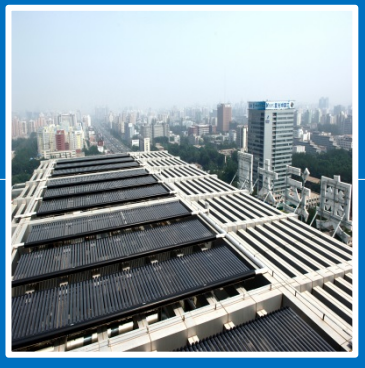
MINISTRY FOR THE ENVIRONMENT LAND AND SEA




Seventh National Communication under the UN Framework Convention on Climate Change

Italy



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Summary

Foreword

I am pleased to present the Italian Seventh National Communication under the United Nations Framework Convention on Climate Change. The National Communication also contains information required under the Kyoto Protocol and Its Doha amendment.
This Communication represents a further step forward in the implementation of Italy's objective to fostering growth with clean technologies and pursuing sustainable development at all level. Policies and measures in all sectors described in the Communication are in fact consistent with the vision set out by the recent updated Italian Sustainable Development Strategy and the new Italian National Energy Strategy which specifically define Italy roadmap for the decarbonisation of its economy up to 2030 and beyond, in line with the EU Paris Agreement commitment.

Italy has reached its Kyoto Protocol target, ratified the Doha amendments and it is well on track to meet its 2020 target. Last available data, as presented in this communication, clearly show that in 2015 Italy has already reached Its EU 2020 target, while the economy growth has keeping on steadily recovering from the latest recession. Italy has also adopted its National Adaptation Strategy to climate change. The Strategy analyses the state of scientific knowledge on impacts and vulnerability to climate change for the major socio-economic and environmental sectors and proposes a portfolio of adaptation actions. Those actions, as well as the need for a monitoring, reporting and evaluating system are in the process of being specified in the National Adaptation Plan, whose drafting has already started and it is about to be adopted.

Italy strongly believes that climate change is a global challenge and thus need a global response. To this end, Italy acknowledges particular attention to the international cooperation aimed at strengthening the global response to the threat of climate change by both reducing emissions and adapting to climate change. Specific attention is devoted to the least developed and most vulnerable countries in which enhancing the capacity to respond to climate change is for Italy a priority. In the general contest of the cooperation activities, Italy is undertaking continuous efforts to scale-up its international climate finance and will continue to do so. Since 2015, 31 new bilateral agreements with developing countries including regional groups to support mitigation and adaptation actions, to facilitate access to climate finance, to provide capacity building and technology transfer were signed. In the provision of public financial resources, a fair balance between mitigation and adaptation over time has been looked for. Direct support for adaptation in the period 2015-2016 increased more than five times compared to previous years. The adaptation component in 2015-2016 represents 53% of the total public climate finance addressing mitigation and adaptation, without considering crosscutting activities.

Italy remains fully committed to the long term temperature goal set out by the Convention, its Protocol and lastly the Paris Agreement and will continue to work constantly with all national and international partners at all level to pursue the decarbonized, resilient and solidarity pathway she has already undertook since the adoption of the UNFCCC Convention.

Francesco La Camera
UNFCCC National Focal Point

1 EXECUTIVE SUMMARY

1.1 National Circumstances

In Italy, the protection of the environment, ecosystem and cultural resources are under the exclusive competences of the central Government. The Italian Ministry for the Environment Land and Sea (IMELS) is also responsible for the implementation of the Kyoto Protocol; under this framework, it has started the process for the adoption of the National Strategy for Adaptation to Climate Change. The Inter-Ministerial Committee for Economic Planning (CIPE) is a collective governmental body, chaired by the President of the Council of Ministers, whose competences also include climate change. In fact, the committee is in charge for taking resolutions concerning the national plan for the reduction of emissions of gases responsible for the greenhouse effect. The latest CIPE resolution was adopted in 2013, in order to enable Italy to reach the goals set by the EU legislation by 2020. The new National Energy Strategy ("SEN 2017") was adopted on 10th November 2017, setting further goals to be achieved in 2030.

Demographic and social trends of countries are generally considered among the main driving forces for the emissions trends. Although changes in the national population have occurred over the last 20 years, they have not directly affected the national trend of emissions significantly. The national population in 2011 increased compared to 2001, according to the national surveys, due to the migratory movements. The aging trend of population has been increasing because of a low birth rate and a continuous growth of the elders. Italy is still the second European Union country with the oldest population. The two factors combined point out that the proportion of population of working age has been shrinking and even positive migratory movements from abroad cannot avoid the imbalance in the ratio of the young to the elders from occurring. The family size has been decreasing. In the period 1991-2015, the number of dwellings, the population and the number of families have increased at different growth rates. So, even if new buildings are more energy efficient, the increase of number of families and dwellings has also contributed to increasing residential energy demand through the last two decades.

Due to the climate profile, domestic heating is required through winter months and the use of air conditioning systems during summer months has been increasing in the last decade. As far as temperature is concerned, year 2016 was the 6th Italian warmest year since 1961. The indicators about extreme temperature trends confirm the positive thermal deviation of the year 2016 although it does not rank as one of the five warmest years. As for the average sea surface temperature, 2016 was the 4th warmest year after 2015, 2012 and 2014. To date, no statistically significant trend in national precipitation is registered, except for Central Italy where a negative trend can be detected. Several extremes of precipitation occurred in 2016, especially in one region.

Italy was the world's eighth world largest economy and the fourth largest economy among the EU countries in 2016. During the last decade, a global financial and economic crisis has hit advanced economies thus resulting into severe recession in the EU, Japan and the United States from 2007-2009. Between 2012 and 2013, Italy, like many advanced economies, has moved into recession again, but in the very last years the national economy has been showing a moderate recovery. The driving sector of the national economy is still the service sector; the industry-related activities have been recovering in the last years; agriculture has returned to its 2011 values; while construction has remained stable during the last three years.

Italy is also the world's ninth largest exporter of goods and the twelfth largest importer of goods. Italian trade balance registered a deficit in 2009 and 2012-2013, and a surplus in 2010-2011 and 2014-2015.

The percentage change of exports of goods turned positive in 2015. At a world scale, Italian exports and imports have been losing market shares since 2000. In 2016, Italian exports of goods were driven by: machinery and auto vehicles, pharmaceuticals, shoes, oil refinery products and iron & steel products. The imports of goods showed an increasing trend from 1990 to 2007 and a fluctuating trend afterwards, due to the fluctuation of the domestic demand through the last years. In 2016, the main imported goods were: machinery and auto vehicles, energy products, chemical products and pharmaceuticals.

Compared with others European countries, Italy's energy primary consumption is characterized by a major use of oil and gas, a structural electricity imports, a weak coal contribution and the absence of nuclear power. The share of renewable energy in Italy's energy supply mix is higher compared with the OECD's average, mostly due to hydropower.

In 2015, primary energy demand was about +3.4% compared to 2014. The preliminary value for the national energy bill for 2016 is lower than the previous year and it has been decreasing since the peak in 2012.

The energy dependence of Italy from abroad is high compared with the average of the EU27 countries.

In 2015, 44.1% of the energy end-uses total consumption was related to the tertiary sector, 29.3% to the transports sector and 22.3% to the industrial sector. Concerning the electric sector, about 68% of the production was provided by thermoelectric power plants in 2015 (it was 77% in 2010 and about 82% in 1990), the rest is covered by renewable energy sources (hydropower, wind, photovoltaic and landfill gas) whose weight has kept growing in the latest years.

Italy's energy intensity is lower than the EU average mainly due to the shift of the Italian economy from industrial activities to services. Despite the improvement of energy efficiency in the industry sector, the gap with the EU average has reduced in the recent years because consumption patterns in the civil sector have become more energy intensive.

As for passenger transportation, among the EU countries Italy has the third highest motorisation rate (610 cars per 1,000 inhabitants). Mobility demand and, particularly, road transportation shares have increased in the period from 1990 to 2015. The number of vehicles for road transportation has kept growing steadily over the last two decades, and the circulating passenger car fleet has been gradually aging.

The energy demand in the transportation sector has increased in the period 1990-2015, with significant increases in the consumption of natural gas, diesel, LPG, renewable and electricity. Transport sector keeps depending almost completely on oil. Under the EU legislation setting standards and mandatory targets in the manufacturing of new cars, CO_2 emission per km from new cars is targeted to decrease over time; in Italy, CO_2 emissions from passenger cars have been decreasing along the last two decades (2015 emissions level is lower than in 1995).

Main drivers of GHG emission trends for Agriculture are the number of animals, the variation of cultivated surface/crop production and use of nitrogen fertilizers. Trends and changes of these parameters at national level have also been affected by the implementation of the Common Agricultural Policy (CAP) in the European legislation. Changes in livestock populations have occurred since 1990. The total agricultural area, the utilized agricultural area and the number of agricultural holdings have been decreasing since 1982, resulting in the noticeable increase of the average size of the Italian agricultural holdings along the same years. As for the use of fertilizers, in the last decade the decrease in the use of mineral products with a corresponding increase of organic formulated products is in line with the CAP and it is also a consequence of the trend of the fertilizers market prices.

In Italy over the last two decades, changes in the land use has resulted in the increase of the forested area, of the grassland area and of the settlement area; a reduction of cropland area compared to 1990 is also observed. Italian land surface belonging to “Forest” category was about 31% of our national land surface in 2015. Although the forest expansion has been decreasing during the last decade, Italian forested area is spreading due to the dismissal of agriculture practices, mostly in mountain zones, and to the natural conversion of cultivated lands and grazing into forests.

In 2015, forested areas affected by fires amount to approximately 37.7% of the total land surface burned by fire in the same year.

The production of municipal waste in Italy increased between 1990 and 2005, it has remained approximately around 30 Mt since 2013. A reduction trend can be observed for the last years in Italy, driven mainly by changes in life style and consumption patterns more than the enforcement of waste legislation. The international crisis of the economy has contributed too. In 2015, the amount of municipal waste per year and per person was lower than the previous years in Italy.

The production of special waste by manufacturing industries had been increasing since 1990 (about 40 Mt in 2010), but in 2015 it decreased (26.5 Mt). Although separate collection rates vary across the country, an overall increasing trend since 1996 can be observed, but figures are still lower than national targets set by the legislation.

Since early ‘90s, landfilling as a waste disposal practice has been decreasing also due to changes in national policies which support other waste treatments (e.g. incineration; mechanical-biological treatment; composting; anaerobic digestion; etc.).

The number of incineration plants in 2015 is approximately the same as in 1990, after a peak experienced in 2010; the share of waste treated in installations with energy recovery systems was 99% in 2015.

The production of special waste has been increasing since 1990, reaching 132.4 Mt in 2015; the correlation between special waste production trend and the Italian GDP trend is good: especially for the last years, the ups and downs in the special waste production trend are related to the trend of the national economy. It is worth noting that the amount of special waste destined to the recovery of material has been increasing for the last years and landfilling of special waste has been reducing for the same years.

1.2 Greenhouse Gas Inventory

Total greenhouse gas emissions, in CO_2 equivalent, excluding emissions and removals from land use, land use change and forestry (LULUCF), have decreased by 16.7% between 1990 and 2015, varying from 520 to 433 CO_2 equivalent million tons (Mt).

The most important greenhouse gas, CO_2, which accounts for 82.5% of total emissions in CO_2 equivalent, shows a decrease by 17.9% between 1990 and 2015. In the energy sector, in particular, CO_2 emissions in 2015 are 15.6% lower than in 1990.

CH_4 and N_2O emissions are equal to 10.0% and 4.2% of the total CO_2 equivalent greenhouse gas emissions, respectively. CH_4 emissions have decreased by 20.3% from 1990 to 2015, while N_2O has decreased by 32.5%.

As for other greenhouse gases, HFCs account for 2.8% of total emissions, PFCs and SF_6 are equal to 0.4% and 0.1% of total emissions, respectively; the weight of NF_3 is less than 0.01%. Among these

gases, HFCs show a strong increase in emissions, and the meaningful increasing trend will make them even more important in next years.

The share of the different sectors, in terms of total emissions, remains nearly unvaried over the period considered.

Specifically, the energy sector is the largest contributor to national total GHG emissions with a share, in 2015, of 81.8%. Emissions from this sector have decreased by 15.8% from 1990 to 2015; in particular, an upward trend is noted from 1990 to 2004 (+13.6%) in total greenhouse gas emissions in CO_2 equivalent excluding LULUCF, whereas a reduction by 25.8% between 2004 and 2015 is observed. From 2004, GHG emissions from the sector are decreasing as a result of the policies adopted at European and national level to implement the production of energy from renewable sources and, from the same year, a further shift from petrol products to natural gas in producing energy has been observed.

Emissions from industrial processes and product use account for 6.9% of total national GHG emissions, excluding LULUCF. Total emission levels, in CO_2 equivalent, reduced by 25.7% from 1990 to 2015.

The decrease is prevalently to be attributed to the drop of emissions in the mineral and chemical industries, explaining 71.1% and 18.9%, respectively, of the sectoral total. Emissions from mineral production decreased by 46.3%, mostly for the reduction of cement production whereas the reduction in chemical industries (-71.9%) is due to the general reduction in the level of productions and the introduction of abatement technologies especially in the production process of nitric and adipic acid.

The agriculture sector is also contributing with a 6.9% to total greenhouse gases, excluding the LULUCF sector. Emissions mostly refer to methane and nitrous oxide levels, which account for 61.6% and 37.0% of total emissions of the sector, respectively. The decrease observed from 1990 to 2015 (-15.9%) is due to the decrease of CH_4 emissions from enteric fermentation (-11.1%) and N_2O from agricultural soils (-18.0%), which account for 46.0% and 29.9% of total agricultural emissions, respectively. Main drivers behind these downward trends are the reduction in the number of animals, especially cattle, as well as the use of nitrogen fertilizers, mainly due to the Common Agricultural Policy (CAP) measures. In addition, there has been a significant increase in the recovery of the amount of biogas produced from animal manure and used in the energy sector for the production of electricity and combined electricity and heat production in the last years.

Finally, the waste sector accounts for 3.6% of total national greenhouse gas emissions, excluding LULUCF. Emissions show a decrease of 10.9% from 1990 to 2015 mainly driven by the reduction of emissions from solid waste disposal (-17.8%), which account for 71.5% of the total sectoral emissions; in fact, despite the continuous increase of waste production, solid waste disposal on land has decreased due to waste management policies in place in the last years, specifically the growth of waste incineration, the composting and mechanical and biological treatment and the increasing practice of recyclable waste collected. At the same time, the increase in the methane-recovered percentage has led to a further reduction in net emissions.

Italy has established a national system, which includes all institutional, legal and procedural arrangements for estimating emissions and removals of greenhouse gases, as well as reporting and archiving inventory information.

The National System for the Italian Greenhouse Gas Inventory was established by the Legislative Decree n° 51 of March 7th 2008. The Institute for Environmental Protection and Research (ISPRA) is the single entity in charge of the development and compilation of the national greenhouse gas emission inventory. The Institute annually draws up a document which describes the national system including all updated

information on institutional, legal and procedural arrangements for estimating emissions and removals of greenhouse gases and for reporting and archiving inventory information.
As for the official consideration of the inventory, the Italian Ministry for the Environment, Land and Sea is responsible for endorsement and for communication to the Secretariat of the UN Framework Convention on Climate Change and the Kyoto Protocol. The inventory is also submitted to the European Commission in the context of the Greenhouse Gas Monitoring Mechanism.
A complete description of the Italian National System can be found in the document "National Greenhouse Gas Inventory System in Italy. Year 2016" (ISPRA, 2016), publicly available at http://www.sinanet.isprambiente.it/it/sia-ispra/serie-storiche-emissioni.
As single entity, ISPRA is responsible for all aspects of national inventory preparation, reporting and quality management. A specific unit of the Institute is in charge of the management of the emission inventory. Activities include the collection and processing of data from different data sources, the selection of appropriate emissions factors and estimation methods, the compilation of the inventory following the QA/QC procedures, the assessment of uncertainty, the preparation of the National Inventory Report and the reporting through the Common Reporting Format, the response to the review processes, the updating and data storage. The website address where all the information related to the inventory can be found is: http://www.sinanet.isprambiente.it/it/sia-ispra/serie-storiche-emissioni.
The 'National Registry for Carbon sinks', instituted by a Ministerial Decree on 1st April 2008, is part of the Italian National System.

ISPRA is also responsible for the administration of the national section of the Union Registry under the European Directive 2009/29/EC, as set out by the Legislative Decree N. 30 of 13 March 2013. The Institute performs these tasks under the supervision of the national Competent Authority.
The registry is operated by the European Union through the centralization of the EU ETS operations into a single European Union registry, as established by the Directive 2009/29/EC. With a view to increase efficiency in the operations of their respective national registries, the EU Member States who are also Parties to the Kyoto Protocol (25) plus Iceland, Liechtenstein and Norway decided to operate their registries in a consolidated manner in accordance with all relevant decisions applicable to the establishment of Party registries, in particular Decision 13/CMP.1 and decision 24/CP.8.

1.3 Policies and Measures

The policies and measures taken by Italy to mitigate climate change are driven by the commitment undertaken under:

- the Kyoto Protocol target: for the period 2008-2012 in the framework of the EU Burden Sharing Agreement, Italy has committed to reduce its greenhouse gas emissions by 6.5% below base-year levels (1990). Moreover, to ensure no gaps occurred between the end of first commitment period of the Kyoto Protocol in 2012 and the new global agreement, expected to become fully operational from 2020, the 'Doha Amendment to the Kyoto Protocol' for the 2013-2020 period was adopted on 8 December 2012. The EU and its Member States have committed to this second phase of the Kyoto Protocol and have established to reduce their collective emissions to 20% below their levels in 1990.

- the "EU Climate Energy Package" for the period 2013-2020: the 8th and 9th March 2007 conclusion of the European Council named "Integrated Energy and Climate Change Package" (IECCP) commits to European Member States to achieve by 2020, 20% reduction of EU greenhouse gas emissions compared to 1990, 20% reduction in energy use to be achieved by improving energy efficiency, 20% use of renewable energy, 10% use of biofuels in the transport sector. A comprehensive set of legislation act was agreed at EU level and is being implemented to reach those objectives and according with that all the national emissions should be divided, starting from year 2013, in two main sectors:
    - EU – ETS sector: the EU-ETS was established by the Directive 2003/87/EC, this directive has been recently amended by the Directive 2008/101/EC of 19 November 2008 in order to include the aviation sector and by Directive 2009/29/EC of 23 April 2009 that introduces substantive changes in the scheme. The most important one relates to the cap-setting procedure, where the new system will be no longer based on national-cap setting but on an EU single wide cap to be allocated to each operator on the basis of benchmarks.
    - ESD (Effort Sharing Decision) sector: at 2020 Italy should reduce of 13% the GHG emissions, respect the 2005, in all the sectors not covered by the EU ETS, such as transport, civil, agriculture and waste, according with the "*Decision n. 406/2009/EC of the European Parliament and of the Council of 23 April 2009 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 (ESD*)".

On the 12th December 2015, UNFCCC Decision 1/CP.21 adopted the Paris Agreement, a new international agreement aimed at reducing GHG emissions. Decision 1/CP.21 also welcomes the submission of Intended Nationally Determined Contributions (INDCs). The European Union submitted an INDC committing its Member States to reduce its overall GHG emissions by at least 40% by 2030, comparing to 1990 levels. The new Framework contains the following binding targets to be reached by 2030: at least 40% reduction in GHG emissions compared to 1990 (-43% and -30% by 2030, compared to 2005 levels, for EU ETS sectors and ESD sectors, respectively), at least 27% of energy consumption from renewable sources, at least 27% of energy efficiency improvements. Moreover, as a follow-up of the EU Effort Sharing Decision (ESD), on the 20th July 2016 the European Commission presented the Effort Sharing Regulation (ESR) proposal, which assigns to Italy a 33% GHG emissions reduction target for sectors not covered by ETS, to be achieved by 2030 compared to 2005 levels.

The potential emissions reductions of the policies and measures has been assessed up to 2030 and the policies and measures have been divided into two types : implemented measures by 31st December 2014, plus the Interministerial decree June 26th 2015 "Minimum requirements for buildings" and planned measures as of 31st May 2017.

In particular have been reported:

- Cross sectoral measures that include the Legislative Decree N. 28 of 3rd March 2011 that defines the mechanisms, the incentives and the institutional, financial and legal tools necessary to achieve the 2020 targets regarding the renewable energy use; the 28th December 2012 decree, the so called "Conto Termico" decree, that implements the incentive scheme introduced by Legislative Decree 28/2011, the White Certificates system, aimed at promoting energy efficiency and delivering emission reductions in all the energy end-use sectors, , the legislative decree 20/2007 on the eco-design of energy-using products and the structural funds 2007-2013.

