**-7263.79**	**-26.6%**
A. Forest land	-7721.79	1.64	1.08	NA	-7719.07	-28.2%
B. Cropland	145.96	NO	7.81	NA	153.77	0.6%
C. Grassland	-91.27	0.12	0.13	NA	-91.03	-0.3%
D. Wetlands	7.06	NO	0.86	NA	7.92	0.0%
E. Settlements	557.31	NO	64.73	NA	622.04	2.3%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-237.43	NA	NA	NA	-237.43	-0.9%
5. Waste	**0.05**	**1308.60**	**83.74**	**NA**	**1392.39**	**5.1%**
A. Solid waste disposal	NA,NO	1098.53	NA	NA	1098.53	4.0%
B. Biological treatment of solid waste	NA	0.97	0.69	NA	1.66	0.0%
C. Incineration and open burning of waste	0.05	NA,NO	NA,NO,IE	NA	0.05	0.0%
D. Waste water treatment and discharge	NA	209.10	83.05	NA	292.15	1.1%
Total with LULUCF	**13863.57**	**3416.84**	**2396.94**	**387.86**	**20065.22**	**73.4%**
Total without LULUCF	**21203.74**	**3415.08**	**2322.33**	**387.86**	**27329.01**	**100.0%**
Shares in total with LULUCF	69.1%	17.0%	11.9%	1.9%	100.0%	
Shares in total without LULUCF	77.6%	12.5%	8.5%	1.4%	100.0%	
Memo items:						
International bunkers	315.09	0.35	0.89	NA	316.34	1.2%
Aviation	295.46	0.31	0.74	NA	296.50	1.1%
Navigation	19.64	0.04	0.15	NA	19.83	0.1%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5940.99	NA	NA	NA	5940.99	21.7%

Year 2011	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**18764.79**	**648.39**	**221.65**	**NA**	**19634.83**	**72.9%**
A. Fuel combustion (sectoral approach)	18084.55	399.28	221.45	NA	18705.28	69.5%
1. Energy industries	6297.13	5.02	23.00	NA	6325.15	23.5%
2. Manufacturing industries and construction	2779.55	4.57	8.00	NA	2792.12	10.4%
3. Transport	5726.02	16.65	56.88	NA	5799.55	21.5%
4. Other sectors	3281.84	373.05	133.57	NA	3788.46	14.1%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	680.24	249.11	0.20	NA	929.55	3.5%
1. Solid fuels	NO	NO	NO,NA	NA	NO,NA	NO,NA
2. Oil and natural gas	680.24	249.11	0.20	NA	929.55	3.5%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**1889.39**	**1.94**	**786.76**	**405.58**	**3083.66**	**11.5%**
A. Mineral industry	1220.06	NA	NA	NA	1220.06	4.5%
B. Chemical industry	571.33	1.94	754.16	NA	1327.43	4.9%
C. Metal industry	29.45	NA,NO	NO	NA	29.45	0.1%
D. Non-energy products from fuels and solvent	68.55	NA	NA	NA	68.55	0.3%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	396.21	396.21	1.5%
G. Other product manufacture and use	NO	NO	32.60	9.37	41.96	0.2%
3. Agriculture	**105.18**	**1394.68**	**1285.70**	**NA**	**2785.56**	**10.3%**
A. Enteric fermentation	NA	1040.66	NA	NA	1040.66	3.9%
B. Manure management	NA	354.03	150.33	NA	504.36	1.9%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1135.37	NA	1135.37	4.2%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	21.32	NA	NA	NA	21.32	0.1%
H. Urea application	83.86	NA	NA	NA	83.86	0.3%
4. Land use, land-use change and forestry	**-6357.16**	**18.63**	**87.77**	**NA**	**-6250.76**	**-23.2%**
A. Forest land	-6720.77	15.20	10.02	NA	-6695.55	-24.9%
B. Cropland	116.01	NO	7.47	NA	123.48	0.5%
C. Grassland	-65.42	3.43	3.74	NA	-58.25	-0.2%
D. Wetlands	6.71	NO	0.81	NA	7.52	0.0%
E. Settlements	565.94	NO	65.73	NA	631.67	2.3%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-259.63	NA	NA	NA	-259.63	-1.0%
5. Waste	**0.05**	**1339.44**	**85.13**	**NA**	**1424.61**	**5.3%**