- Energy efficiency measures that include cogeneration currently supported by incentive schemes, energy efficiency in the civil sector through specific actions targeted for existing and new buildings and appliances; mandatory use of biofuels and infrastructural projects, intermodal and fleet update measures in the transport sector.
- No Energy measures that include implementation of the most advanced technology to reduce the N_2O emissions in plants for the production of nitric acid; emission reduction from agricultural soil and electricity generation from animal waste in the agriculture sector; compliance with separate collection targets and reduction of biodegradable waste disposed into landfills in the waste sector. All this measures have been considered implemented.

The total GHG reduction for the implemented measure can be estimated as 51,090 kt CO_2eq at 2020 and 4,000 kt CO_2eq at 2030, regarding the planned measures the reduction impact can be estimated as 12,209 kt CO_2eq at 2020 and as 38,124 kt CO_2eq at 2030.

1.4 Projections and Effects of Policies and Measures

GHG emissions for the latest available inventory year (2015) report a decrease of 16.7% and 25.3% with reference to 1990 and 2005, respectively. Italy's share within the EU target is to achieve a 13% emissions reduction by 2020 with respect to 2005 in the non-ETS sector. The reduction target for non-ETS sector to be achieved in 2030 is still under negotiation among EU Member States, although a provisional target has been set to -33% with reference to 2005 level. According to the WM scenario, Italy is in line to meet 2020 targets, while there is a sizeable distance between projections and targets proposed for 2030.

The scenario presented in this NC was elaborated in 2016 and projections include all PaMs implemented or adopted up to the end of 2014 and minimal efficiency standards for buildings adopted in 2015. The scenario has been geared taking account of the most recent energy scenarios and specific estimates on non-energy source emissions.

The projection data are reported by sector and by gas, with a brief explanation of trends. The effect on 2020 EU target and provisional 2030 EU target are reported. GHGs emissions from combustion are drawn from the partial equilibrium model TIMES. The scenario shows that gross inland consumption in 2020, estimated according to Eurostat methodology, will be about 154.8 Mtoe, very close to 1990 level. From 2020, gross inland consumption is expected to continue decreasing until 150.4 Mtoe in 2025, to remain then constant up to 2030.

The scenario takes into account the effects of the economic crisis, that has hit all national activities, and the evolution trend is based on the current economic recovery and the development of low carbon technologies, mainly for the electricity generation sector, and efficiency enhancements in the civil sector.

Finally, an historical review of projections from different National Communications is reported in order to get an insight in emissions trends that would have been occurred without the economic crisis and measures implemented after 2007.

1.5 Vulnerability assessment, climate change impacts and adaptation measures

Italy is located in an area identified as particularly vulnerable to climate change. Climate observations already confirm an increase of the average temperature as well as an upward trend in extreme

temperatures. Climate projections highlight a general warming by the end of XXI century, along with a general reduction in precipitation, especially according to the RCP8.5 scenario. Projections also show an increase in heavy precipitations and extreme temperatures. Italy is prone to natural hazards and climate change is expected to increase its vulnerability to climate-related hazards over the next decades.

The Italian National Adaptation Strategy (NAS) to climate change analyzes the state of scientific knowledge on impacts and vulnerability to climate change for the major socio-economic and environmental sectors, namely: water resources (quality and quantity), desertification, land degradation and drought, hydrogeological risk, biodiversity and ecosystems (terrestrial, marine, inland water and transition ecosystems), forestry, agriculture, aquaculture, fishery, coastal zones, tourism, health, urban settlements, critical infrastructures (cultural heritage, infrastructure and transport, industrial hazards), energy, and 2 special cases - mountain areas (Alps and Apennines), Po river basin.

The main methods used to perform the assessment were the review of existing literature and experts appraisal. The Italian Ministry for the Environment, Land and Sea (IMELS), that is the institution in charge of climate policy, also conducted a public consultation on the perception of the risks of climate change and on the general concept about adaptation, and an “ad hoc” public consultation for the involvement of citizens and stakeholders.

In order to lay the foundation of a multilevel governance on adaptation, an horizontal coordination took place through an Institutional Panel, which involved representatives of the different ministries and other institutions such as the Department of Civil Protection, regional committees, the national association of Italian municipalities and the Union of Italian Provinces. The IMELS also established an Interregional Panel with the national State-Regions Commission for climate change, with the aim to build the ground for adaptation, having in mind the needs and the perspective of all actors involved in the process of tackle climate change and its impacts.

The NAS also proposed a portfolio of adaptation actions based on three approaches: 'soft' (i.e. managerial, legal and policy approaches), 'green' (i.e. ecosystem based approaches) and 'grey' (i.e. technological and engineering solutions) and two implementation terms: short and medium term. The NAS is planned to be updated within five years.

The ongoing process toward a National Adaptation Plan, started in 2016, is currently taking into consideration the need for a Monitoring, Reporting and Evaluation of adaptation, which will be then defined within the NAP framework.

1.6 Financial resources and transfer of technology, including information under Articles 10 and 11 of the Kyoto Protocol

Italy is undertaking continuous efforts to scale-up its international climate finance as demonstrated by the substantial increase of its public climate finance in the period 2015-2016 compared to the levels of previous years (2013-2014), while improving the quality and transparency of its reporting.

Total public climate specific support that is currently being reported amount, for the biennium 2015-2016, to 729,75 million US dollars. This represents more than a 70% increase compared to the public climate specific support reported for the biennium 2013-2014, amounting to 428,76 million US dollars. The total public climate specific support for the period 2013-2016 amounts to 1.158,51 million US dollars.

In the provision of public financial resources, Italy aims to strike a fair balance between mitigation and adaptation over time. Direct support for adaptation in the period 2015-2016 increased more than five times compared to previous years. The adaptation component in 2015-2016 represents 53% of the total public climate finance addressing mitigation and adaptation, without considering crosscutting activities.

In this context, the Italian development cooperation aims at effectively mainstreaming environmental and climate considerations into its activities. Starting from 2015, the Italian Government allocated additional financial resources to the international development cooperation. On top of these resources, the commitment of Italy to tackle climate change and related support to developing countries is strongly expressed in Decree nr.30 (DLGS n.30 13/03/2013).

The Italian Government increased its efforts on international activities on climate change, over the past four years through:

- contributing to multilateral funds and development banks, dedicated to reduce the impact of human activities on climate change, and to support adaptation actions;
- supporting mitigation and adaptation measures in developing countries across different regions particularly in most vulnerable countries, particularly in Africa and Pacific Small Islands;
- strengthening capacity building in least developing countries.

Since 2015, the Italian Ministry for the Environment signed 31 new bilateral agreements with developing countries including regional groups to support mitigation and adaptation actions, to facilitate access to climate finance, to provide capacity building and technology transfer. Priority actions have been focused on 8 areas: management of extreme events, promotion of renewable energy and energy efficiency, water resources management, waste management, air quality, address forest degradation, land rehabilitation and soil improvement, sustainable mobility.

Many Italian adaptation, mitigation and technology transfer programmes are administrated by bilateral agreements. However, Italy plays a pivotal role in some significant multilateral organizations, such as the World Bank (WB), the Green Climate Fund (GCF), the Global Environment Facility (GEF), the Least Developed Countries Fund (LDCF), the Adaptation Fund (AF), the Food and Agriculture Organisation (FAO) and the African Development Bank (ADB).

1.7 Research and systematic observations

In the last years Italy made a particular effort to improve the research sector. The new national research policy (PNR - Programma Nazionale per la Ricerca 2015-2020) aims at strengthening the research system in the context of European and international cooperation and competition. It coordinates Italian research programmes within the European Horizon 2020 framework, in order to align objectives, find synergies and improve the results at international level. For this reason, Italy shares the same priorities of all EU countries and climate change is among the most impelling. The PNR 2015-2020 increases funding for research up to € 2.5 billion. Also other programmes contribute to finance climate change research projects: the National Research Programme in Antarctica (PNRA – Programma Nazionale di Ricerca in Antartide) and the Strategical Plan for Research and Innovation in the agricultural, food and forestry sectors 2014-2020. In this policy frame, Italy increases its participation to European and international research activities, contributing significantly to climate science.

In the field of climate prediction and simulation, through CMCC Foundation, Italy developed a new Earth System Model (CMCC-ESM) for seasonal–to–decadal (S2D) forecasting. CMCC Foundation also provided new high-resolution protocols and flagship simulations for the World Climate Research Programme (WCRP)'s Coupled Model Intercomparison Project (CMIP6) and for CORDEX Programme. Moreover, Italy published the results of regional simulations using the COSMO-CLM Model with high resolution to obtain more detailed climate analysis and scenarios, that can be used for impact models (evaluation of climate change effects on different hydrogeological hazards).

Concerning systemic observations, Italy is equipped with a comprehensive domestic observation network, which covers all the national territory in the field of atmosphere, land, ocean and space and it also contributes to international observation programmes.
The Italian Air Force Meteorological Service, ENEA, CNR, ISPRA, several Universities, the Civil Protection and the Regional Environmental Agencies manage all together the atmosphere surface stations network. In particular, the network of Air Force Meteorological Service contributes to the main international observing systems: the GCOS Surface Network (GSN), the GCOS Upper Air Network (GUAN) and the GAW (Global Atmospheric Watch). Besides their stations networks in Italy, Italian institutions also manage polar stations in Arctic and Antarctica: Thule High Arctic Atmospheric Observatory (Greenland), the Italian Arctic Station Dirigibile Italia (Svalbard Islands), the Italian Meteo-Climatological Antarctic Observatory (Antarctica) and the International Center for Earth Sciences, together with the Argentina Dirección Nacional Del Antártico (Jubany, Antarctic Peninsula). All the data collected by the network are standardized by ISPRA and transmitted to EEA (European Environmental Agency) and to other international bodies such as EMEP (European Monitoring and Evaluation Programme).
Italy also contributes to ocean observation, providing data from its in-situ and satellite monitoring systems to international initiative such as: GOOS initiative (participating to EUROGOOS and MONGOOS); EU Copernicus Programme (Italy manages the Mediterranean Monitoring and Forecasting Centre, the Ocean Color Thematic Assembly Centre and it contributes to CMEMS in-situ TAC and Global Ocean Reanalysis); ARGO and REC-MMO-Med (Hub for marine meteorology and oceanography). Italian institutions operate several ocean observing stations, among them the Mareographic station of Trieste and the Oceanographic Observatory of Lampedusa.

Italy is active in land and ecosystems monitoring, through domestic programmes, such as CONECOFOR (Forest Ecosystems Controls) and the INFC (National Inventory of Forests and forest Carbon pools) and international projects, such as eLTER, ECOPOTENTIAL and ETS-ICOS.
Italy is also equipped with a satellite earth observation system: the COSMO-Sky MED. The country is member of the Polar Space Task Group (PSTG) for the study of ice sheets, permafrost, snow and floating ice and of the CEOS (Committee on Earth Observations Satellite) for the coordination of more than 30 civil space-based EO programmes.

Finally, Italy directly contributes to capacity building through the participation of several Italian institutions in international and national climate change-related projects in developing countries.

1.8 Education, training and public awareness

Over the last years Italy has made important progress in improving education and training system thanks to the Law 13th July n.107 "La Buona Scuola" introducing a comprehensive reform of the school education system. This progress reflected also on environmental education, education to sustainability and on climate change and adaptation by the issue of new "**Guidelines for Environmental Education and Sustainable Development** by the Ministry of Environment, Land and Sea (IMELS) in collaboration with the Ministry for Education, University and Research (MIUR) covering a number of thematic issues (biodiversity, food, climate change, transport, water, cities..), and differentiated for each level of school. In addition to this, in November 2016 IMELS and MIUR signed a new Programme of commitments: the "**Rome Charter**", from biodiversity to mobility, from digital communication to climate change. The Rome Charter is also aimed at supporting the implementation of the renewed Italian National Strategy on Sustainable Development as well as the 2030 Agenda Objectives.

Al local level, Regional Environmental Agencies, Regional and Provincial Administration and municipalities are continuing to play an important role in promoting and implementing teaching and learning paths on climate change issues and awareness raising initiatives.

In order to raise public awareness with specific reference to Climate Change, in view of the UN COP21 in Paris, Italian Government held, in Spring 2015, the **States General on Climate Change** presenting an overview of the risks, actions and opportunities related to climate change, and invited the "Italian system" to put climate change at the heart of national policy. In addition it's worth to mention the Global event **Expo Milano 2015,** hosted by the city of Milan from 1 May to 31 October 2015 involving all of Italy's institutions, a unique international event from educational, cultural and scientific viewpoints.

Several communication campaigns aimed at spreading environmental education and information at large and disseminating European environmental policies were organized at national level by IMELS, as the event, called "**States General of Youth on Environment**" in the framework of the Earth Day celebrations in April 2017, and "**All4theGreen**" in Bologna, a set of initiatives aimed at various types of public introducing and "sensitizing" to the G7 Environment 2017 held in Bologna on June 2017.

A strong encouragement to public participation on climate change policies and related measures came also from environmental NGOs and non-profit organizations, welcomed and willingly supported by Italian Ministry of the Environment, as for the initiative "**Italian Youth Think Tank on Intergenerational Equity**" aimed at drafting a policy proposal for the implementation of the intergenerational equity

principle to be included within the global climate change agreement, which was later signed as Paris Agreement.

With reference to training offer of Italian Universities is nowadays very diversified and spread throughout the Italian territory from North to South of the peninsula: long-distance training, Graduate Programs, Summer and Winter Schools, PhD programmes, Master Degrees are active in many Universities as Venice, Padua, Milan, Rome, Bologna, Turin, Genoa and Calabria.

Regarding international cooperation activities Italy is undertaking continuous efforts to scale-up its international climate finance and the Italian Development Cooperation has undergone an important legislative reform introduced by the Law 125/2014 entered into force in August 2014, leading to a new institutional framework designed to make it more effective as well as cooperation policies more consistent.

With regard to environmental intervention lines, the Italian Ministries of Foreign Affairs and International Cooperation (MAECI) and IMELS act often jointly, focusing their environmental support actions on the fragile and more vulnerable ecosystems, in areas subject to desertification, Small Island States and mountains. In particular, the activity of the IMELS is addressed to support actions for the decarbonisation of the economy; for the implementation of measures for efficient use of resources and to support the most exposed countries to the effects of global warming: especially in those developing countries with less resilience capacity and less ability to fight change climate effects.

Following 'Lima Ministerial Declaration on Education and Awareness-raising', reaffirming the importance of **Article 6 of the UNFCCC** in meeting its ultimate objective and in promoting climate resilient sustainable development, and in line with what governments agreed in Paris, to cooperate in taking measures, as appropriate, to enhance climate change-related education, training, public awareness, public participation and public access to information and recognizing the importance of these steps to enhance actions under the Paris Agreement, the Italian **Ministry for the Environment, Land and Sea, appointed its national focal points on Action for Climate Empowerment (ACE)** activities .

In order to provide a platform for sharing and disseminating initiatives and best practices, a permanent section specifically dedicated to environmental education and sustainable development has been created by IMELS on its website. In collaboration with the Italian Ministry of Education "The guidelines on environmental education" and the "Chart on Environmental education and sustainable Development" have been produced. This collaboration aiming at enhancing the implementation of the Doha Work program and toward the definition of a national strategy on Action for Climate Empowerment was strengthened in 2016 with the signing of a Memorandum of Understanding on environmental education and sustainable development in schools under the PON (National Operative Plan) School 2014-2020.

According to the revised guidelines for the preparation of national communications by Parties, a new aspect on education, training and public awareness is being introduced : **"Monitoring, review and evaluation of the implementation of Article 6 of the Convention"** . Since the current edition we have hardly tried to provide some information on the empowerment that the reported initiatives have generated through the introduction of possible indicators. We have tried to identify "when possible" an indicator of the effectiveness or at least of the reaction of recipients to the initiatives.

The indication in numbers has something to do with the “range” of the initiative and does not always correspond with the real impact or the quality and strength of the connected empowerment. With social media for example, through platforms or pages it is more immediate to obtain an acknowledgement of the appreciation or the sharing of the initiatives through some tools such as *“followings”*, *“followers”*, “*I like*”, “*visualizations*” or “*thoughts*” expressing approval, appreciation or commitment. As for education, the recurring indicator measure for the monitoring and the evaluation proved to be the number of students/schools who participated to the initiative.

The way initiatives are implemented and disseminated has changed, from regular live workshop for example, we have passed through the growing phenomena of virtual meetings or “webinar” where every participation can be immediately tracked. Another participation tool like “*Tweets*” on Thematic “*hash tag”* proved to be another useful indicator to monitor the participation or interest to a certain topic. Even public awareness initiatives like campaigns or civic crowd funding reveal a possible indicator, in terms of acceptance and subscription we may have information on the success of the initiative and the interest of the public. As for the access to information, “visitors”, “recipients” or downloads of documents may be representative.

2 NATIONAL CIRCUMSTANCES[1]

2.1 Introduction

This chapter contains relevant information concerning Italy, which helps understanding the national data on emissions trend (which are presented in chapter 3 of this document) and the factors that produce them. The main drivers of the emissions trend, according to the IPCC, are discussed, too, specifically: population dynamics; the rate of urbanization; the mobility for work and study reasons; employment rate; national economy indicators and a short analysis of the most significant macro sectors.

2.2 Generic information

2.2.1 Government profile

Italy is a bicameral parliamentary Republic administratively divided into 20 Regions, which are part of the constitutional structure of the State. Thus, in Italy, a sovereign public entity coexists with other territorial entities, Provinces and Municipalities are lower-level territorial entities too.

The Constitutional law n.3 of 2001 has deeply modified the attributions of powers between the central and the local Governments with the aim to establish a system of administrative federalism. The Regions have legislative powers for matters not expressly reserved to the exclusive competence of the central Government and have the responsibility to administer matters on which they legislate. The Constitutional Law also rearranged the distribution of administrative functions foreseeing an enhanced administrative role for municipalities.

The protection of the environment, of the ecosystem and cultural resources are under the exclusive competences of the central Government. In particular, the Italian Ministry for the Environment was established in 1986 as the Italian Ministry for the Environment and Territory and renamed as IMELS in 2006. The IMELS is responsible for sustainable development, protection of territory, pollution and industrial risks, international protection of the environment, appraisal of environmental impact, nature conservation, waste and clean up, and protection of seas and inland waters. The IMELS is also committed to promote and support international partnership and cooperation towards global sustainable development. In some other sectors as the energy production, transport and distribution, the central Government and the Regions have concurrent legislative powers. Regarding climate change, the IMELS is responsible for elaborating the national plan for the reduction of greenhouse gas emissions to be proposed for adoption to the Inter-Ministerial Committee for Economic Planning[2] (CIPE) – a collective governmental body chaired by the President of the Council of Ministers[3]. The IMELS also adopted the National Strategy for Adaptation to Climate Change in 2015 (for further details, see chapter 6 of this document) pursuant to the adoption of the EU Adaptation Strategy in April 2013 (an evaluation of the implementation and performance of the EU strategy was launched in 2016 and it is scheduled to be completed by the end of 2018). In 2016, the national plan for the implementation of the National Strategy for Adaptation to Climate Change was prepared and in February 2017 a public consultation was

[1] Lead author: Andrea Gagna (ISPRA); Contributing authors: Antonella Bernetti (ISPRA), Antonio Caputo (ISPRA), Eleonora Di Cristofaro (ISPRA), Barbara Gonella (ISPRA), Ernesto Taurino (ISPRA), Marina Vitullo (ISPRA).

[2] http://www.cipecomitato.it/it/index.html

[3] CIPE's resolution n. 17/2013 was adopted to enable Italy to contribute in the achievements of the goals set by Decision EC/406/2009 (on the efforts of Member States to reduce their GHG emissions to meet the EU's GHG emission reduction commitments up to 2020). The measures to be taken are discussed in chapter 4 of this document.

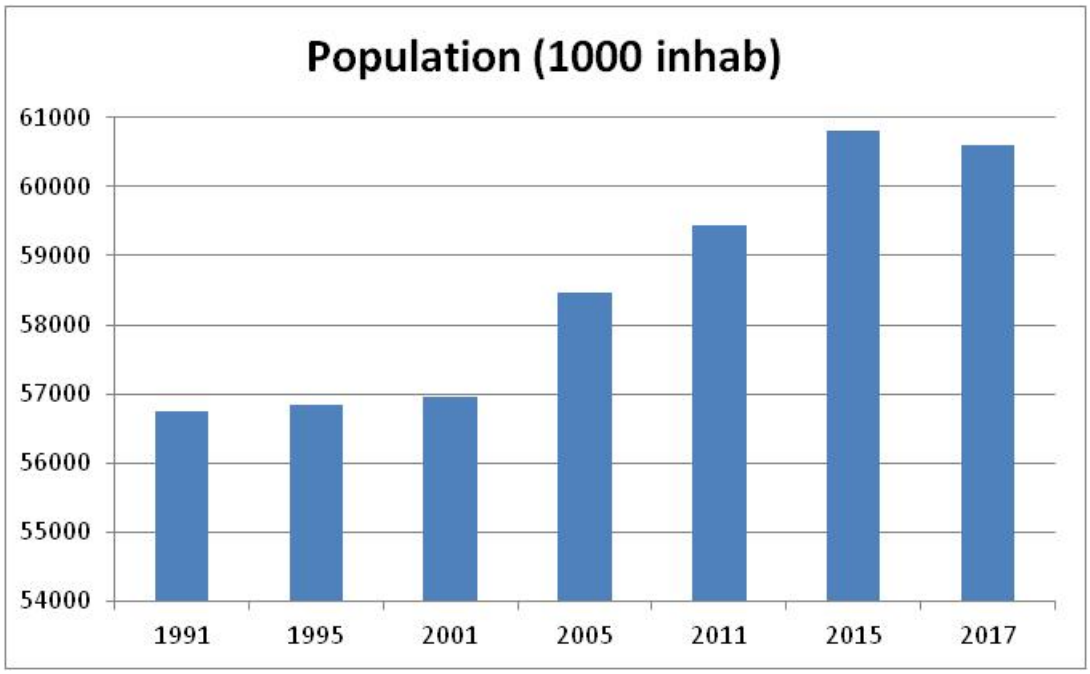
held concerning the national plan.

The national energy policy is within the competences of the Italian Ministry of Economic Development (IMED), the determination of the policy at the specific sector level is based on the general guidelines set by the Government as a whole and by Parliament. The new National Energy Strategy was presented by IMED and IMELS in early 2017 and during June-September 2017 a public consultation was held about it. The final document was adopted officially on 10th November 2017 setting qualitative and quantitative goals to be achieved in 2030 in compliance with the EU binding legislation.

2.2.2 Population profile, urban structure and building stock

Demographic and social trends in countries are generally considered among the main driving forces for the emissions trends. Although changes in the national population have occurred (Figure 2.1) over the last 20 years they have not directly affected the national trend of emissions significantly. The national population was 56.744 million in 1991 (13th national survey) and 56.960 million in 2001 (14th national survey) while it was 59.433 million on October 2011 when the 15th national survey was carried out by the Italian national institute of statistics (ISTAT)[4]. According to the results of the survey, the increase in population, 4.3% compared to 2001, is due to the migratory movements that counterbalance the negative natural trend. In 2011, there were approximately 3 million people more than in 2002 living in Italy; the peaks in migratory movements occurred in 2003-2004, in 2007-2008 and in 2009-2010. The trend in the number of non-EU citizens increased from 2007 to 2010, before undertaking a decreasing path: in 2011, a 39% reduction compared to 2010 was registered, while a further reduction by 3.8% was observed in 2015 compared to 2014[5]. The Italian population is expected to reach about 60.08 million in 2030.

Figure 2.1 - The population (1000 inhabs) of Italy along the last two decades

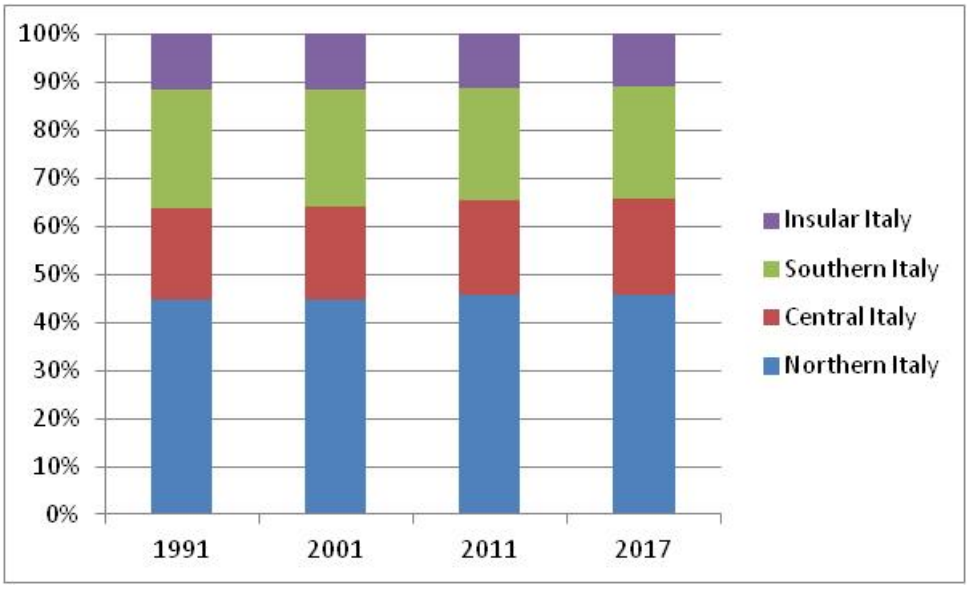


Source: ISTAT (the Italian National Institute of Statistics)

[4] http://demo.istat.it/ , ISTAT
[5] http://noi-italia.istat.it/ , ISTAT

About 46% of the resident population lives in northern Italy, about 20% of the population lives in central Italy, about 23% of the population lives in southern Italy and the remaining 11% lives in the islands (Figure 2.2). Based on the official statistics, increases in the resident population since 1991 have occurred above all in northern and central Italy (especially in north-eastern Italy), while minor increases have occurred in resident population of southern and insular Italy. The distribution of the population may have implications for transport demand and for the development of energy supply infrastructure.

Figure 2.2 - Distribution of the Italian population among four statistical regions



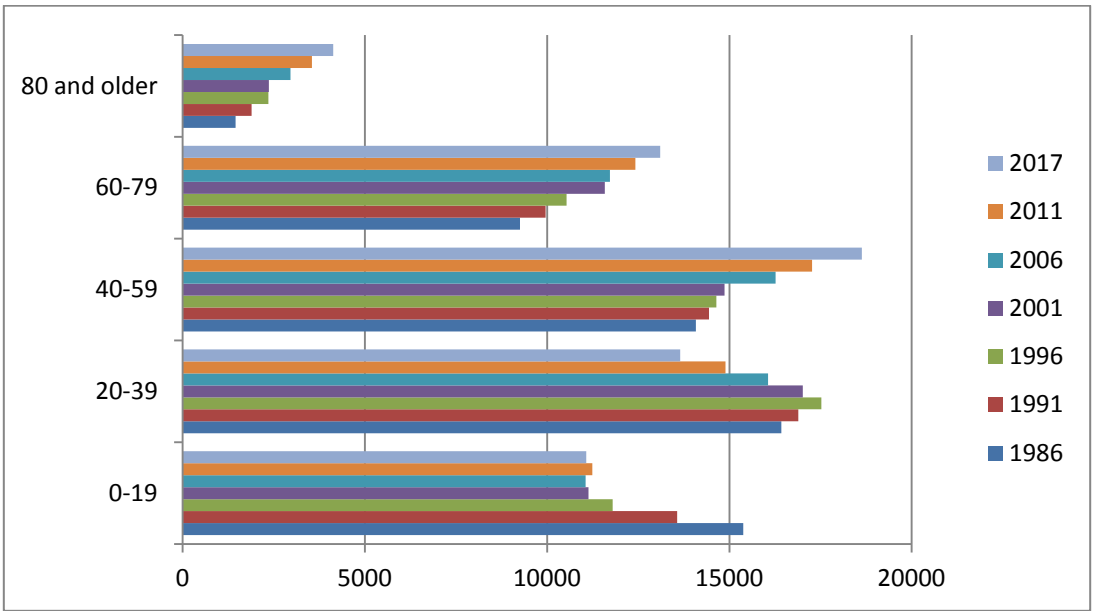
Source: ISTAT, the Italian National Institute of Statistics

The aging trend of population has been increasing due to a low birth rate (about 1.35 children per woman in 2015) and a continuous growth of the elders. Italy is the second European Union country with the oldest population: on 1st January 2016, the median age of the Italian population was 44.7 years[6] (42.6 years is the median age in the EU27[7]) and the Italian old age index was 161.4% in 2016 (123% is the average value in the EU27 in the same year). The extremely elderly people, people aged 80 and older, are 7% in 2017 and they were 6% of the population in 2011 and 4.4% in 2002; they represent a considerable and growing portion of the Italian population (Figure 2.3).

A low birth rate reduces the younger age groups and produces aging from the "foundation" of the population pyramid, an increasing age index (Figure 2.4, and 2.5) describes the aging "at the top" of the population pyramid. The two factors combined point out that the proportion of population of working age has been shrinking and those even positive migratory movements from abroad cannot avoid the imbalance in the ratio of the young to the elders from occurring.

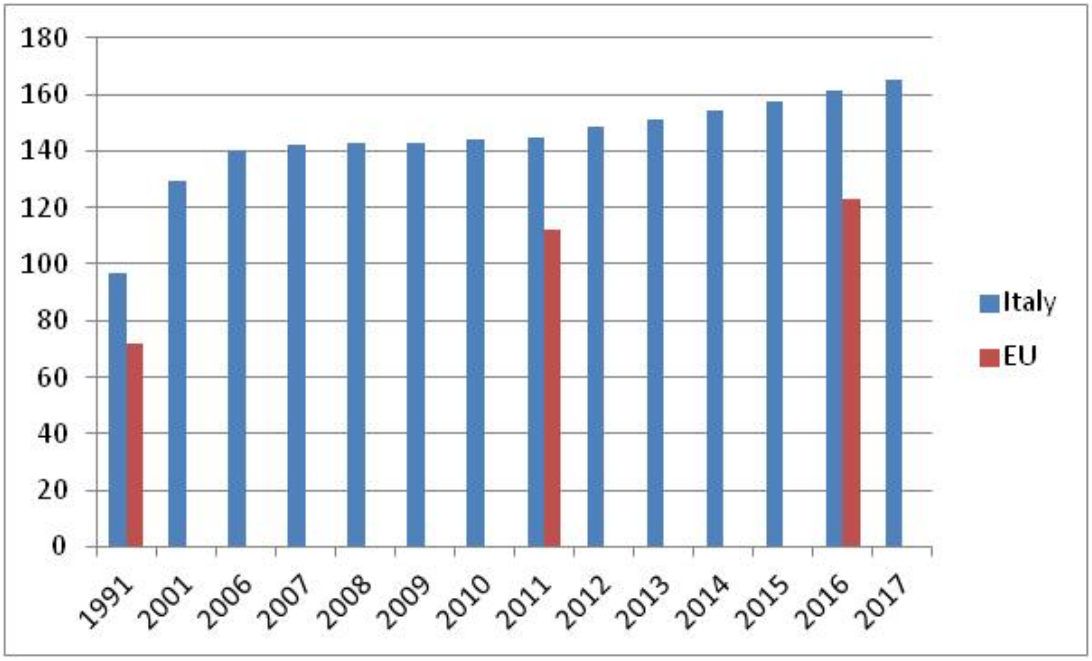
[6] ISTAT, http://dati.istat.it/
[7] EUROSTAT, http://ec.europa.eu/eurostat/statistics-explained/index.php/Population_structure_and_ageing

Figure 2.3 - Distribution of Italian population (1000-inhabitants) in age classes through the last three decades



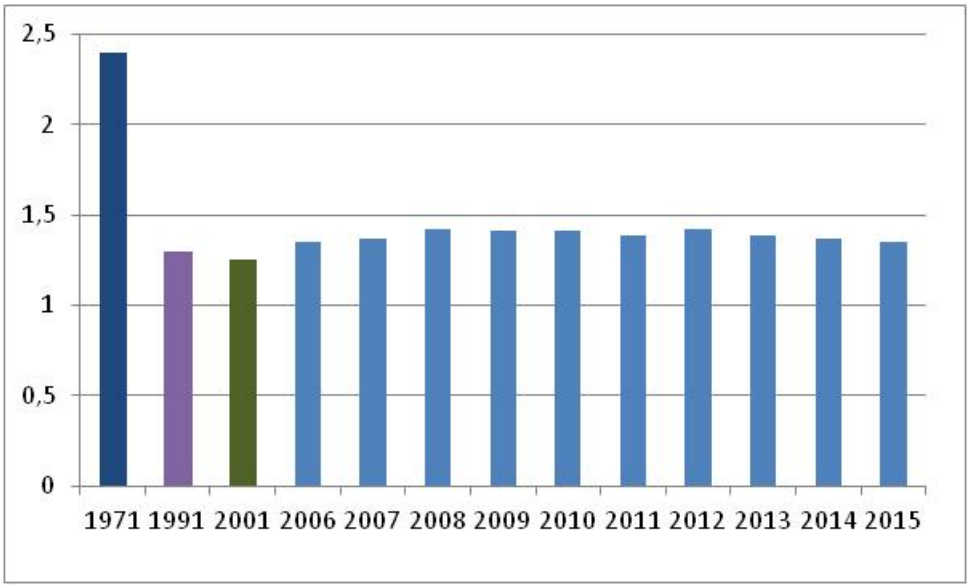
Source: ISTAT, the Italian National Institute of Statistics

Figure 2.4 - Age index in Italy along the last decade (EU average values are in red)



Source: ISTAT, the Italian National Institute of Statistics

Figure 2.5 - Birth rate in Italy along the last decade and birth rates in 1971 and 1991

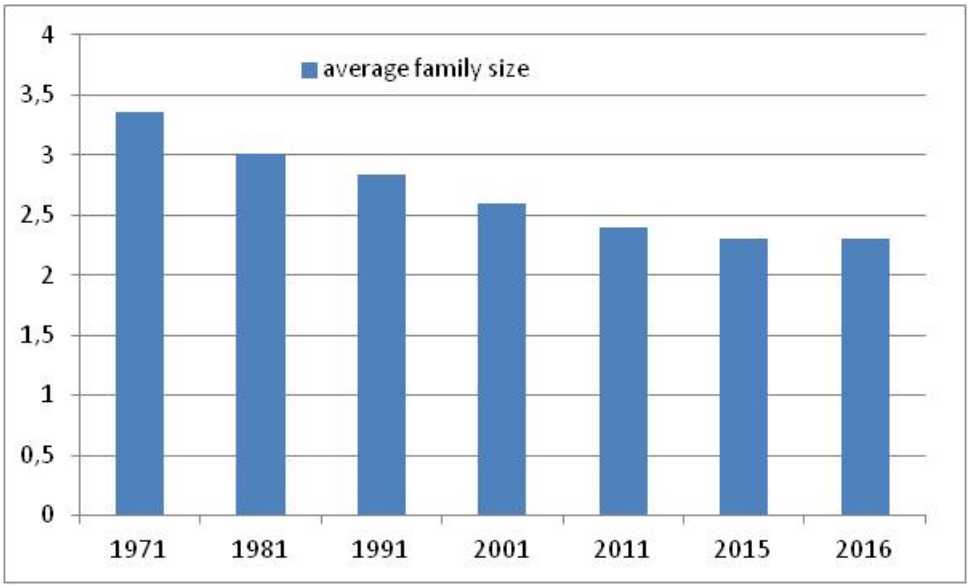


Source ISTAT, the Italian National Institute of Statistics

Another characteristic which may affect efficiency consumption patterns and emissions is the average family size (Figure 2.6). In general, small average family size implies greater consumptions, because of a larger acquisition and use of durable goods as household appliances, cars, etc., previously shared among a greater number of people. According to the results of annual surveys concerning Italian families, over the last decade more than 90% of the families lives in dwellings with domestic heating (92% in 2009), a washing machine (97,4% in 2009) and a dishwasher (42.2% in 2009); the share of families living in dwellings with an air conditioning system has been increasing since 2001 (10.7% in 2001; 20.9% in 2005; 30.4% in 2010; and 38.6% in 2016)[8]. In Italy, according to the National Institute of Statistics, there are 25.775 million families in 2016 with an average size of 2.3 people per family. The family size decreased from 3.4 to 2.6 people in the period 1971-2001, while the average value for the years 2013-2015 is 2.4 people per family[9].

[8] "ISTAT, National Institute for Statistics
[9] ISTAT

Figure 2.6 - Average family size in Italy along the last four decades



Source: ISTAT, the Italian National Institute of Statistics

Another factor affecting Italian GHG emissions per capita is the mobility demand for work and study, which is due to the mismatch between the residential areas and the areas where the economic activities are concentrated, the so-called local labour market areas. Based on the official statistics, it is possible to state that in 2015 about 11% of the Italian population walk to reach their work place, while about 90% goes to work by public or private transportation means. Specifically, about 80% of people goes to work by private transportation means, about 10% of people uses public transport to go to work, approximately 3% of people goes to work by bicycle.

The population density in Italy has increased in the last decade from 189.7 inhabitants per km^2 in 2002, to 201 inhabitants per km^2 in 2015. In fact, in Italy there were 8,046 municipalities in 2015: 5,650 (about 70%) have less than 5,000 inhabitants (17% of the Italian population); 2,350 municipalities (about 29%) have a number of inhabitants ranging from 5,000 to 100,000 (60% of the Italian population); the remaining 46 municipalities have more than 100,000 inhabitants (about 23% of the Italian population) which also correspond to about 3.4% of the total national area. On 31st December 2015, 46 municipalities had a population exceeding 100,000 inhabitants: 25 municipalities out of 46 had more than 150,000 inhabitants, 6 out of 46 more than 500,000 and 2 out of 46 (Rome and Milan) had more than 1,000,000 inhabitants.

As regards the building stock, according to the National Institute of Statistics, in Italy there were about 19.7 million occupied dwellings in 1991, 24 million in 2011 and 24.13 million in 2015. In the period 1991-2015, the number of dwellings has increased by about 22.3%, the population by about 6.8% and the number of families of around 21%. Although new buildings are more energy efficient, the increase in number of families and dwellings has resulted in an increase in residential energy demand through the last two decades.

2.2.3 Climate and geographic profile

Italy is located in the Southern part of Europe and includes the Italian peninsula, that from the Alps

stretches into the Mediterranean Sea, and several islands including Sicily (the largest in the Mediterranean Sea) and Sardinia. The Alps mountain range is the Italian natural northern border which separates Italy from the rest of Europe. The total national area is 301,340 km^2, about 40% of the total national area is mountainous.

In Italy about 871 areas can be found in the 2010 revised list of protected areas[10]:

- 24 National Parks,
- 27 Marine Protected Areas,
- 147 State Natural Reserves,
- 3 Other National Protected Areas,
- 134 Regional Natural Parks,
- 365 Regional Natural Reserves,
- 171 Other Regional Natural Protected Areas

About 10.5% of the national surface over land is included in protected areas.

The Italian peninsula lies between latitudes 47° and 35° N and longitudes 6° and 18° E, it is nearly in the middle of the temperate area of the boreal hemisphere.

Being Italy surrounded by sea, Italy's climate is temperate Mediterranean.

From the Alps to Sicily there are 11 latitude degrees. The peninsula is divided into two versants from Apennines, and the continental part of the country is surrounded by Alps.

Italy's climate is formally divided in four types, characterized by specific features:

- Alpine climate, dominant on Alps and northern and central Apennines, characterized by night and winter low temperatures and moist summer;
- Mediterranean climate, in the island and in the southern Italy, characterized by mild temperatures and moist winter;
- Peninsular climate, peculiar of the central part of the peninsula, characterized by mild temperatures along the coast and in the prompt hinterland (in the middle where the altitude is high there is an alpine climate), moist in spring and autumn;
- Po valley climate, with low temperatures in the winter, high in the summer, moist in spring and autumn.