A. Solid waste disposal	NA,NO	1131.57	NA	NA	1131.57	4.2%
B. Biological treatment of solid waste	NA	1.01	0.72	NA	1.73	0.0%
C. Incineration and open burning of waste	0.05	NA,NO	NA,NO,IE	NA	0.05	0.0%
D. Waste water treatment and discharge	NA	206.86	84.40	NA	291.26	1.1%
Total with LULUCF	**14402.24**	**3403.08**	**2467.00**	**405.58**	**20677.90**	**76.8%**
Total without LULUCF	**20759.40**	**3384.45**	**2379.23**	**405.58**	**26928.66**	**100.0%**
Shares in total with LULUCF	69.7%	16.5%	11.9%	2.0%	100.0%	
Shares in total without LULUCF	77.1%	12.6%	8.8%	1.5%	100.0%	
Memo items:						
International bunkers	387.14	0.50	1.36	NA	389.01	1.4%
Aviation	311.17	0.33	0.78	NA	312.28	1.2%
Navigation	75.97	0.17	0.59	NA	76.73	0.3%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5834.61	NA	NA	NA	5834.61	21.7%

Year 2012	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**17363.42**	**610.71**	**213.31**	**NA**	**18187.43**	**72.4%**
A. Fuel combustion (sectoral approach)	16791.33	395.19	213.13	NA	17399.64	69.3%
1. Energy industries	5895.66	4.88	21.78	NA	5922.32	23.6%
2. Manufacturing industries and construction	2409.07	4.69	8.12	NA	2421.88	9.6%
3. Transport	5544.99	14.06	55.20	NA	5614.24	22.3%
4. Other sectors	2941.62	371.55	128.03	NA	3441.19	13.7%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	572.09	215.52	0.18	NA	787.79	3.1%
1. Solid fuels	NO	NO	NO,NA	NA	NO,NA	NO,NA
2. Oil and natural gas	572.09	215.52	0.18	NA	787.79	3.1%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**1707.69**	**0.15**	**694.87**	**406.49**	**2809.20**	**11.2%**
A. Mineral industry	1163.71	NA	NA	NA	1163.71	4.6%
B. Chemical industry	478.93	0.15	652.54	NA	1131.62	4.5%
C. Metal industry	2.02	NA,NO	NO	NA	2.02	0.0%
D. Non-energy products from fuels and solvent use	63.03	NA	NA	NA	63.03	0.3%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	397.31	397.31	1.6%
G. Other product manufacture and use	NO	NO	42.33	9.18	51.50	0.2%
3. Agriculture	**101.23**	**1365.05**	**1238.35**	**NA**	**2704.64**	**10.8%**
A. Enteric fermentation	NA	1024.33	NA	NA	1024.33	4.1%
B. Manure management	NA	340.73	146.24	NA	486.97	1.9%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	1092.11	NA	1092.11	4.3%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	14.38	NA	NA	NA	14.38	0.1%
H. Urea application	86.85	NA	NA	NA	86.85	0.3%
4. Land use, land-use change and forestry	**-6117.91**	**38.88**	**101.49**	**NA**	**-5977.54**	**-23.8%**
A. Forest land	-6470.73	36.09	23.80	NA	-6410.84	-25.5%
B. Cropland	185.75	NO	7.12	NA	192.87	0.8%
C. Grassland	-95.91	2.79	3.04	NA	-90.08	-0.4%
D. Wetlands	6.36	NO	0.77	NA	7.13	0.0%
E. Settlements	566.81	NO	66.76	NA	633.57	2.5%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-310.18	NA	NA	NA	-310.18	-1.2%
5. Waste	**0.08**	**1335.26**	**85.32**	**NA**	**1420.67**	**5.7%**
A. Solid waste disposal	NA,NO	1140.22	NA	NA	1140.22	4.5%
B. Biological treatment of solid waste	NA	1.87	1.34	NA	3.21	0.0%
C. Incineration and open burning of waste	0.08	NA,NO	NA,NO,IE	NA	0.08	0.0%
D. Waste water treatment and discharge	NA	193.18	83.99	NA	277.17	1.1%
Total with LULUCF	**13054.52**	**3350.06**	**2333.34**	**406.49**	**19144.40**	**76.2%**
Total without LULUCF	**19172.43**	**3311.17**	**2231.85**	**406.49**	**25121.94**	**100.0%**
Shares in total with LULUCF	68.2%	17.5%	12.2%	2.1%	100.0%	
Shares in total without LULUCF	76.3%	13.2%	8.9%	1.6%	100.0%	
Memo items:						
International bunkers	330.03	0.35	0.83	NA	331.20	1.3%
Aviation	330.03	0.35	0.83	NA	331.20	1.3%
Navigation	NO	NO	NO	NA	NO	NO
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	6017.15	NA	NA	NA	6017.15	24.0%

Year 2013	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**16609.97**	**596.43**	**209.27**	**NA**	**17415.67**	**72.8%**
A. Fuel combustion (sectoral approach)	16066.05	391.71	209.09	NA	16666.85	69.7%
1. Energy industries	5274.69	4.16	20.92	NA	5299.77	22.2%
2. Manufacturing industries and construction	2380.65	4.40	7.72	NA	2392.78	10.0%
3. Transport	5631.06	13.91	54.58	NA	5699.55	23.8%
4. Other sectors	2779.65	369.23	125.88	NA	3274.76	13.7%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	543.92	204.72	0.18	NA	748.82	3.1%
1. Solid fuels	NO	NO	NO,NA	NA	NO,NA	NO,NA
2. Oil and natural gas	543.92	204.72	0.18	NA	748.82	3.1%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**1840.82**	**0.15**	**282.52**	**415.07**	**2538.56**	**10.6%**
A. Mineral industry	1275.91	NA	NA	NA	1275.91	5.3%
B. Chemical industry	485.96	0.15	240.45	NA	726.56	3.0%
C. Metal industry	16.88	NA,NO	NO	NA	16.88	0.1%
D. Non-energy products from fuels and solvent	62.06	NA	NA	NA	62.06	0.3%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	408.97	408.97	1.7%
G. Other product manufacture and use	NO	NO	42.06	6.10	48.17	0.2%
3. Agriculture	**74.61**	**1325.33**	**1137.04**	**NA**	**2536.99**	**10.6%**
A. Enteric fermentation	NA	996.04	NA	NA	996.04	4.2%
B. Manure management	NA	329.29	140.30	NA	469.60	2.0%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	996.74	NA	996.74	4.2%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	14.23	NA	NA	NA	14.23	0.1%
H. Urea application	60.39	NA	NA	NA	60.39	0.3%
4. Land use, land-use change and forestry	**-6600.49**	**1.93**	**76.75**	**NA**	**-6521.81**	**-27.3%**
A. Forest land	-6829.76	1.46	0.96	NA	-6827.34	-28.5%
B. Cropland	167.13	NO	6.77	NA	173.90	0.7%
C. Grassland	-55.38	0.47	0.51	NA	-54.39	-0.2%
D. Wetlands	6.01	NO	0.73	NA	6.73	0.0%
E. Settlements	572.52	NO	67.78	NA	640.30	2.7%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-461.02	NA	NA	NA	-461.02	-1.9%
5. Waste	**0.04**	**1345.66**	**85.63**	**NA**	**1431.33**	**6.0%**
A. Solid waste disposal	NA,NO	1142.37	NA	NA	1142.37	4.8%
B. Biological treatment of solid waste	NA	2.85	2.04	NA	4.89	0.0%
C. Incineration and open burning of waste	0.04	NA,NO	NA,NO,IE	NA	0.04	0.0%
D. Waste water treatment and discharge	NA	200.44	83.59	NA	284.03	1.2%
Total with LULUCF	**11924.95**	**3269.50**	**1791.21**	**415.07**	**17400.73**	**72.7%**
Total without LULUCF	**18525.44**	**3267.57**	**1714.46**	**415.07**	**23922.55**	**100.0%**
Shares in total with LULUCF	68.5%	18.8%	10.3%	2.4%	100.0%	
Shares in total without LULUCF	77.4%	13.7%	7.2%	1.7%	100.0%	
Memo items:						
International bunkers	366.52	0.38	0.90	NA	367.80	1.5%
Aviation	366.52	0.38	0.90	NA	367.80	1.5%
Navigation	NO	NO	NO	NA	NO	NO
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5962.40	NA	NA	NA	5962.40	24.9%

Year 2014	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO₂ equivalent (kt)					(%)