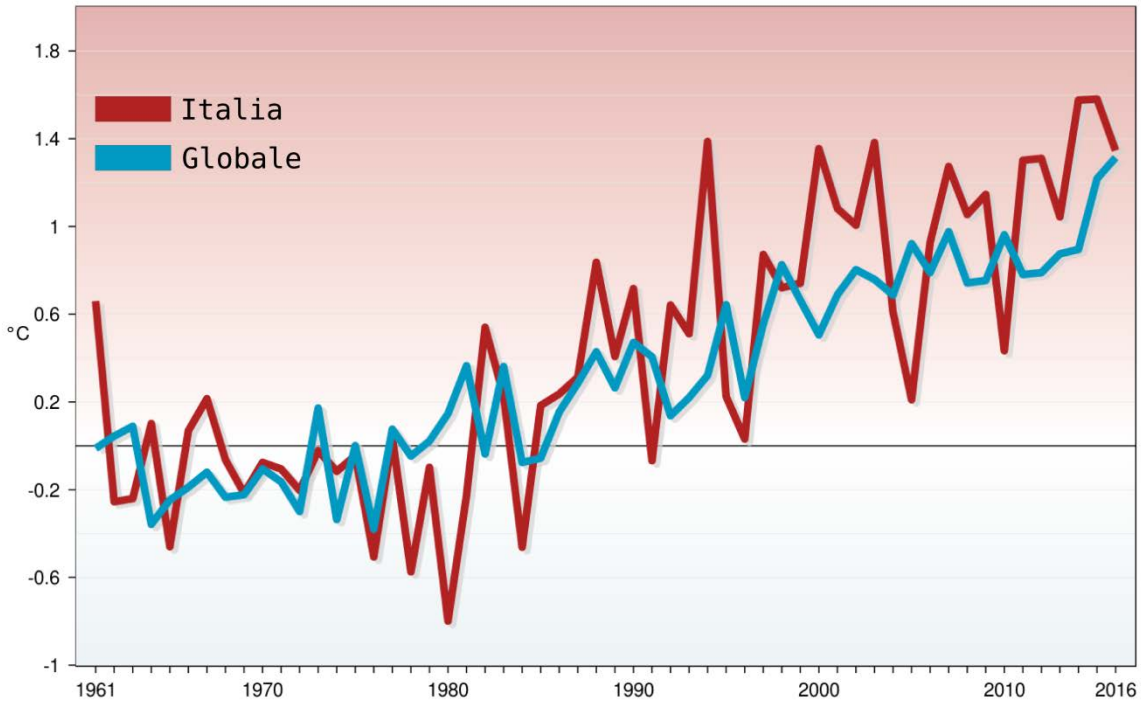
With these features, domestic heating is required through winter months and the use of air conditioning systems during summer months has been increasing in the last decade.

Regarding the climate state and variations over Italy, temperature and precipitation trends are updated every year based on climate data, indices and indicators gathered through the National System of climate data (SCIA, www.scia.isprambiente.it) and reported on the annual bulletin published by the National System for Environmental Protection (SNPA)[11] .

[10] Supplemento Ordinario alla Gazzetta Ufficiale n.125 del 31 Maggio 2010 – Serie Generale

[11] "Gli indicatori del clima in Italia nel 2016, XII Ed.", ISPRA – Stato dell'Ambiente N. 72/2017

Figure 2.7 - Time series of the inland average thermal deviation at world scale and in Italy, compared with normal climatic values 1961-1990



Sources: NCDC/NOAA and ISPRA. Data processed by ISPRA.

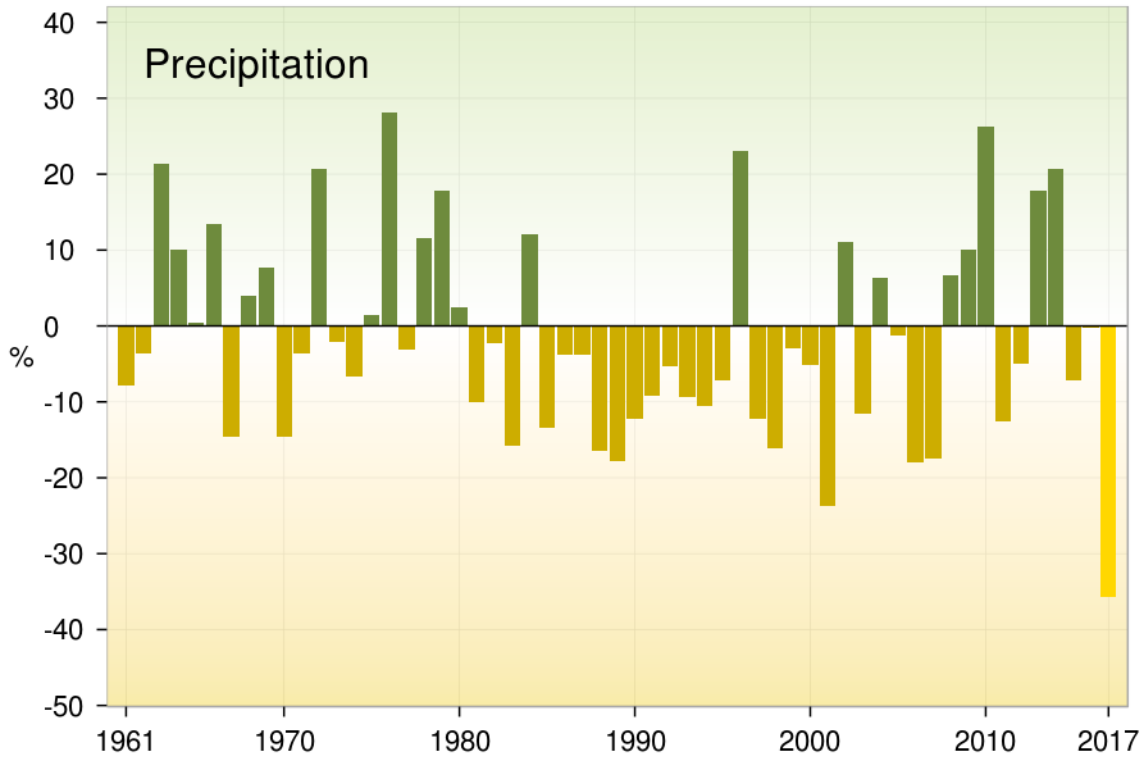
While at the global scale year 2016 resulted again, for the third consecutive year, as the warmest in the historical record, in Italy it was the sixth among the warmest years, with a mean temperature anomaly of 1.35°C with respect to the climatological normal 1961-1990 (Fig. 2.7). However, the first 8 months (January-August) of 2017 have been the warmest of the whole record, with a projection of the annual mean temperature anomaly of about 1.9 °C.

Like the 10 previous years, 2016 has been warmer than the reference climatological normals also for the extreme temperature indices (heat waves, expressed by the *Warm Spell Duration Index*; number of summer days, tropical nights and frost days); however, 2016 doesn't rank as one of the five warmest years. Instead, from provisional data August 2017 has been the warmest of the whole series, with an intense, prolonged heat wave throughout the month, registered almost in the whole national territory; new maximum temperature records were set in many Italian regions.

As for the sea surface temperature of the Italian seas, 2016 ranks as the 4th warmest year after 2015, 2012 and 2014, with a mean anomaly of +0.99°C with respect to 1961-1990.

Mean cumulated precipitations in 2016 have been about 6% lower than the average, with significant differences among different geographical areas of Italy: the negative anomaly was stronger in Northern and Central Italy, while it was weaker in the South. A widespread, common, feature was the very dry behavior of the month of December 2016, when a prolonged period of relative drought began, which caused very serious problems of water resources management especially in Northern and Central Italy. It has been estimated that in the first 8 months of 2017, precipitation over Italy was about 36% lower than the average (Fig. 2.8).

Figure 2.8 - Time series of mean cumulated precipitation anomalies over Italy, for the first 8 months of the year, compared with normals 1961-1990



Source: ISPRA; data from Servizio Meteorologico dell'Aeronautica

In the period 1951-2015, the cumulated precipitation over Italy as a whole slightly decreased, but there are not statistically significant trends, neither on the annual, nor on the seasonal basis. Only in Central Italy a statistically significant negative trend is detected, of -2.0 ± 0.9% /10 years.

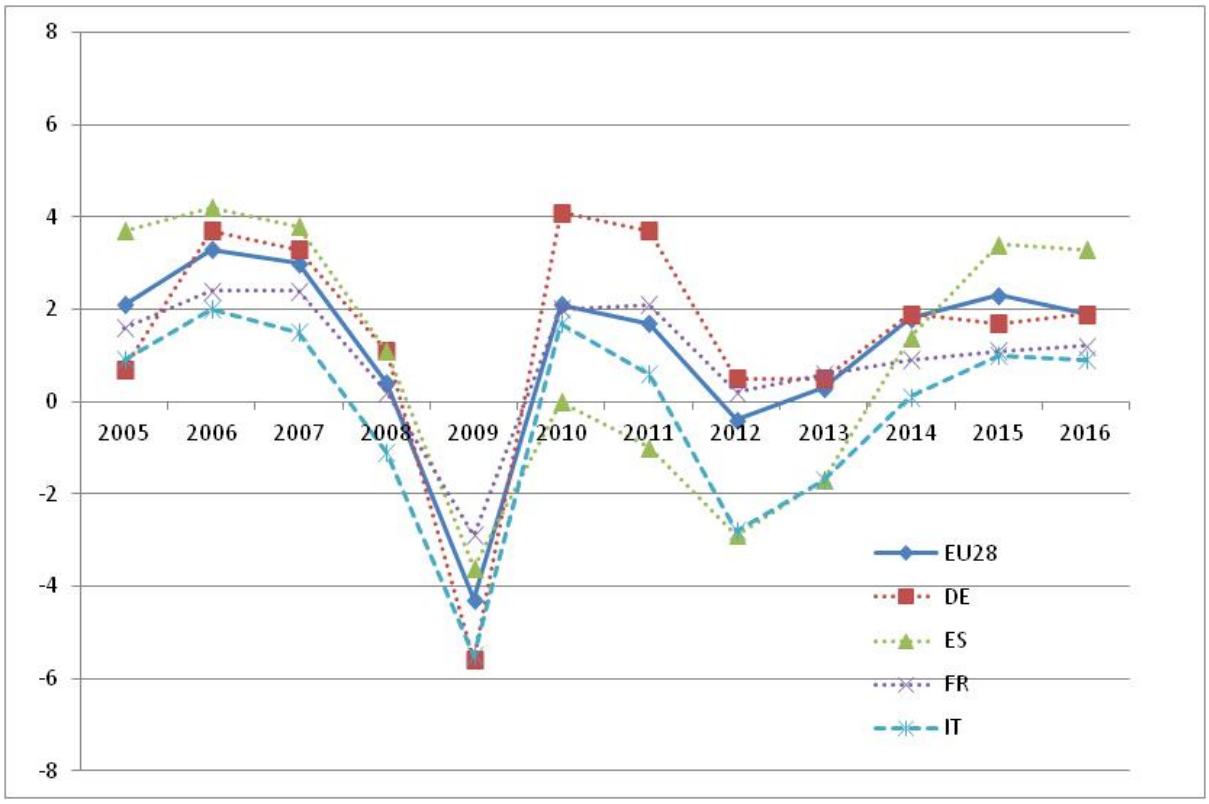
Several extreme precipitation events occurred in 2016, especially in the Liguria region, where peak values of 583 mm daily precipitation and 100.8 mm hourly precipitation were measured.

2.2.4 Economic profile and industry

Italy was the fifth largest economy by nominal GDP in the world in 1990 and its rank has been decreasing since then. According to the World Bank, Italy is the world's eighth largest economy in 2016 and the fourth largest economy in 2016 among the EU countries (11.3% of the EU GDP). The GDP at current prices was 1,568,691 million € in 2016 against 1,604,515 million € in 2010.

During the last decade, a global financial and economic crisis hit the advanced economies thus resulting into severe recession in the EU, Japan and the United States. By the end of 2009 and in 2010, a general recovery in the economies appeared to pick up but since 2011 the growth rate of the major advanced economies, especially in Europe, has been decelerating (Figure 2.8). Between 2012 and 2013, Italy, like many advanced economies, has moved into recession again: GDP fell by 5.5% in 2009 and by 2.4% in 2012. In the very last years, the national economy has been showing a moderate recovery.

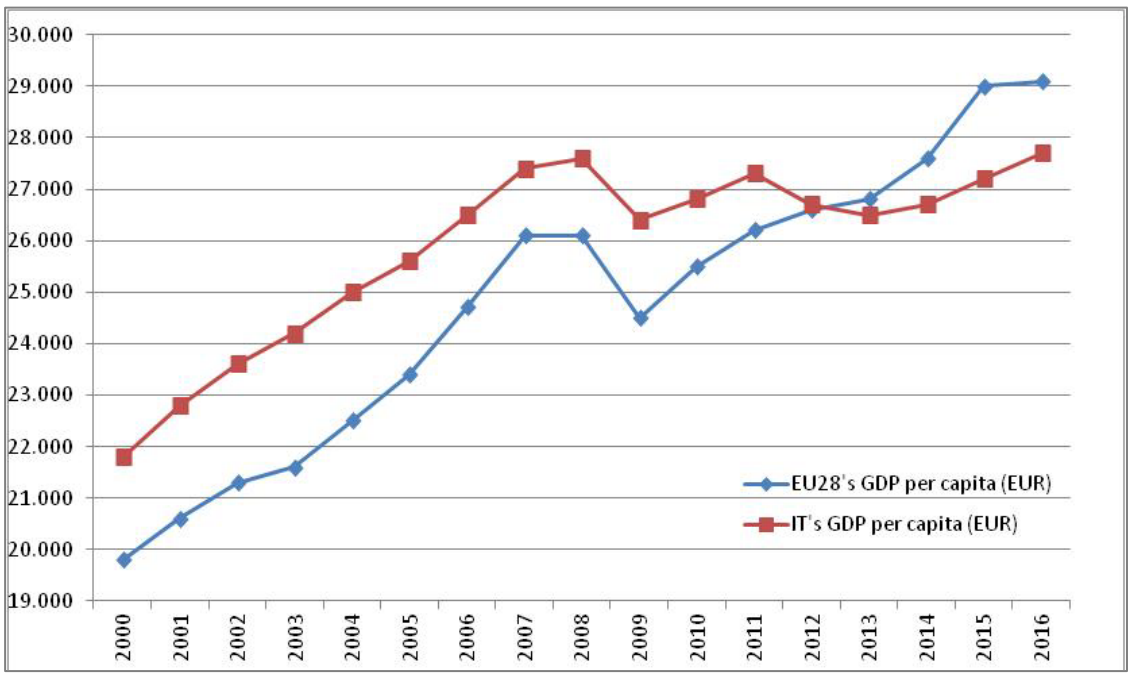
Figure 2.8 - GDP growth rate (% changes on previous year) of EU28, Italy and some EU countries in the last decade



Source: EUROSTAT

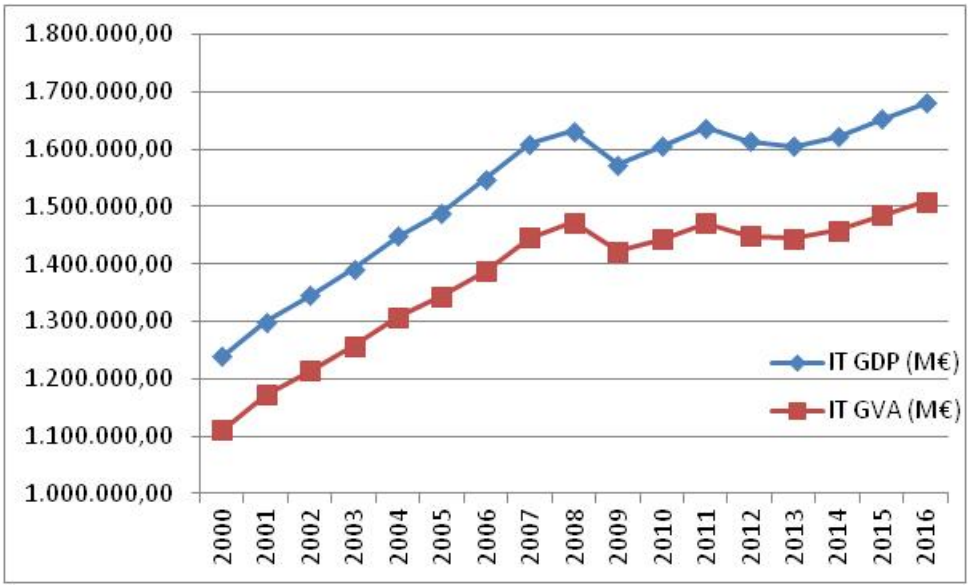
The Italian GDP per capita in 2016 is about 4% below the average EU28 value (Figure 2.9).

Figure 2.9 - GDP per capita (Italy and EU27) time series



Source: EUROSTAT

Figure 2.10 - Italy's GDP and GVA along the last decade (current prices)



Source: EUROSTAT

Italy's Gross value-added has increased between 2000 and 2008, then it has fluctuated at around 2007 GVA values during the 2009-2014 period due to the effects of the financial and economic crisis. Since 2015, GVA has been increasing again (Figure 2.10). The driving sector of the national economy is the service sector, which accounted for 50.5% of GVA in 2000, later increased up to 58.6% in 2009 and finally slightly decreased to 57.7% in 2016. Industry-related activities accounted for 22.3% of GVA in 2000, then declined to 18.3% in 2010 and finally reached 19.1% in 2016. Agriculture and Constructions accounted for 2.8% and 4.8% of GVA, respectively, in 2000; later, while Agriculture decreased to 2.0% in 2010 and to 2.1% in 2016, Construction increased up to 6.0% in 2009 before undertaking a downturn leading to 4.8% in 2016.

Italy is still the world's ninth largest exporter of goods (390,182 million € in 2012 and 417,077 million € in 2016) and it is the twelfth largest importer of goods. The Italian trade balance registered a deficit in 2009 and 2012-2013, and a surplus in 2010-2011 and 2014-2015. The percentage change of exports of goods was negative in 2009, it turned positive in 2010 and again negative between 2012 and 2014; it was +3.8% in 2015. At a world scale, the Italian exports and imports have been losing market shares since 2000: they both accounted for about 3.9% in 2002, then decreased to 3.3% in 2009 and attested to 2.9% and 2.5% for exports and imports, respectively, in 2016. In 2011, Italian exports accounted for 7.9% of EU exports towards EU28 countries and for 10.6% of EU exports towards extra EU countries; both shares have undertaken decreasing trends since 2000, and in 2016 attested to 7.3% ("intra EU28") and 8.4% ("extra EU28"). In terms of value, Italian exports of goods in 2016 were driven by: machinery and auto vehicles (9.8%); pharmaceuticals (4.3%), shoes (2.7%), oil refinery products (2.1%) and iron & steel products (1.8%). European Union (66.3%), the US (9.7%) and East Asia (8.6%) were the largest markets for the Italian exports of goods in 2016[12].

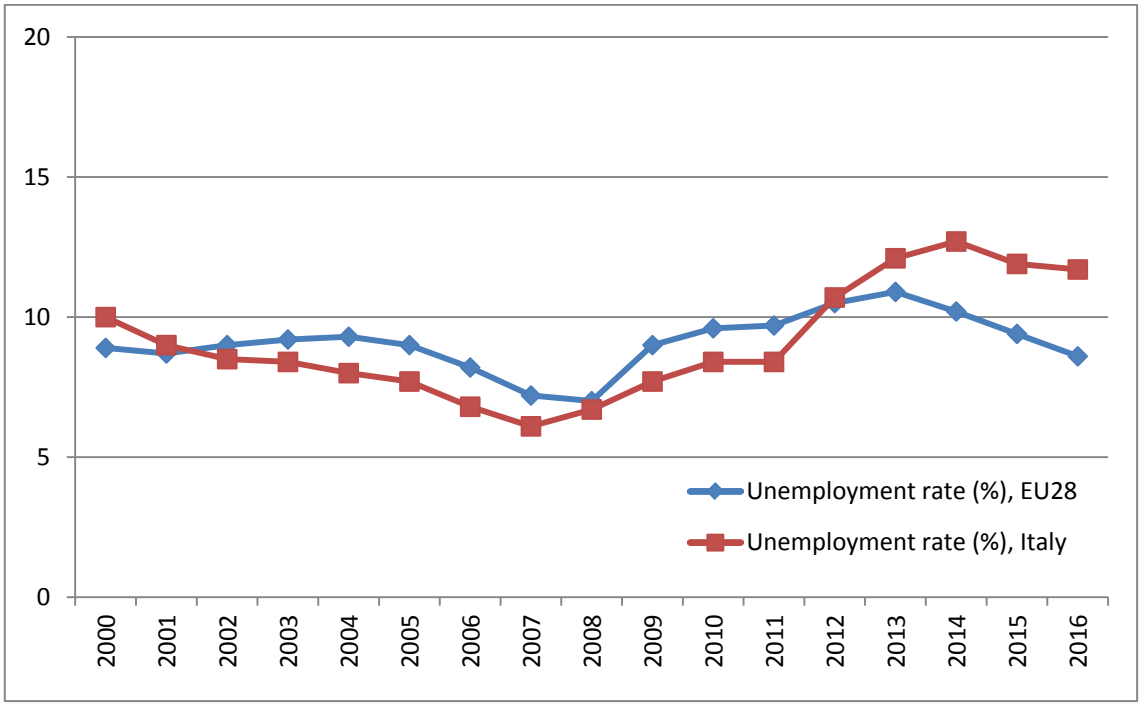
The imports of goods and services showed an increasing trend from 1990 to 2007, then a fluctuating

[12] "Osservatorio economico. Statistiche relative all'import/export italiano". 2017, Italian Ministry of Economic Development

trend due to the fluctuation of the domestic demand through the last years. In 2016, Italian imports were mainly from the European Union (70.2%) and East Asia (12.1%). In terms of value, the main imported goods in 2016 were: machineries including auto vehicles (15.9%), energy products (crude oil, natural gas and oil refinery products - 9.1%), chemical products (6.4%), pharmaceuticals (5.1%)[13].

The unemployment rate in Italy over the last fifteen years is shown in the next Figure 2.11 compared with the unemployment rate in the EU28: it was 10% in 2000 and it showed a decrease for the following seven years; after 2006, it increased again up to 2014 (12.7%), well beyond 2000 values, as a consequence of the recession of the national economy, but it has been decreasing since then.

Figure 2.11 - Unemployment rate in Italy and in the EU28



Source: EUROSTAT

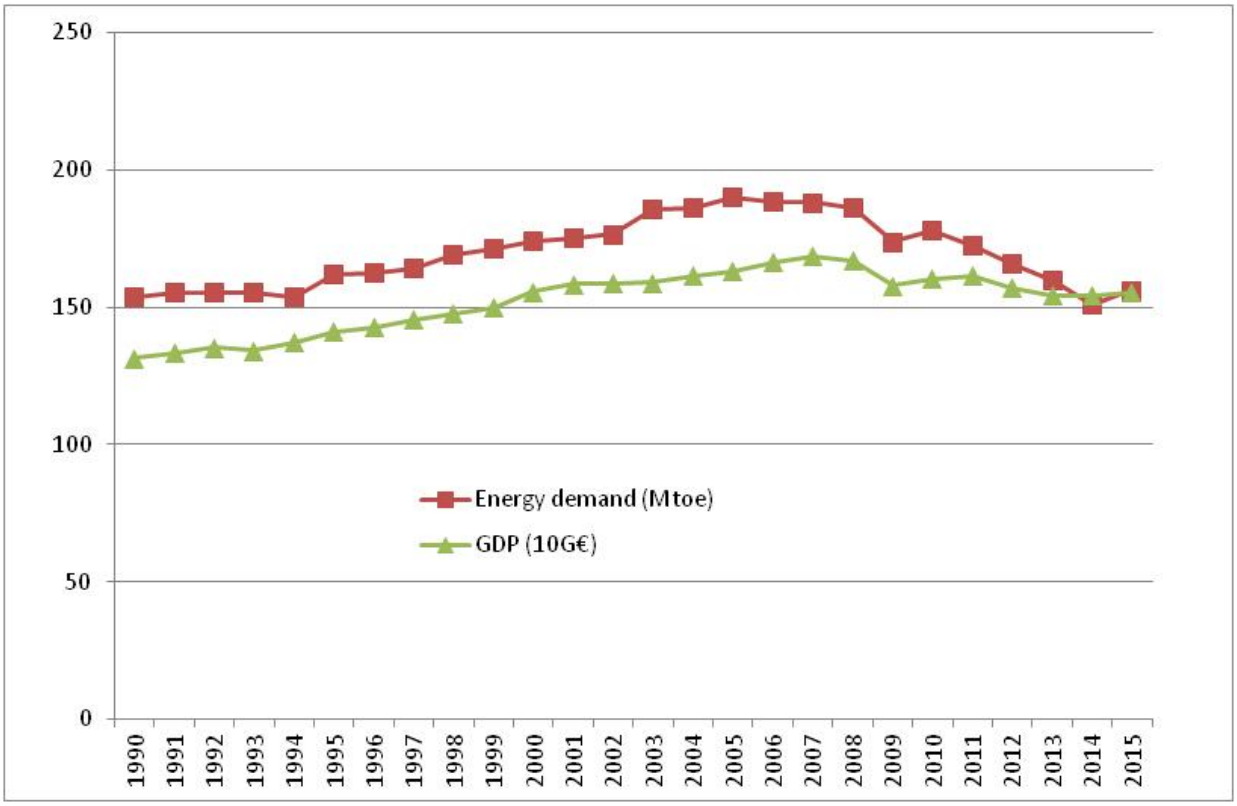
2.3 Sector specific information

2.3.1 Energy

During 1990-2005, in spite of a moderate growth of the national economy, energy consumption has increased at a different growth rate, while from 2005 to 2014 both the economy and the energy consumption have reduced, as shown in figure 2.12.

[13] "Osservatorio economico. Statistiche relative all'import/export italiano". 2017, Italian Ministry of Economic Development

Figure 2.12 - GDP (chained link values 2010) and Total energy demand for the years 1990-2015.



Source: Ministry of Economic Development, National Energy Balance 2015

The primary energy consumption per fuel types is characterized by:

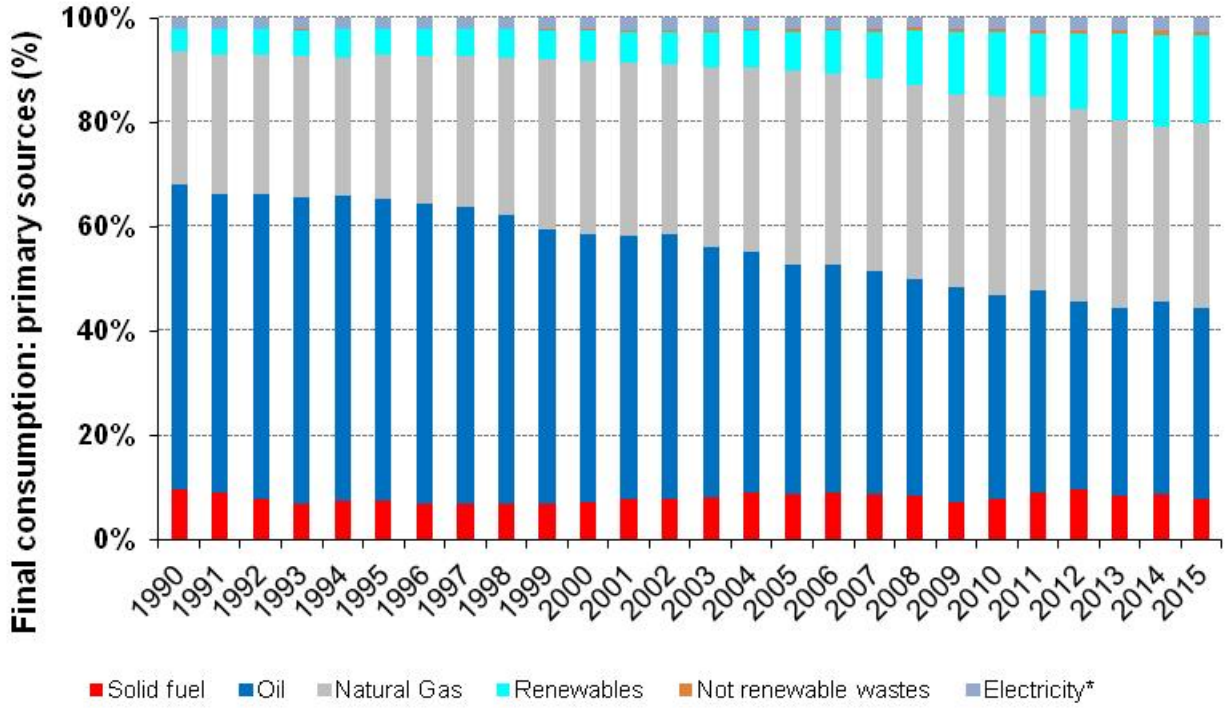
- a reduction of the oil share, which has remained the most important energy source since 1990;
- the corresponding increase in the use of the natural gas;
- and the gradually increasing share of energy from renewable sources.

The consumption trend is also a consequence of the shift from petrol products to natural gas which started in mid '90s (see Figure 2.13).

Compared with other European countries, Italy's energy primary consumption is characterized by a major use of oil and gas, a structural electricity imports, a weak coal contribution and the absence of nuclear power. The share of renewable energy (which increased from 4.2% in 1990 to 16.8% in 2015) in Italy's energy supply mix is higher than the OECD's average (9.2% in 2014), mostly due to hydropower[14].

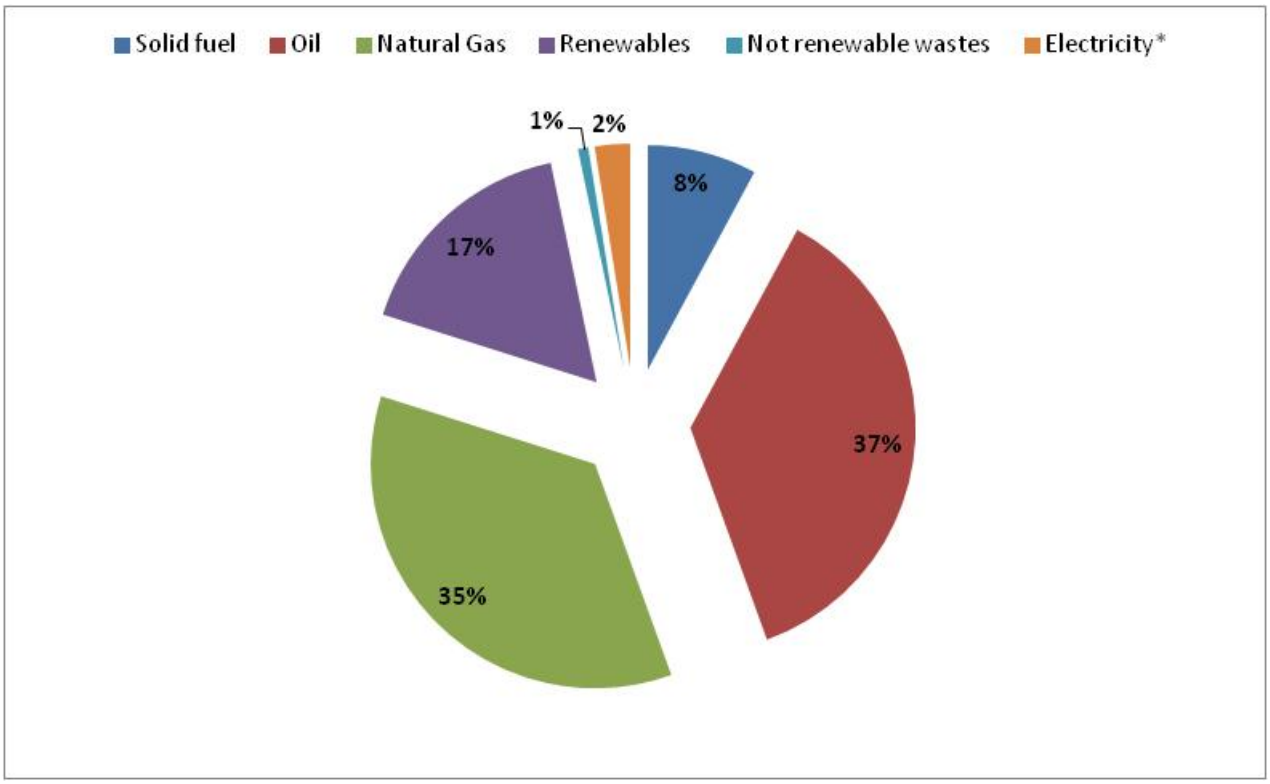
[14] OECD 2016, "Renewable energy", in OECD Factbook 2015-2016:Economic, Environmental and Social Statistics DOI: http://dx.doi.org/10.1787/factbook-2015-43-en

Figure 2.13 - Final consumption: energy primary sources (%)in Italy, trend from 1990 to 2015



Source: Ministry of Economic Development - *Net import of electricity

Figure 2.14 - Breakdown of Italy energy supply mix in 2015



Source: Ministry of Economic Development, National Energy Balance 2015 - *Net import of electricity

In 2015, primary energy demand was about 156.17 Mtoe, +3.4% compared to 2014. The latest trends of energy consumptions in end-uses sectors can be pictured as:

- a stabilization of consumptions in the transport sector (about 40 Mtoe since 2012) after a drop between 2007-2009;
- an overall increase in the consumption trend in the civil sector, mainly driven by consumptions in the service sector which has increased from 1990 up to 2010, while consumptions in the residential sectors have been fluctuating around 34 Mtoe since 2010, except for the drop to 29 Mtoe experienced in 2014;
- energy consumptions in the industry sector have been decreasing since 2004. The fall in energy consumption recorded in 2009 (-24% on 2008) was of course related to the national economy moving into recession and to the fall of the industrial production. In general, the decreasing trend (-27% in 2015 on 1990) is mainly due to the heavy drop of consumptions in the petrochemical sector and to the energy consumptions for mechanics, textile and agri-food which have returned to the early '90s levels.

The national energy bill for 2015 was 34.9 billion € (2.2% of the GDP) and the preliminary value for 2016 is 25.3 billion €, showing a decreasing trend since the peak of € 64.4 billion reached in 2012 (4.1% of the GDP, while during the '90s the average energy bill accounted for 1.5% of the GDP). Table 2.2 summarizes the values of the energy bill along the last two decades.

Table 2.2 - Energy bill 1990-2015

	1990	1995	2000	2005	2010	2015
	(M€)					
Solid fuel	731	991	1,009	1,892	2,270	1,316
Natural Gas	1,859	2,661	7,835	12,194	18,998	14,526
Oil	8,561	9,023	18,653	22,412	28,432	16,190
Biofuels and biomass	-	-	67	135	1,129	837
Others	867	1,563	1,523	2,135	2,409	2,053
total	12,018	14,238	29,087	38,768	53,238	34,922

Source: Unione Petrolifera

The increasing of the energy bill up to 2012 (4% of GDP in 2012) was due to the increase in natural gas imports and, especially, to the increasing prices of energy sources (together with the trend in the US$/€ exchange rate); since 2013, the energy bill has been decreasing (2.2% of the GDP in 2015) mainly due to the reduction of the price of oil and natural gas (especially in the last years, the reductions of the national energy consumption and of the US$/€ exchange rate have been influencing marginally this trend). The oil bill accounted for the largest share of the total energy bill along the time series, the peak in 2012 was due to the decrease of oil imports which were compensated by the increase of the average price paid for 1 ton of oil in the same year.

The energy dependence of Italy from abroad is high compared with the EU27 average (77.1% in 2015 in Italy; 54% in 2015 in EU) as shown in the following table 2.3.

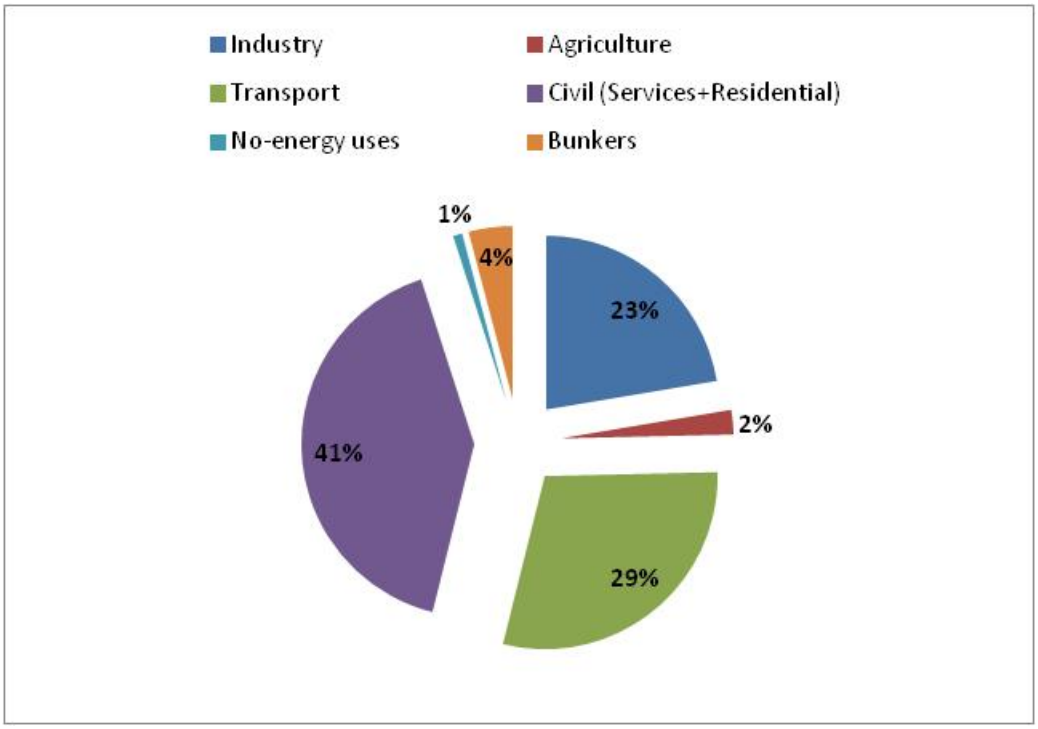
Table 2.3 - Total energy dependence (Italy and EU)

Energy dependence	1990	1995	2000	2005	2010	2015
Italy	84.7	81.9	86.5	83.4	82.6	77.1
EU	44.3	43.1	46.7	52.1	52.6	54

Source: EUROSTAT

Energy end-uses total consumption in 2015 was of 116.4 Mtoe, of which 41.1% related to the tertiary sector (residential, public and tertiary sectors) and 29.3% to the transports sector. Industrial sector accounts for 22.3% of total end-uses energy consumption, as shown in the following figure:

Figure 2.15 - Energy end-use consumptions per sector, 2015 (Mtoe)



Source: Processing of data from the National Energy Balance.

Concerning the electric sector, more than 64% of the production in Italy is provided by thermoelectric power plants[15], while the rest is covered by renewable energy sources (hydropower, wind, photovoltaic and landfill gas). The weight of renewable resources has kept growing in the latest years. Under the EU Renewable Energy Directive there is a target for 17% of Italy's energy consumption to be from renewable sources by 2020. On 10th November 2017, the new proposal of a National Energy Strategy ("SEN 2017") was officially adopted by the Government in the version resulting after public consultation. The National Energy Strategy aims to contribute ensuring Italy's sustainable growth by identifying qualitative and quantitative goals. Specifically:

- Reduction of the energy bill (actions to improve the energy efficiency; change in the energy mix used in specific sectors, e.g. residential and transport; reduction of the differences in market prices of natural gas and electricity);

[15] Dati TERNA riferiti 2015

- Fulfilment of the environmental goals and decarbonisation as set by EU legislation for 2030 in terms of GHG emissions reductions, reduction of primary consumptions and increase of the use of renewable energy sources, also in synergy with the National Strategy for Sustainable Development;
- Achievement of safer energy supplying systems, less dependent on supply from abroad;
- Deployment of investments plan for "green" and "white" economy, in order to contribute in the national economic growth.

The impacts of the "SEN 2017" could not be taken into account for the development of emissions scenarios in chapter 5 of this Communication, due to time reasons (the adoption of the Strategy occurred when the present document was already finalized) and also because of consistency with the development of scenario in the National Communication made by the European Union.

Italy's energy intensity in 2015 (100.2 toe/M€) was higher than 2014, because both GDP and the national energy demand increased. The national energy intensity in 2015 was also lower than the EU average (120 toe/M€) mainly due to the shift of the Italian economy from industrial activities to services. Despite the improvement of energy efficiency for the industry sector, the gap with the EU average has reduced in the recent years because consumption patterns in the civil sector have become more energy intensive.

As for the industry sector, since 1990 an improvement in energy efficiency has been achieved as well as a switch from energy intensive sub-sectors to less energy intensive sub-sectors.

2.3.2 Transport

As for transport facilities, the Italian railroad network had in 2016 about 20,760.24 km, while the Italian road network had at the end of 2015 about 184,297 km, 13.8% more compared to the road extension in 1990.

The extension of the Italian oil pipeline network in 2015 was 4,022 km, with a coefficient of use equal to 50.2%. The extension of the Italian gas pipeline network in 2015 was 32,508 km.

Passengers' transportation in Italy, in 2015, was about 900 billion of passengers-km (+4.2%% compared to 2014). Road transport is the prevailing mean of passengers' transportation: in 2015 it was 92% of the total passengers-km, while railroad transport accounted for 6%, water transportation accounted for 0.4% and air transportation was 2.0% of the total passengers-km. Since 2005, the picture of passenger transportation has not changed significantly. Among the EU countries, Italy has the third highest motorisation rate (610 cars per 1,000 inhabitants in 2014). There were about 50.1 million vehicles circulating in 2016, of which 37.8 million were private cars[16].

The goods transported were more than 177 billion tons-km in 2015 (+0.3% on 2014). The analysis of the related data points out that:

- road transportation of goods is the prevailing means of transportation between 2005 and 2015 (about 54% of the total goods transported in 2015);
- goods transported by sea have increased (about 29% in 2015);
- goods transported by railroad have increased (11.7% in 2015).