1. Energy	**15725.63**	**536.38**	**197.82**	**NA**	**16459.83**	**71.4%**
A. Fuel combustion (sectoral approach)	15200.29	345.17	197.65	NA	15743.10	68.3%
1. Energy industries	4769.85	3.23	17.95	NA	4791.03	20.8%
2. Manufacturing industries and construction	2324.33	3.84	6.79	NA	2334.97	10.1%
3. Transport	5575.58	12.77	54.14	NA	5642.49	24.5%
4. Other sectors	2530.53	325.33	118.76	NA	2974.62	12.9%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	525.34	191.22	0.17	NA	716.73	3.1%
1. Solid fuels	NO	NO	NA,NO	NA	NA,NO	NA,NO
2. Oil and natural gas	525.34	191.22	0.17	NA	716.73	3.1%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**1981.93**	**0.17**	**285.43**	**420.48**	**2688.00**	**11.7%**
A. Mineral industry	1360.19	NA	NA	NA	1360.19	5.9%
B. Chemical industry	534.35	0.17	266.39	NA	800.92	3.5%
C. Metal industry	28.58	NA,NO	NO	NA	28.58	0.1%
D. Non-energy products from fuels and solvent use	58.80	NA	NA	NA	58.80	0.3%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	413.66	413.66	1.8%
G. Other product manufacture and use	NO	NO	19.03	6.81	25.85	0.1%
3. Agriculture	**69.47**	**1301.04**	**1056.54**	**NA**	**2427.05**	**10.5%**
A. Enteric fermentation	NA	974.86	NA	NA	974.86	4.2%
B. Manure management	NA	326.18	136.72	NA	462.90	2.0%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	919.82	NA	919.82	4.0%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	19.99	NA	NA	NA	19.99	0.1%
H. Urea application	49.47	NA	NA	NA	49.47	0.2%
4. Land use, land-use change and forestry	**-6667.68**	**0.32**	**76.08**	**NA**	**-6591.28**	**-28.6%**
A. Forest land	-6552.22	0.22	0.14	NA	-6551.85	-28.4%
B. Cropland	2.26	0.08	6.47	NA	8.80	0.0%
C. Grassland	-42.15	0.03	0.03	NA	-42.10	-0.2%
D. Wetlands	5.66	NO	0.68	NA	6.34	0.0%
E. Settlements	576.84	NO	68.77	NA	645.61	2.8%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-658.07	NA	NA	NA	-658.07	-2.9%
5. Waste	**0.04**	**1388.95**	**85.13**	**NA**	**1474.13**	**6.4%**
A. Solid waste disposal	NA,NO	1178.42	NA	NA	1178.42	5.1%
B. Biological treatment of solid waste	NA	2.86	2.05	NA	4.90	0.0%
C. Incineration and open burning of waste	0.04	NA,NO	NA,NO,IE	NA	0.04	0.0%
D. Waste water treatment and discharge	NA	207.67	83.09	NA	290.76	1.3%
Total with LULUCF	**11109.39**	**3226.86**	**1701.01**	**420.48**	**16457.73**	**71.4%**
Total without LULUCF	**17777.06**	**3226.54**	**1624.92**	**420.48**	**23049.00**	**100.0%**
Shares in total with LULUCF	67.5%	19.6%	10.3%	2.6%	100.0%	
Shares in total without LULUCF	77.1%	14.0%	7.0%	1.8%	100.0%	
Memo items:						
International bunkers	368.10	0.71	0.91	NA	369.73	1.6%
Aviation	368.10	0.71	0.91	NA	369.73	1.6%
Navigation	NO	NO	NO	NA	NO	NO
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	5249.83	NA	NA	NA	5249.83	22.8%

Year 2015	CO_2	CH_4	N_2O	HFCs, PFCs, SF_6, NF_3	Total	Share in total without LULUCF
	CO_2 equivalent (kt)					(%)
1. Energy	**15924.56**	**595.07**	**208.40**	**NA**	**16728.04**	**71.2%**
A. Fuel combustion (sectoral approach)	15597.65	392.91	208.21	NA	16198.77	68.9%
1. Energy industries	4771.67	4.13	19.62	NA	4795.41	20.4%
2. Manufacturing industries and construction	2222.70	3.33	5.98	NA	2232.02	9.5%
3. Transport	5883.52	12.41	55.89	NA	5951.83	25.3%
4. Other sectors	2719.76	373.03	126.72	NA	3219.51	13.7%