[16] ACI, Autoritratto 2016

Italian families' average expenditure for the transport sector was about 12% in 2000, while it has been about 11% from 2005 to 2016.

Mobility demand and, particularly, road transportation shares have increased in the period from 1990 to 2015. The number of vehicles for road transportation has kept growing steadily over the last two decades (1990-2015) as shown in the following table2.4.

Table 2.4 - Road transportation in Italy: trends in fleet

Vehicle category	1990	1995	2000	2005	2010	2015	1990-2015
	number of vehicles						(%)
Passenger Cars	27,431,771	30,363,439	32,573,032	34,665,869	37,636,610	38,503,684	40.4
Light-duty trucks	1,477,403	1,942868	2,679,522	3,317,495	3,898,546	3,944,261	167.0
Heavy-duty vehicles including buses	1,015,505	1,011,799	892,598	1,030,621	1,006,059	947,108	-6.7
Mopeds and Motorcycles	6,609,272	7,383,469	8,827,864	9,658,245	10,610,776	9,578,483	44.9
total	***36,533,951***	***40,701,575***	***44,973,016***	***48,672,230***	***53,151,991***	52,973,536	45.0

During the last years, the reduction of passenger car sales has affected negatively the replacement rate of passenger cars, so the average car life has been increasing and the circulating passenger car fleet has been gradually aging. In 2005, the share of passenger cars in use aged more than 10 years was about 34.5%; since then, this figure has increased up to 51.3% in 2016. The share of passenger cars in use aged more than 20 years was 8.3% in 2000, 7.2% in 2005 and it has increased up to 14% in 2016.

In 2015, the total number of vehicles was 45% more than it was in 1990: passenger cars have increased by 40.4%, light-duty trucks have increased by 167%; heavy-duty vehicles can be considered the same as in 1990, while mopeds and motorcycles have increased by 44.9%. As for the fuel type, the following table 2.5 describes the distribution of the vehicles per fuel type (Gasoline, Diesel, Liquefied Petroleum Gas; Compressed Natural Gas):

Table 2.5 - Road transportation in Italy: distribution of vehicles per fuel types

Fuel type	1990	1995	2000	2005	2010	2015	1990-2015
	number of vehicles						(%)
Gasoline	29,483,790	33,551,154	35,404,960	33,508,446	30,373,198	28,188,320	-4.4
Diesel	5,720,225	5,716,908	7,987,000	13,840,349	18,931,186	20,952,000	266.3
LPG	1,081,816	1,165,746	1,291,826	977,349	2,114,389	2,769,882	156.0
CNG	248,120	267,767	289,230	346,086	713,568	977,200	293.8
E85*	-	-	-	-	231	313	-
Hybrid Gasoline*	-	-	-	-	22,221	85,821	-
total	***36,533,951***	***40,701,575***	***44,973,016***	***48,672,230***	***52,154,793***	52,973,536	45.0

* mixture of up to 85% bioethanol fuel
** electricity and gasoline fuelled vehicles

Over the last two decades, diesel vehicles increased by 266%; LPG vehicles increased by 156% and CNG vehicles increased by 293%.

Road Transport sector energy demand in Italy has increased by about 9% in the period 1990-2015, with significant increases in the consumption of natural gas, diesel, LPG, renewable and electricity, as shown in the following table 2.6.

Table 2.6 -Road Transport sector energy consumption in Italy per fuel (kToe) referred to 1990-2015

	Fuel	1990	1995	2000	2005	2010	2015	1990-2015
		kToe						(%)
Renewables	Biodiesel	na	na	na	177	1419	1167	559*
Primary fossil	Natural Gas	208	243	327	380	695	901	333
	Other oil products	6	5	na	na	na	na	
	Gasoline	13,547	18,058	17,556	14,175	10,276	8,192	-40
	Diesel	15,697	14,814	17,437	22,921	22,017	21,526	37
	LPG	1,474	1,624	1,562	1,131	1,334	1,817	23
Secondary	Electricity	na	na	na	na	5	6	20**
	Total	30,932	34,744	36,882	38,784	35,746	33,609	9

*comparison between 2005-2015
**comparison between 2010-2015
Source: National Energy Balance

As shown in the previous table, energy consumption in the road transport sector raised by about 3 Mtoe in the period 1990-2015. Road transport sector keeps depending almost completely on oil products (93.8% in 2015).

Energy prices and economic recession had an effect in the transport sector. In the latest years, the market trends are towards: a downsizing of cars and reduction of engine displacements, a preponderance of gasoline versus diesel in the low segments of the market and the use of alternative fuels (methane, LPG, hybrid). In 2009, the EU adopted legislation (Regulation EC No 443/2009) setting standards and mandatory targets in the manufacturing of new cars; Regulation EC No 333/2014 amended Regulation 443/2009 in order to define the modalities for reaching the 2020 targets to reduce CO_2 emissions from new passenger cars. Emissions of CO_2 per km from new cars is targeted to decrease over time, table 2.7 shows the decrease in CO_2 emissions from passenger cars along the last two decades (2015 emissions level is lower than 1995's).

Table 2.7 - Trend of CO_2 emissions from passenger cars in Italy in the period 1990-2015

Emissions from passenger cars	1990	1995	2000	2005	2010	2015
CO_2 (Mt)	54.5	64.2	68.0	69.2	61.0	61.7

Source: ISPRA

The EU cars legislation aim to improve the fuel economy of cars sold in the European market. These factors linked to energy prices are moving the market towards new technologies.

2.3.3 Agriculture

Main drivers of GHG emission trends for Agriculture are the number of animals, the variation of cultivated surface/crop production and use of nitrogen fertilizers. Trends and changes of these parameters at national level have been affected also by the implementation of a Common Agricultural Policy at EU level. Specific information about CAP measures (e.g. how they influence the emissions trend) implemented at national level are provided in chapter 4.

In Italy, 12.9% of the total agricultural holdings in 2013 dealt with livestock farming. Changes in livestock farms have occurred since 1982: the number of livestock farms has decreased by 77.8%. Changes in livestock populations have occurred since 1990: specifically, in 2015 cattle reduced by 25.4% while swine and poultry increased by 3.3% and 13.3%, respectively.

The total agricultural area, the utilized agricultural area (UAA) and the number of agricultural holdings have been decreasing since 1982 (table 2.8) according to the Agricultural Census conducted by ISTAT every 10 years; the data related to 2013 are the results of the Farm Structure Survey 2013, a three-year investigation in the form of sample surveys based on the same definitions of the Census. The reduction in the number of agricultural holdings (-53.0% in 2013 compared to 1982) is more significant than the reduction of UAA (-21.5%) thus resulting in the noticeable increase of the average size of Italian agricultural holdings along the same years (+65.6%). In 30 years, small farms (with UAA less than 1 ha) declined by 25%, while large-scale farms (with UAA more than 10 ha) increased by 80%. Furthermore, few farms hold the majority of UUA, as small and medium-sized companies have come to large companies over the years (large-scale farms have increased the average share of UAA from 65.0% to 76.6%). Official statistics concerning the distribution of agricultural holdings by type show that family-run business is still a peculiar feature of the Italian agricultural holdings.

Table 2.8 - Agricultural holdings characteristics in Italy between 1982 and 2013

Agricultural holdings characteristics	1982	1990	2000	2010	2013*
Number of agricultural holdings	3,133,118	2,848,136	2,396,274	1,620,884	1,471,185
UAA (ha)	15,832,613	15,025,954	13,181,859	12,856,048	12,425,995
Total agricultural area (ha)	22,397,833	21,628,355	18,766,895	17,081,099	16,678,296
Average size of agricultural holdings (ha)	5.1	5.3	5.5	7.9	8.4

Source: ISTAT Agricultural Census for the years 1982 to 2010; ISTAT Farm Structure Survey (FSS) 2013

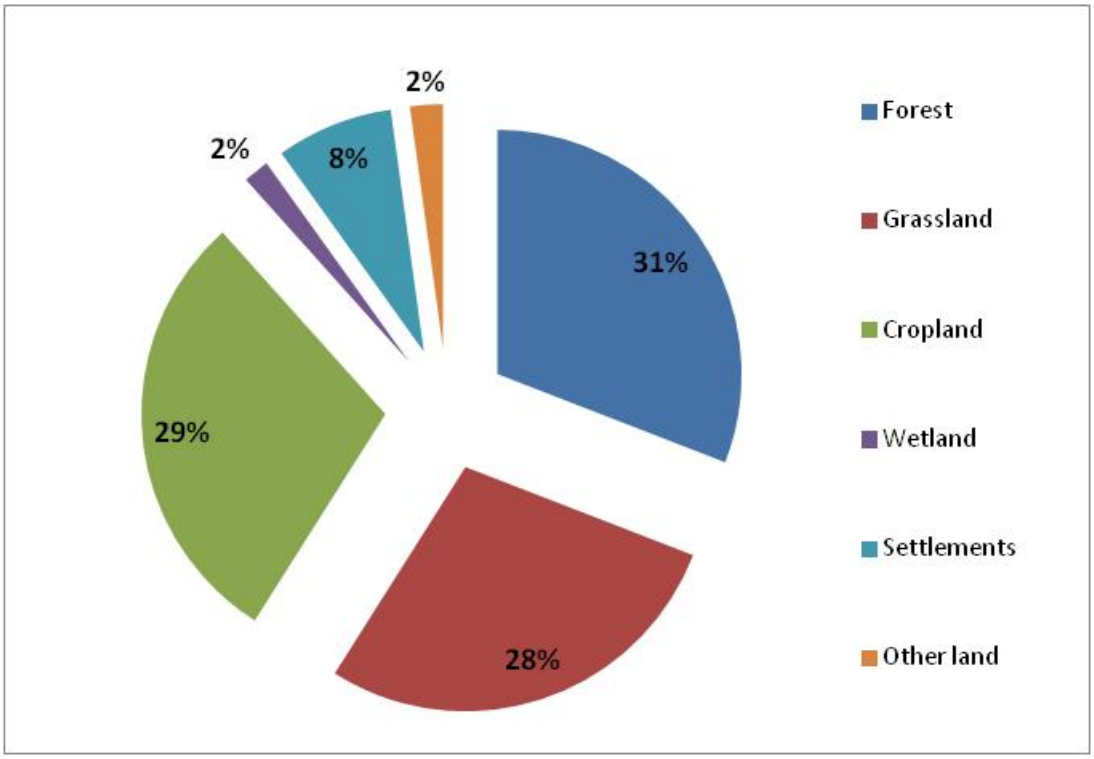
In the last decade, the decrease in the use of fertilizers is the result of both CAP and trend of the fertilizers market prices. The decrease in the use of mineral products with a corresponding increase of organic formulated products is also in line with the CAP aiming at promoting the use of organic manures and fertilizers instead of the use of synthetic mineral products, in order to improve the quality of the agriculture products, the environment and the health of consumers.

According to FSS2013, the number of agricultural holdings that produce renewable energy is 21,000 (about 1.4% of total agricultural holdings in 2013), representing a six-time increase compared to 2010.

2.3.4 LULUCF

Over the last 25 years, changes in the land use in Italy have resulted in the increase of the forested area (23%), of wetlands (2%) and of the settlement area (42%); a reduction of grassland area (5%) and of the cropland area (18%) compared to 1990 areas is also observed.

Figure 2.16 - Land use in Italy in 2015



Italy has a rich biological heritage of forest and several types of landscape, as our peninsula constitutes a bridge between the central European environmental settings, including those of the continental type, and the Mediterranean ones. The diversification can be observed, in terms of forestry resources, in the contrast between the Alpine woods of resinous trees, similar to those of central and northern Europe, and the mixed forests of leave bearing trees, with the range extending to Mediterranean brush and formations typical of cold, arid climates closely related to those of the North African countries.

Italian land surface belonging to "Forest" category was about 7,590 kHa in 1990; 8,369 kHa in 2000; 9,032 kha in 2010; and 9,305 kHa in 2015, equivalent to 31% of our National land surface. The Italian forested area is spreading due to the dismissal of agriculture practices, mostly in mountain zones, and to the natural conversion of cultivated lands and grazing into forests. However, forest expansion rate has been decreasing along the last decade: it was about 78 kha y^{-1} in 2000 and it was about 53.8 kha y^{-1} in from 2010 to 2015.

The natural protected areas (established on various administrative levels: national, regional and local) include 30.5% of the total forested areas.

Total forest areas in Italy certified under international forest management certification schemes was 818,293 ha in 2012 and it is 874,783.71 ha in 2017: 92.7% under the Programme for Endorsement of Forest Certification schemes (PEFC)[17] and 7.3% under the Forest Stewardship Council (FSC).

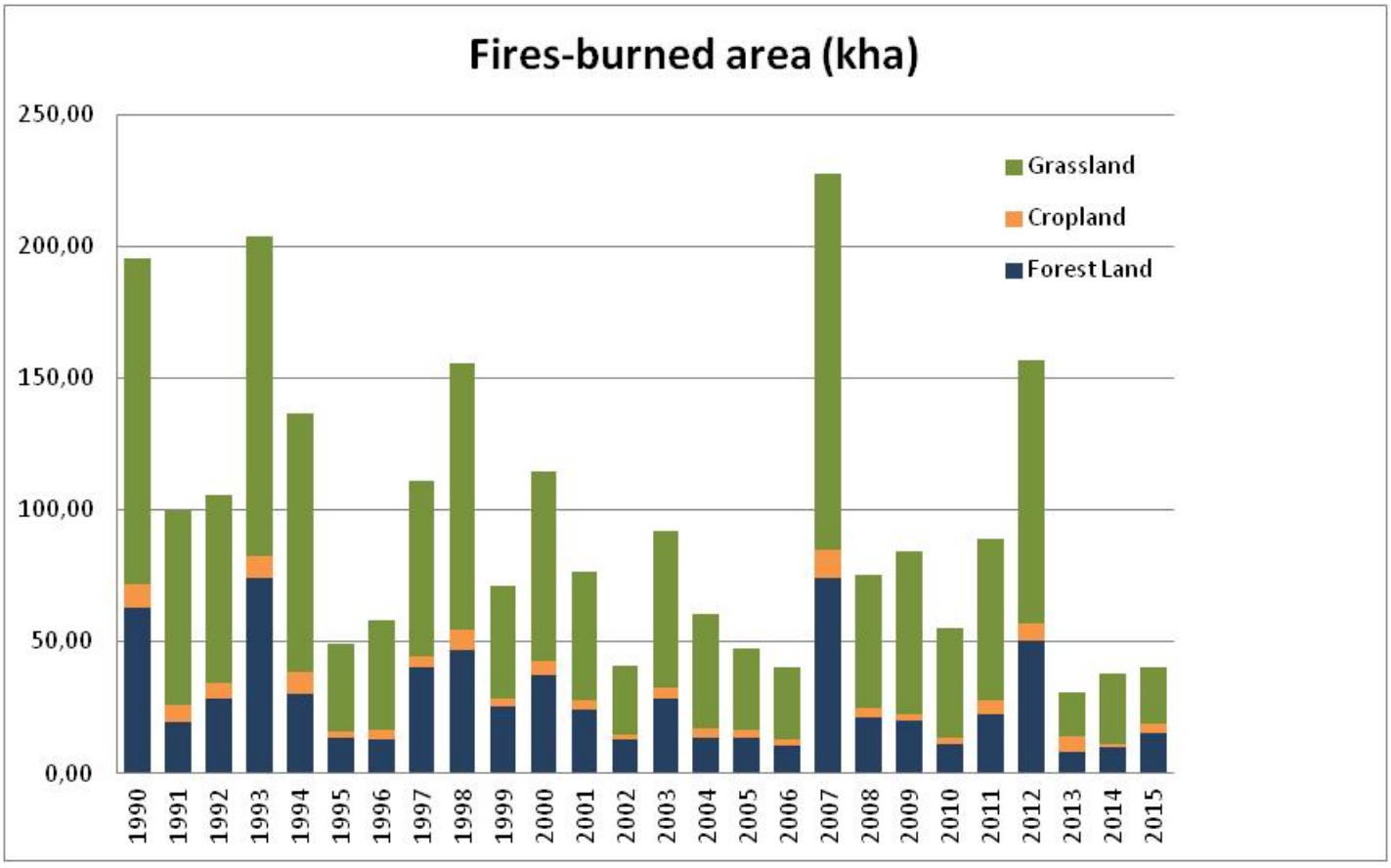
[17] https://www.pefc.it/

Table 2.9 - Italian land surface areas according to the GHG inventory, along the inventory period[18]

Categories	Area [kha]					
	1990	1995	2000	2005	2010	2015
Forest	7,590	7,980	8,369	8,759	9,032	9,305
Grassland	8,891	8,278	8,186	8,265	8,573	8,472
Cropland	10,841	10,924	10,487	9,879	9,159	8,849
Wetland	510	512	515	517	519	519
Settlements	1,644	1,782	1,920	2,058	2,196	2,334
Other land	658	657	656	656	655	655
TOTAL	30,134	30,134	30,134	30,134	30,134	30,134

The areas (forests, cropland and grassland) burnt by fires since 1990 are depicted in figure 2.17: forested areas affected by fires in 2015 amount to approximately 37.7% (15.18 kha) of the total land surface burned by fire in the same year (40.25 kha).

Figure 2.17 – Forest land, Cropland and Grassland (kha) affected by fires along the GHG inventory period.



Source: ISPRA, NIR 2017

[18] ISPRA, NIR2017

2.3.5 Waste

According to the National Institute of Statistics in 2012 about 99.5% of the Italian municipalities were served by a sewer system and about 96% of the population was connected to wastewater treatment plants. In the following table 2.10 estimates of the number of facilities for the treatment of waste in Italy are reported.

Table 2.10 – Waste and wastewater treatment in Italy: number of facilities

Type of waste facility	1990	1995	2000	2005	2010	2015
Landfills	480	650	657	340	211	149
Incinerators	122	135	132	111	148	124
WWTP	6,673	9,456	12,139	14,823	17,506	20,189

The production of municipal waste in Italy has increased from 22 Mt in 1990 to about 32 Mt in the years between 2005 and 2010, while it has remained approximately stable around 29.6 Mt since 2013, although a reduction trend can be observed for the last few years. Changes in life style and consumption patterns, rather than the enforcement of waste legislation, seem to be the main drivers for the gradual reduction in MSW production; the international crisis of the economy has contributed too. In 2015, approximately 29.52 Mt of municipal waste were produced, corresponding to 486.7 kg/year per person (EU28 average per capita MSW production was about 474 kg/year in 2014).

The production of special waste by manufacturing industries has been increasing since 1990: it accounted for about 33 Mt in 2000; 36.7 Mt in 2005; 39.4 Mt in 2010; and it decreased to 26.5 Mt in 2015.

Separate collection has been increasing since 1996: in 2015, about 14 Mt of MSW (47.5%) were subjected to separate collection compared to 8.3 Mt (25.8%) in 2006 and to 1.8 Mt (7.2%) in 1996. Although separate collection rates vary across the country, an increasing overall trend during the last years can be observed; but figures are still lower than national targets set by the legislation.

The municipal wastes have been managed as shown in table 2.11 for the last two decades:

Table 2.11 – Main management systems of Municipal Waste (%)

Treatment	1990	2000	2005	2010	2015
Landfilling	91.1	76	48.6	46.2	26
Incineration	6	8	10.2	13.5	19
Mechanical-biological treatment	2	11	22.5	28.8	36
Composting	1	7	5.6	12.1	14

In Italy, the number of landfills has been decreasing since 1999: a reduction of 508 landfill installations was registered in 2015 due to the decommissioning of unmanaged and smaller size landfills. Since early '90s, landfilling as a waste disposal practice has been decreasing also due to changes in national policies which now support other waste treatments (e.g. incineration; mechanical-biological treatment; composting; anaerobic digestion; etc). Poor information was available up to 2000 concerning the number of installations for the recovery of biogas at landfills in Italy: the number of installations was 32 in 2011, and it has increased since then. The amount of methane deriving from landfill gas and sent to energy recovery was 132 kt in 2000, 271 kt in 2010 and 278 kt in 2015.

The number of operating incineration plants was 122 in 1990, it reached 138 in 2010 and it was 124 in

2015. In 2011, more than 95% of the total amount of incinerated waste was treated in installations with energy recovery systems and this share has increased up to 99% in 2015.

The production of special waste in Italy has increased since 1990: from 77.1 Mt in 1990, 137 Mt in 2010 and 132.4 Mt in 2015. The per capita production of special waste in 2010 at national level was 2.2 t/y, 2.1 t/y for non-hazardous special waste and 0.1 t/y for hazardous special waste, respectively. The correlation between special waste production trend and the Italian GDP trend is good: especially for the last years, the ups and downs in the special waste production trend are related to the trend of the Italian economy.