5. Other	NO,IE	NO,IE	NO,IE	NA	NO,IE	NO,IE
B. Fugitive emissions from fuels	326.91	202.17	0.19	NA	529.27	2.3%
1. Solid fuels	NO	NO	NA,NO	NA	NA,NO	NA,NO
2. Oil and natural gas	326.91	202.17	0.19	NA	529.27	2.3%
C. CO2 transport and storage	NO	NA	NA	NA	NO	NO
2. Industrial processes and product use	**1924.80**	**0.17**	**315.35**	**425.18**	**2665.51**	**11.3%**
A. Mineral industry	1313.14	NA	NA	NA	1313.14	5.6%
B. Chemical industry	537.04	0.17	311.55	NA	848.76	3.6%
C. Metal industry	13.63	NA,NO	NO	NA	13.63	0.1%
D. Non-energy products from fuels and solvent use	60.99	NA	NA	NA	60.99	0.3%
E. Electronic Industry	NA	NA	NA	NA	NO	NO
F. Product uses as ODS substitutes	NA	NA	NA	419.92	419.92	1.8%
G. Other product manufacture and use	NO	NO	3.81	5.26	9.07	0.0%
3. Agriculture	**69.34**	**1368.82**	**1117.17**	**NA**	**2555.32**	**10.9%**
A. Enteric fermentation	NA	1024.36	NA	NA	1024.36	4.4%
B. Manure management	NA	344.46	146.73	NA	491.19	2.1%
C. Rice cultivation	NA	NO	NA	NA	NO	NO
D. Agricultural soils	NA	NA	970.44	NA	970.44	4.1%
E. Prescribed burning of savannas	NA	NA	NA	NA	NA	NA
F. Field burning of agricultural residues	NA	NO	NO	NA	NO	NO
G. Liming	12.09	NA	NA	NA	12.09	0.1%
H. Urea application	57.25	NA	NA	NA	57.25	0.2%
4. Land use, land-use change and forestry	**-5092.05**	**13.96**	**86.37**	**NA**	**-4991.72**	**-21.2%**
A. Forest land	-5607.26	9.82	6.48	NA	-5590.96	-23.8%
B. Cropland	121.75	2.58	7.78	NA	132.11	0.6%
C. Grassland	-78.78	1.57	1.70	NA	-75.51	-0.3%
D. Wetlands	5.31	NO	0.64	NA	5.95	0.0%
E. Settlements	593.11	NO	69.78	NA	662.89	2.8%
F. Other land	NO	NO	NO	NA	NO	NO
G. Harvested wood products	-126.19	NA	NA	NA	-126.19	-0.5%
5. Waste	**0.05**	**1466.58**	**86.65**	**NA**	**1553.28**	**6.6%**
A. Solid waste disposal	NA,NO	1253.82	NA	NA	1253.82	5.3%
B. Biological treatment of solid waste	NA	6.16	4.41	NA	10.57	0.0%
C. Incineration and open burning of waste	0.05	NA,NO	NA,NO,IE	NA	0.05	0.0%
D. Waste water treatment and discharge	NA	206.60	82.25	NA	288.85	1.2%
Total with LULUCF	**12826.69**	**3444.61**	**1813.95**	**425.18**	**18510.43**	**78.8%**
Total without LULUCF	**17918.75**	**3430.64**	**1727.57**	**425.18**	**23502.15**	**100.0%**
Shares in total with LULUCF	69.3%	18.6%	9.8%	2.3%	100.0%	
Shares in total without LULUCF	76.2%	14.6%	7.4%	1.8%	100.0%	
Memo items:						
International bunkers	359.45	0.71	0.92	NA	361.08	1.5%
Aviation	354.08	0.70	0.87	NA	355.65	1.5%
Navigation	5.37	0.01	0.04	NA	5.42	0.0%
Multilateral operations	C	C	C	NA	C	C
CO2 emissions from biomass	6010.65	NA	NA	NA	6010.65	25.6%

3. SUMMARY OF REPORTING SUPPLEMENTARY INFORMATION UNDER ARTICLE 7, PARAGRAPH 2 OF THE KYOTO PROTOCOL

Information reported under Article 7, paragraph 2	**Chapter in 7th National Communication**
National systems in accordance with Article 5, paragraph 1	3.3.
Nacional registries	3.4.
Supplementary relating to the Mechanisms pursuant to Articles 6, 12, 17	5.2.6.
Policies and measures in accordance with Article 2	4.2.
Domestic and regional programmes and/or legislative arrangements and enforcements and administrative procedures	4.1.
Information under Article 10:	
Article 10.a	3.4.1.
Article 10.b	4.1., 4.2.
Article 10.c	7.2.
Article 10.d	8.
Article 10.e	9.
Financial resources	7.1.