For the last two decades, the amounts of special wastes produced in Italy have been reported in the following table 2.12.

Table 2.12 - Special wastes produced in Italy between 1990 and 2015 (Mt)

	1990	1997	2000	2005	2008	2009	2010	2015
Non-hazardous special waste	-	56.1	51.8	55.6	60.5	58.7	61.1	70.3
Hazardous special waste	-	3.4	3.9	7.9	11.3	10.3	9.6	9.1
Inert waste (Mt)	-	-	27.3	45.9	70.8	65.3	67	52.9
Total Special Waste	77.1	59.5	83.0	109.4	142.8	134.6	137.9	132.4

The different systems of managing the special wastes in Italy for the last decade are summarized in the table 2.13.

Table 2.13 - Management of Special Waste (%)

Treatment	2000	2005	2010	2015
Storage	15.1	13.7	13.6	10.8
Other disposal operation	14.5	14.6	17.2	13.7
Energy recovery	2.5	2.7	1.6	1.5
Incineration	1	1.1	0.7	0.7
Recovery of material	39.8	48.6	57.5	65.1
Landfilling	27.1	19.4	8.2	8.2

It is worth noting that the amount of special waste destined to the recovery of material has been increasing for the last years and landfilling of special waste has been reducing for the same years.

As for the wastewater treatment plants, the overall treatment capacity over the last 20 years has been increasing as reported in the following table:

Table 2.14 - Wastewater treatment capacity in Italy

	1990	1995	2000	2005	2010	2015
Number of WWTPs	6,673	9,456	12,139	14,823	17,506	20,189
Total treatment capacity (M p.e.)	46	60	70	98	101	103

2.4 Summary of the parameters in this chapter that affect GHG emissions inventory and Projections (Chapters 3 and 5)

The following parameters, considered for the description of the national circumstances in this chapter, are also taken into account directly or indirectly in the update of the emissions estimates in the national GHG inventory and of the projections, which are discussed respectively, in chapters 3 and 5:

Parameters	Chapter 2 – National circumstances	Chapter 3 – GHG inventory	Chapter 5 Projections and effects of policies and measures
GDP – Gross Domestic Product	Yes	Yes	Yes
GVA – Gross Value Added	Yes	No	Yes
Energy consumption	Yes	Yes	Yes
Population	Yes	No	Yes
Nr of dwellings	Yes	Yes	Yes
Nr of appliances and increase of cooling systems	Yes	Yes	Yes
Passenger transport: passenger-km	Yes	Yes	Yes
Goods transport: tons-km	Yes	Yes	Yes
Railway network	Yes	No	Yes
Agriculture: SAU and nr of holdings	Yes	Yes	Yes
Forest land; cropland; grassland	Yes	Yes	Yes
Collection of landfill gas	Yes	Yes	Yes
Electricity generation from animal waste digestion	Yes	Yes	Yes

3 GREENHOUSE GAS INVENTORY[19]

3.1 Greenhouse gas emission trends

The national greenhouse gas emission (GHG) inventory is communicated through compilation of the Common Reporting Format (CRF) and the National Inventory Report (NIR), in accord with the guidelines provided by the United Nations Framework Convention on Climate Change (UNFCCC).

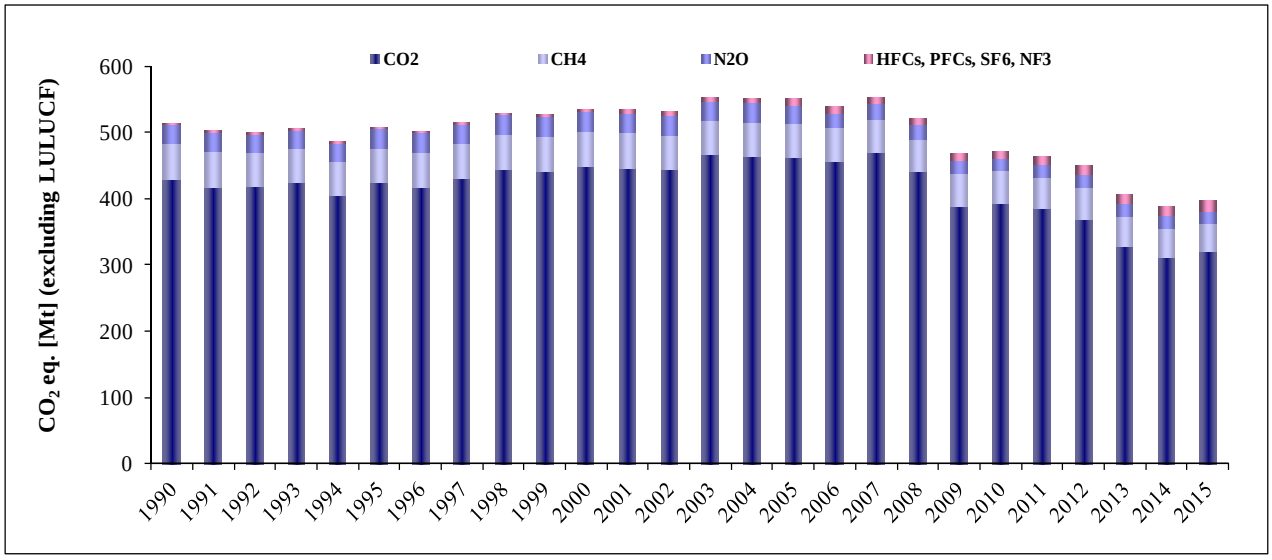
The emissions presented in this document are those communicated in the 2017 submission to the UNFCCC Secretariat and to the European Commission in the context of the Greenhouse Gas Monitoring Mechanism. A complete description of the factors underlying the Italian emission trends, the rationale for the choice of methodologies, the emission factors and parameters used to estimate emissions for the relevant sectors is provided in the National Inventory Report (ISPRA, 2017)[20].

The CRF files, national inventory reports and other related documents can be found at the following addresses: http://www.sinanet.isprambiente.it/it/sia-ispra/serie-storiche-emissioni; http://groupware.sinanet.isprambiente.it/reportnet/library; http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/10116.php.

Summary tables of emission trends are included in the Third Biennial Report.

Figure 3.1 illustrates the national trend of greenhouse gases for 1990-2015, expressed in CO_2-equivalent and by gas; figures do not include emissions and removals from land use, land use change and forestry.

Figure 3.1 - National greenhouse gas emissions from 1990 to 2015 (excluding LULUCF)



Under the Kyoto Protocol, Italy has set 1990 as the base year for carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O); as for fluorinated gases (F-gases), 1990 is also the base year for HFCs, PFCs, SF_6 whereas 1995 is the base year for NF_3.

[19] Lead authors: Daniela Romano (ISPRA); Chiara Arcarese (ISPRA; § 3.3). Contributing Authors: Antonella Bernetti (ISPRA), Antonio Caputo (ISPRA), Riccardo De Lauretis (ISPRA), Eleonora Di Cristofaro (ISPRA), Andrea Gagna (ISPRA), Barbara Gonella (ISPRA), Ernesto Taurino (ISPRA), Marina Vitullo (ISPRA).

[20] ISPRA, 2017. Italian Greenhouse Gas Inventory 1990-2015. National Inventory Report 2017. ISPRA, 261/2017.

Total greenhouse gas emissions, in CO_2 equivalent, excluding emissions and removals from LULUCF, have decreased by 16.7% between 1990 and 2015, varying from 520 to 433 CO_2 equivalent million tons (Mt).

It should be noted that the economic recession has had a remarkable influence on the production levels affecting the energy and industrial process sectors, with a consequent notable reduction of total emissions, in the last six years.

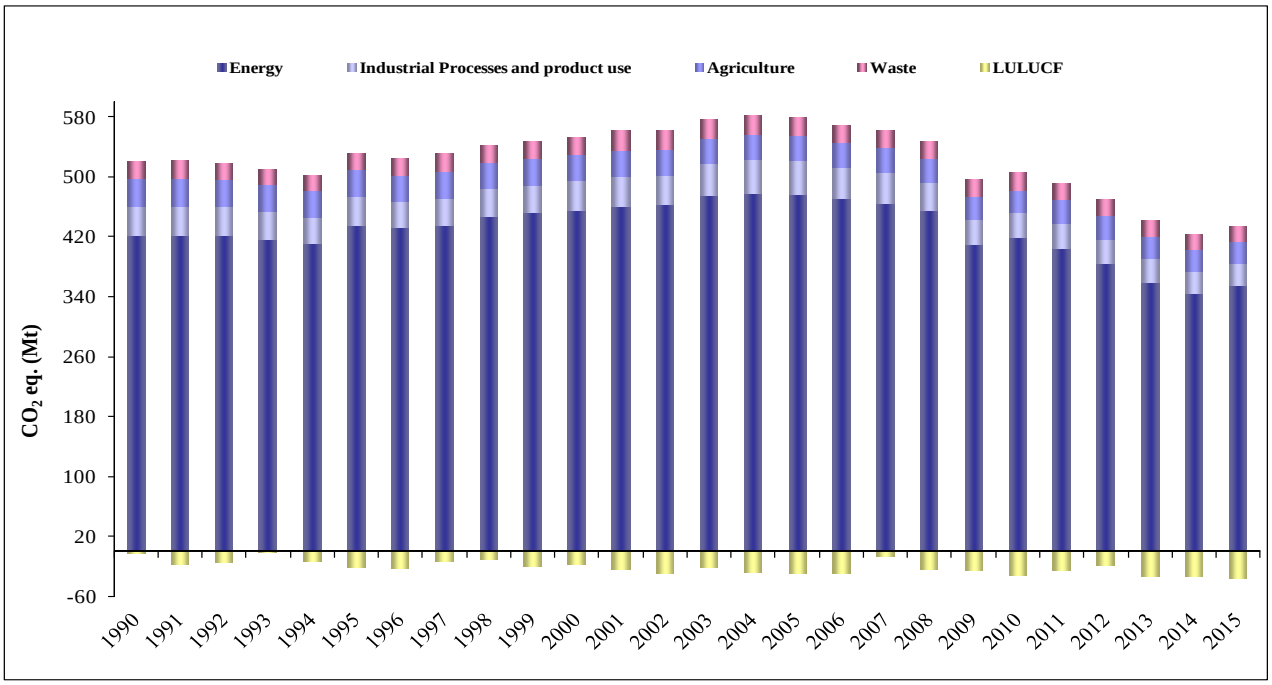
The most important greenhouse gas, CO_2, which accounts for 82.5% of total emissions in CO_2 equivalent, shows a decrease by 17.9% between 1990 and 2015. In the energy sector, in particular, CO_2 emissions in 2015 are 15.6% lower than in 1990.

CH_4 and N_2O emissions are equal to 10.0% and 4.2% of the total CO_2 equivalent greenhouse gas emissions, respectively. CH_4 emissions have decreased by 20.3% from 1990 to 2015, while N_2O has decreased by 32.5%.

As for other greenhouse gases, HFCs account for 2.8% of total emissions, PFCs and SF_6 are equal to 0.4% and 0.1% of total emissions, respectively; the weight of NF_3 is less than 0.01%. Among these gases, HFCs show a strong increase in emissions, and the meaningful increasing trend will make them even more important in next years.

Total greenhouse gas emissions and removals subdivided by sector, including LULUCF, are shown in Figure 3.2.

Figure 3.2 - National greenhouse gas emissions and removals from 1990 to 2015 by sector



Emission trends excluding LULUCF

The share of the different sectors in terms of total emissions remains nearly unvaried over the period considered. Specifically, in 2015, the greatest part of the total greenhouse gas emissions is to be attributed to the energy sector, with a percentage of 81.8%, followed by industrial processes and agriculture, accounting each for 6.9% of total emissions, and waste contributing with 4.3%.

For the energy sector, the decrease in total emissions is equal to 15.8% in the period 1990-2015; in particular, an upward trend is noted from 1990 to 2004, with an increase by 13.6% in total greenhouse gas emissions in CO_2 equivalent excluding LULUCF, whereas a reduction by 25.8% between 2004 and 2015 is observed.
From 2004, GHG emissions from the sector are decreasing because of the policies adopted at European and national level to implement the production of energy from renewable sources. From the same year, a further shift from petrol products to natural gas in producing energy has been observed because of the starting of the EU greenhouse gas Emission Trading Scheme (EU ETS) in January 1st, 2005. From 2009, a further drop of the sectoral emissions is due to the economic recession. From 2008 to 2009 the decrease observed in GHG emissions is, indeed, equal to -10.0% followed by a slight increase (+2.2%) from 2009 to 2010; since then the annual variations are always negative until 2015, when emissions increased by 3.1% with respect to 2014 due to a reduction in energy production by hydroelectric which resulted in an increase of energy production from thermoelectric plants to satisfy the energy demand.

In general, from 1990 to 2015 the decrease in emissions is driven by the reduction in the energy industries and manufacturing industries and construction, which account for 29.9% and 14.8% and reduced by 23.7% and 38.9%, respectively. Specifically, for the manufacturing industries and construction, the reason for the reduced emissions is the cut in production in some subsectors (e.g. chemical, construction and building materials, steel) due to the effects of the economic recession but also to an increase in efficiency, especially identified in the chemical sector.
On the other hand, an increase in emissions still occurs in two relevant sectors, transport and other sectors, which increased by about 3.2% and 3.5% and account for 29.9% and 23.1%, respectively.
Road transport is the most relevant source in the transport sector, accounting in 2015 for 22.9% of total national CO_2 equivalent emissions. In 2015, GHG emissions from road transport were about 93.8% of the national emissions from transport. From 1990 to 2015, GHG emissions from the sector increased by 5.2%; this trend has a twofold explanation: on one side, a strong increase starting from 1990 until 2007 (27.3%), due to the increase of vehicle fleet, total mileage and consequently fuel consumptions; on the other side, from 2007 onwards, a decrease in fuel consumption and emissions basically due to the economic crisis (emissions decrease of about -17.3%).
The increase in other sectors, which refer to emissions originated from energy use in the civil sector and from military mobile activities, is due, from 1990 to 2000, to the increase in numbers and size of building with heating, and to the trend in weather conditions, while from 2002, and especially in the last few years, to the increase in other greenhouse gas emissions than CO_2 for the growing use of woody biomass and biogas for heating.

The substance with the highest impact, in the energy sector, is CO_2, accounting for 96.5% of the total, whose levels have decreased by 15.6% from 1990 to 2015. The trend is mostly driven by the energy industry and manufacturing industries and construction sectors, as previously described. The transport sector shows an increase of emissions until 2007 and then a decrease both for the economic recession and the penetration of vehicles with low fuel consumption.

Describing patterns of other GHGs except for CO_2, the trend of N_2O emissions is related to the technology development in road transport and to the switch from gasoline to diesel fuel consumption; CH_4 emission trend is driven by the combined effect of technological improvements that limit volatile organic compounds (VOCs) from tail pipe and evaporative emissions (for cars) and the expansion of two-wheelers fleet.

Emissions from industrial processes and product use account for 6.9% of total national greenhouse gas emissions, excluding LULUCF. Total emission levels, in CO_2 equivalent, reduced by 25.7% from 1990 to 2015.
The decrease is prevalently to be attributed to the drop of emissions in the mineral and chemical industries, explaining 71.1% and 18.9%, respectively, of the sectoral total. Emissions from mineral production decreased by 46.3%, mostly for the reduction of cement production.

In the chemical industry, emissions diminished by 71.9%; trends are affected by the general reduction in productions and by the introduction of abatement technologies especially in the production process of nitric acid from 2008 and adipic acid from 2005, for which the abatement system has been applied with an increasing operating time and a fully abatement rate.

On the other hand, a considerable increase is observed in F-gas emissions (283.4%), whose share on total sectoral emissions is 40.8%. The main drivers of the increase are the consumption of HFCs in refrigeration and air-conditioning devices, together with their use in pharmaceutical aerosols.

The agriculture sector is also contributing with a 6.9% to total greenhouse gases, excluding the LULUCF sector. Emissions mostly refer to methane and nitrous oxide levels, which account for 61.6% and 37.0% of total emissions of the sector, respectively; CO_2 accounts for the remaining 1.4%.
The decrease observed in total emissions from 1990 to 2015 (-15.9%) is due to the decrease of CH_4 emissions from enteric fermentation (-11.1%) and N_2O from agricultural soils (-18.0%), which account for 46.0% and 29.9% of total agricultural emissions, respectively. Main drivers behind these downward trends are the reduction in the number of animals, especially cattle in the whole period as well as the use of nitrogen fertilizers, mainly due to the Common Agricultural Policy (CAP) measures. In addition, there has been a significant increase in the recovery of the amount of biogas produced from animal manure and used in the energy sector for the production of electricity and combined electricity and heat production in the last years, thus contributing to the reduction of total emissions.

The waste sector accounts for 3.6% of total national greenhouse gas emissions, excluding LULUCF, and shows a decrease of 10.9% from 1990 to 2015. The trend is mainly driven by the emissions from solid waste disposal, accounting for 71.5% of the total sectoral emissions, which decreased by 17.8%; in fact, despite the continuous increase of waste production, solid waste disposal on land has decreased due to waste management policies in place in the last years, specifically the growth of waste incineration, the composting and mechanical and biological treatment and the increasing practice of recyclable waste collected. At the same time, the increase in the methane-recovered percentage has led to a further reduction in net emissions.
Conversely, wastewater handling, which accounts for 26.7% of the total, shows an increase in emissions equal to 22.2% essentially dependent on the number of equivalent inhabitants served.

Emission trends including LULUCF

So far, national totals have been described excluding the LULUCF sector. Accounting for emissions and removals in this sector, national totals show a downward trend of 23.2% from 1990 to 2015.

Total removals, in CO_2 equivalent, in the LULUCF sector, show a high variability in the period, remarkably influenced by the annual fires occurrence and the relevant area burned by fires. Specifically, in the LULUCF sector, CO_2 accounts for 97.8% of total emissions and removals of the sector. The key driver for this sector is the increase of carbon stock changes from forest land (the area reported under forest land has raised by 14.9%).

Emissions and removals from the LULUCF sector are reported in Table 3.1.

Table 3.1 - Total emissions from the LULUCF sector by source / sinks

	1990	1995	2000	2005	2010	2015
			Gg CO_2 eq.			
Total emissions / removals	**-3,256**	**-21,944**	**-16,242**	**-28,385**	**-31,609**	**-36,218**
Forest land	-17,020	-30,954	-25,472	-34,477	-36,541	-39,924
Cropland	2,225	1,861	2,046	1,459	1,335	2,160
Grassland	4,914	-993	669	-2,648	-4,172	-6,658
Wetlands	-	5	8	8	-	-
Settlements	7,145	8,941	6,982	7,804	7,897	7,936
Other land	-	-	-	-	-	-
Harvested wood products	-520	-804	-476	-531	-128	267

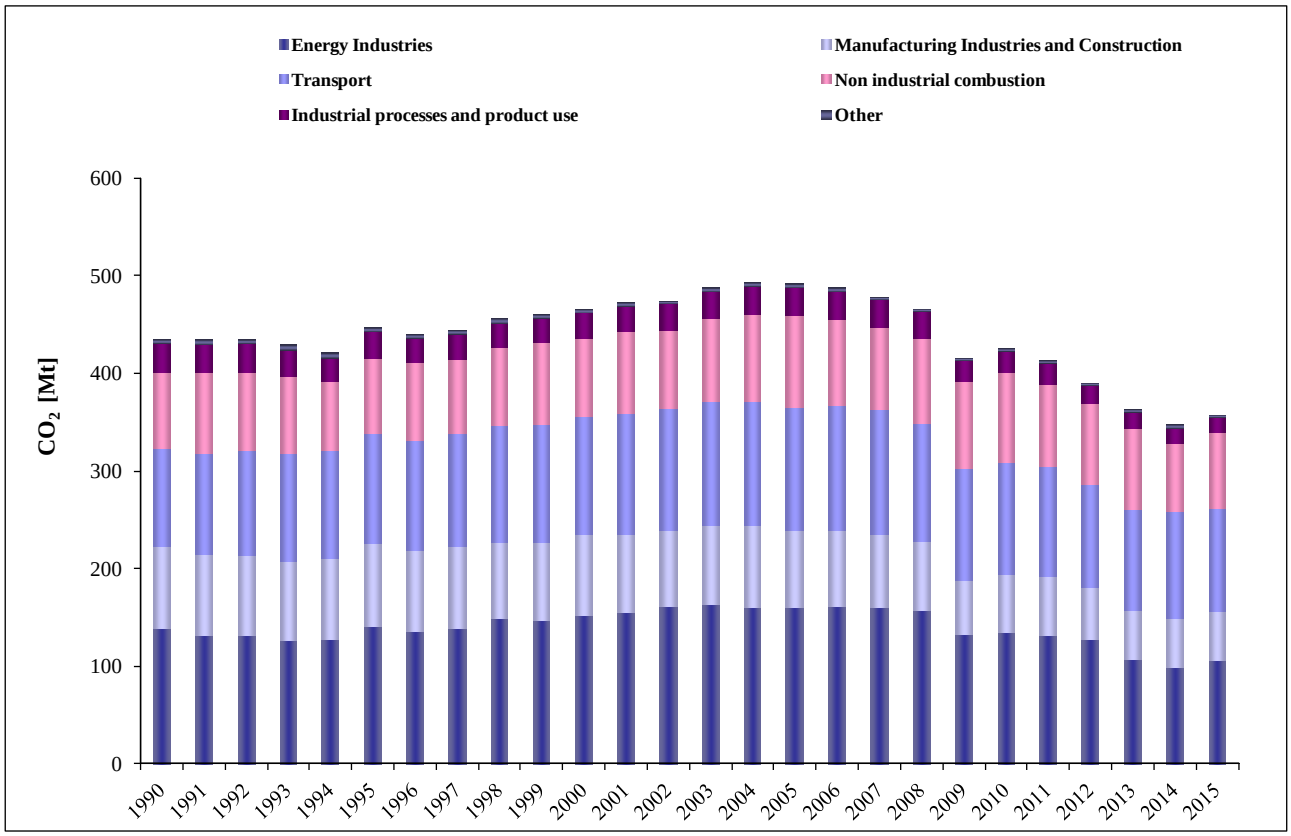
3.1.1 Carbon dioxide emissions

CO_2 emissions, excluding CO_2 emissions and removals from LULUCF, have decreased by approximately 17.9% from 1990 to 2015, reducing from 435 to 357 million tons.

The most relevant contributions derive from the energy industries (29.5%) and transportation (29.3%). Non-industrial combustion accounts for 21.6% and manufacturing and construction industries for 14.4%, while the remaining emissions derive from industrial processes (4.2%) and other sectors (0.1%).

The performance of CO_2 emissions by sector is shown in Figure 3.3.

Figure 3.3 - CO_2 emissions by sector from 1990 to 2015



The main sectors in charge of the reduction of CO_2 emissions are the energy industries and manufacturing industries and construction; in the period 1990-2015, emissions from energy industries have decreased by 23.8% while those from manufacturing industries and construction show a decrease of 39.1%. The transport sector shows an increase of emissions until 2007, due to an increase in the number of vehicles and mileages driven in road transport, and then a decrease both for the economic recession and the penetration of vehicles with low fuel consumption.

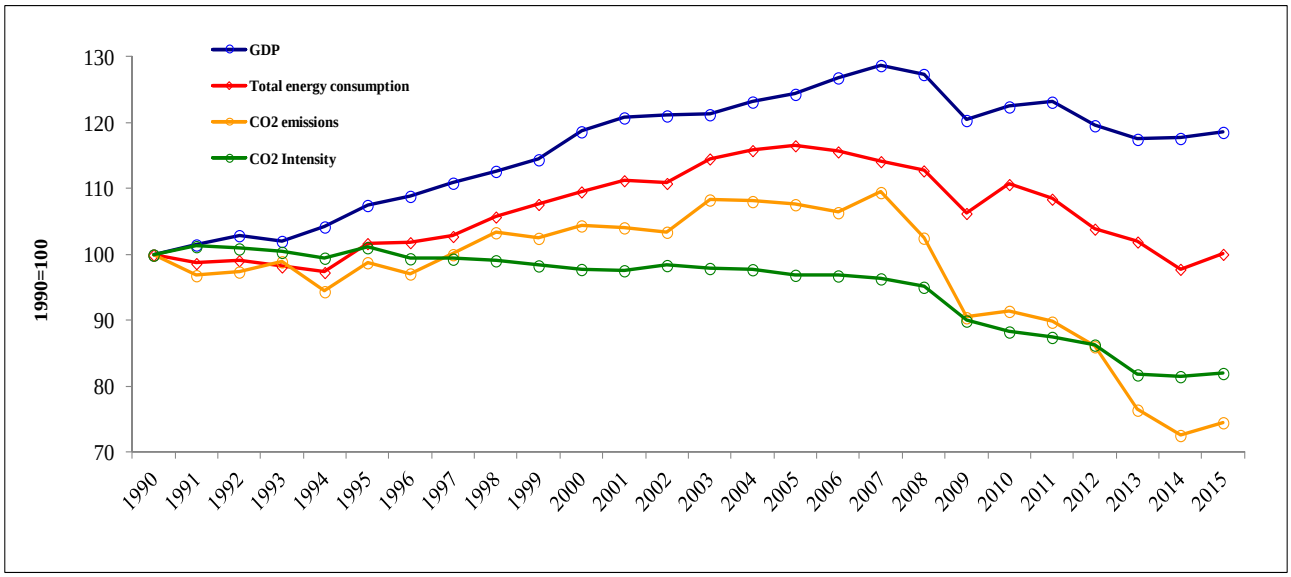
Non-industrial combustion emission trend is driven by the annual climatic variation while emissions from industrial processes decreased by 50.0% mainly for the decrease of cement production.

Figure 3.4 illustrates the performance of the following economic and energy indicators:

- Gross domestic product (GDP) at market prices as of 2000 (base year 1990=100);
- Total Energy Consumption;
- CO_2 emissions, excluding emissions and removals from land-use change and forestry;
- CO_2 intensity, which represents CO_2 emissions per unit of total energy consumption.

The trend of CO_2 emissions per total energy unit shows that CO_2 emissions in the 1990s essentially mirrored energy consumption. A decoupling between the curves is observed only in recent years, mainly because of the substitution of fuels with high carbon contents with methane gas in the production of electric energy and in industry. In the last years, the increase in the use of renewable sources has led to a notable reduction of CO_2 intensity.

Figure 3.4 - Energy-related and economic indicators and CO_2 emissions



3.1.2 Methane emissions

Methane emissions, excluding the LULUCF sector, represent 10.0% of total greenhouse gases in 2015, equal to 43.2 Mt in CO_2-equivalent, and show a decrease of approximately 20.3% compared to 1990 levels.

CH_4 emissions, in 2015, originate mainly from the agriculture sector, which accounts for 42.7% of total methane emissions, as well as from waste (38.8%) and energy (18.4%).

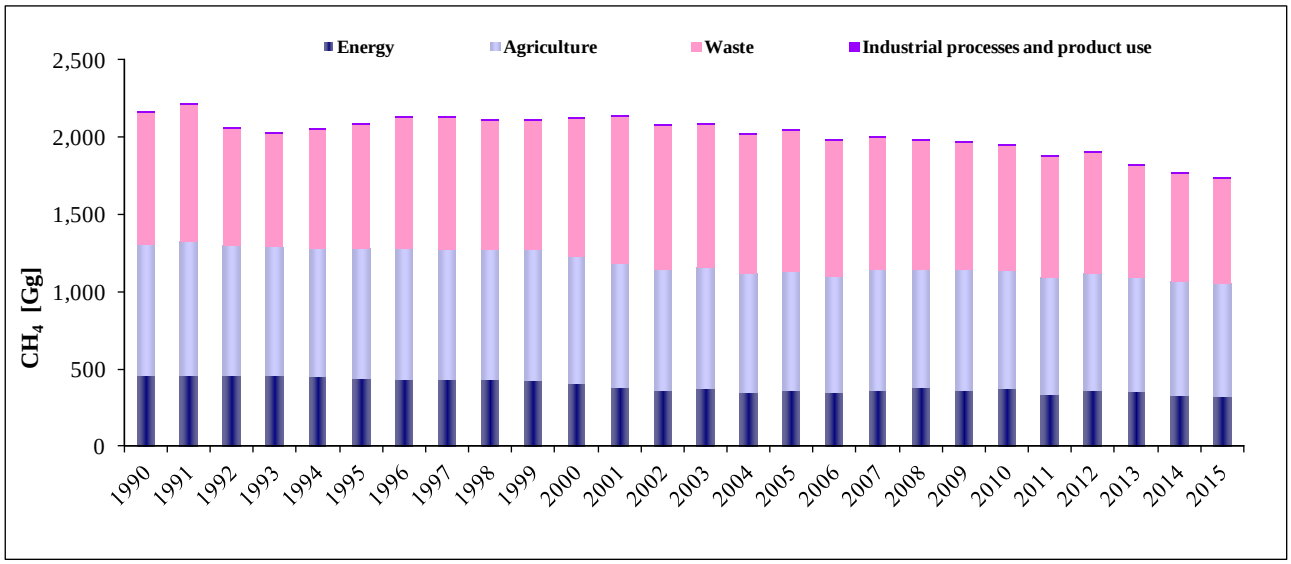
Emissions in the agriculture sector regard mainly the enteric fermentation (74.7%) and manure management (16.1%) categories. The agriculture sector shows a decrease of emissions equal to 13.5% compared 1990, attributable widely to a reduction in livestock and the recovery of biogas for energy purposes.

Activities typically leading to emissions in the waste-management sector are the operation of dumping sites and the treatment of industrial waste-water. The waste sector shows a downward trend in emission levels, equal to -21.7% compared to 1990; the largest emission share origins from the solid waste disposal on land subcategory (76.5%) and waste-water handling (13.5%), which decreased by 22.3%, and 22.7%, respectively.

In the energy sector, the reduction of CH_4 emissions (-30.1%) is the result of two contrasting factors; on the one hand there has been a considerable reduction in emissions from energy industries, transport, and fugitive emissions from fuels (caused by leakage from the extraction and distribution of fossil fuels, due to the gradual replacement of natural-gas distribution networks); conversely, a strong increase in emissions is observed in the civil sector due to the increased use of methane and biomass in heating systems.

Figure 3.5 shows national CH_4 emission trends by sector.

Figure 3.5 - CH_4 emissions by sector from 1990 to 2015



3.1.3 Nitrous oxide emissions

In 2015 nitrous oxide emissions, excluding the LULUCF sector, represent 4.2% of total greenhouse gases, with a decrease of 32.5% between 1990 and 2015, decreasing from 26.9 to 18.2 Mt CO_2-equivalent.

The major source of N_2O emissions is agriculture (60.8%), especially for the use of both chemical and organic fertilisers, as well as the management of waste from the raising of animals. Emissions from the agriculture sector show a decrease of 19.9% in the 1990-2015 period, due to a reduction in livestock number.

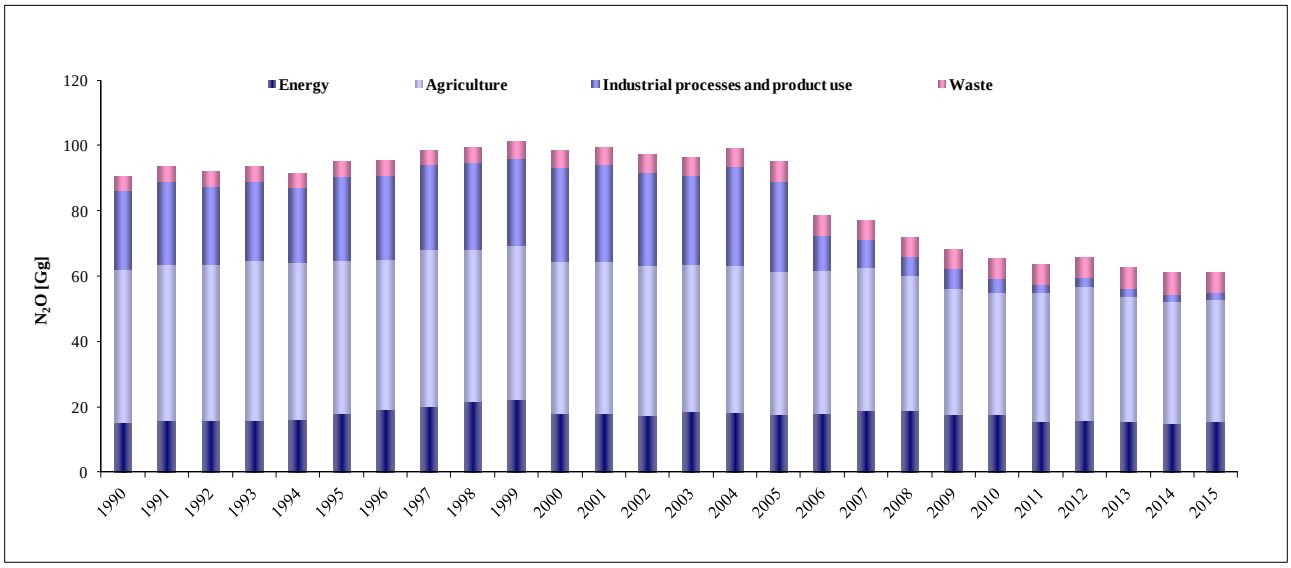
N_2O emissions in the energy sector (25.4% of the total) increased by 0.3% from 1990 to 2015; this growth can be traced back primarily to the increase of emissions by 39.0% in the civil sector, which accounts for 13.3% of the total, as a result of the increased use of biomass in heating systems. This increase was counterbalanced by the reduction of 40.9% in the manufacturing and construction industries (which account for 4.3% of the total) mainly due to the reduction in the last years of cement production.

The industrial sector accounts for about 3.4% of total N_2O emissions. The sector shows the most significant reduction in emission levels due to the chemical industry. Specifically, emissions from the production of nitric acid have decreased by 98.2% from 1990 to 2015, with a notable decrease in the last years due to the introduction of the abatement systems in the main production plant; emissions from production of adipic acid show a decrease from 1990 to 2015 of 97.5% because of the introduction of an abatement technology. A further component, which has contributed to the reduction, is the decreasing use of N_2O for medical purposes.

Other emissions in the waste sector, primarily regarding the processing of industrial and domestic waste-water, account for 10.4% of national total.

Figure 3.6 shows national N_2O emission figures by sector.

Figure 3.6 - N_2O emissions by sector from 1990 to 2015



3.1.4 Fluorinated gas emissions

Emissions of fluorinated gases represent 3.3% of total greenhouse gases in CO_2-equivalent in 2015 and they show a significant increase between 1990 and 2015. This increase is the result of different factors for the different gases.

HFCs, for instance, have increased considerably from 1990 to 2015, from 0.4 to 12.3 Mt in CO_2-equivalent. The main sources of emissions are the consumption of HFC-134a, HFC-125, HFC-32 and HFC-143a in refrigeration and air-conditioning devices, together with the use of HFC-134a in pharmaceutical aerosols. Increases during this period are due both to the use of these substances as substitutes for gases that destroy the ozone layer and to the greater use of air conditioners in vehicles.

Emissions of PFCs show a decrease of 41.9% from 1990 to 2015. The level of PFC emissions in 2015 is 1.7 Mt in CO_2-equivalent, and it is due to by product emissions in the fluorochemical production (91.2%) and the use of the gases in the production of semiconductors (8.1%).

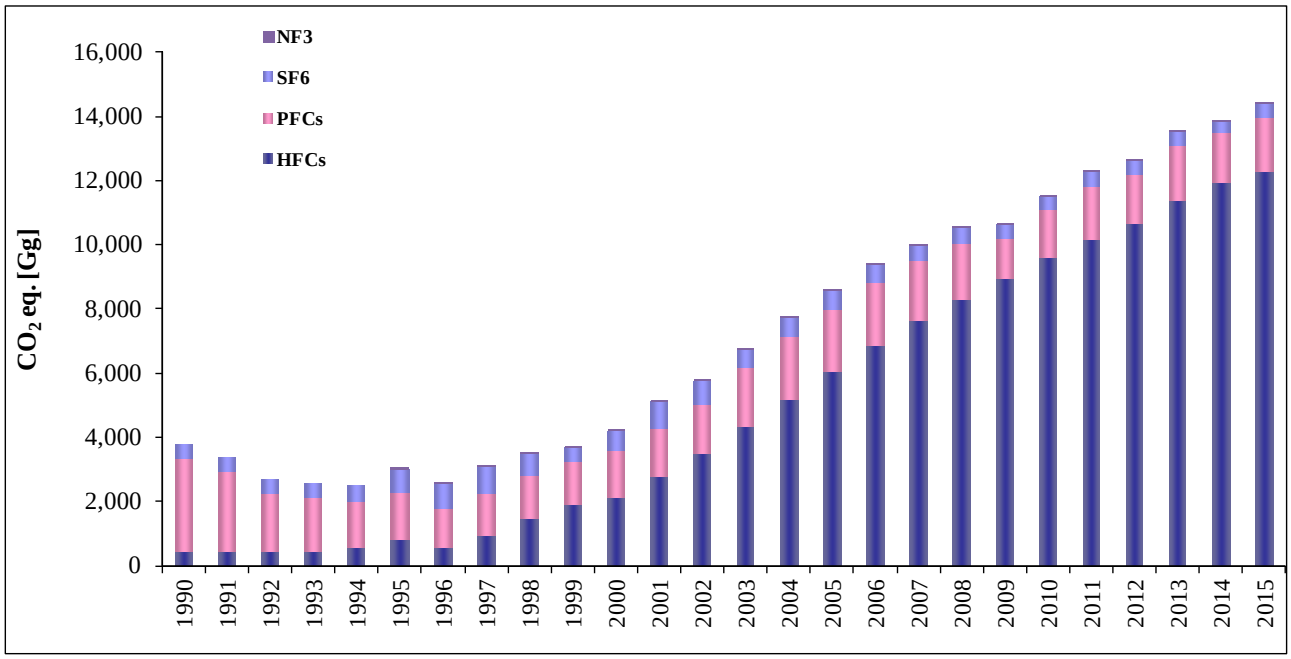
Emissions of SF_6 are equal to 0.4 Mt in CO_2 equivalent in 2015, with a decrease of 13.3% as compared to 1990 levels. In 2015, about 79.3% of SF_6 emissions derive from the gas contained in electrical equipment and 10.0% from the use of this substance in accelerators and 10.7% from the gas used in the semiconductors manufacture.

NF_3 emissions account for 0.03 Mt in CO_2 equivalent in 2015 and derive from the semiconductors industry.

The National Inventory of fluorinated gases has largely improved in terms of sources and gases identified and a strict cooperation with the relevant industry has been established. Higher methods are applied to estimate these emissions; nevertheless, uncertainty still regards some activity data, which are considered of strategic economic importance and therefore kept confidential.

Figure 3.7 shows emission trends of F-gases by gas, expressed in CO_2-equivalent.

Figure 3.7 - Emissions of fluorinated gases from 1990 to 2015



3.2 National System for preparing the Italian Greenhouse Gas Inventory

3.2.1 Institutional arrangements

The National System for the Italian Greenhouse Gas Inventory was established by the Legislative Decree n° 51 of March 7th 2008. The Institute for Environmental Protection and Research (ISPRA), former Agency for Environmental Protection and Technical Services (APAT), is the single entity in charge of the development and compilation of the national greenhouse gas emission inventory, as specified by art.14 bis of the above Decree. The Institute annually draws up a document which describes the national system including all updated information on institutional, legal and procedural arrangements for estimating emissions and removals of greenhouse gases and for reporting and archiving inventory information; the plan is submitted to the Ministry for the Environment, Land and Sea for approval.

As for the official consideration of the inventory, the Ministry for the Environment, Land and Sea is responsible for endorsement and for communication to the Secretariat of the UN Framework Convention on Climate Change and the Kyoto Protocol. The inventory is also submitted to the European Commission in the framework of the Greenhouse Gas Monitoring Mechanism.

A complete description of the Italian National System can be found in the document "National Greenhouse Gas Inventory System in Italy. Year 2016" (ISPRA, 2016), publicly available at http://www.sinanet.isprambiente.it/it/sia-ispra/serie-storiche-emissioni

No changes with respect to the last submission occurred in the National System.

As single entity, ISPRA is responsible for all aspects of national inventory preparation, reporting and quality management. A specific unit of the Institute is in charge of the management of the emission inventory. Activities include the collection and processing of data from different data sources, the selection of appropriate emissions factors and estimation methods, the compilation of the inventory following the QA/QC procedures, the assessment of uncertainty, the preparation of the National

Inventory Report and the reporting through the Common Reporting Format, the response to the review processes, the updating and data storage. The web address where all the information related to the inventory can be found is: http://www.sinanet.isprambiente.it/it/sia-ispra/serie-storiche-emissioni.

Different institutions are responsible for communication and publication of statistical basic data, which are essential for ISPRA to carry out emission estimates. These institutions are part of a National Statistical System (Sistan), which periodically provides national official statistics; moreover, the National Statistical System ensures the homogeneity of the methods used for official statistics data through a coordination plan, involving the entire public administration at central, regional and local levels. The Italian National Institute of Statistics (ISTAT) coordinates the National Statistical System whereas other participant bodies are the statistical offices of ministries, national agencies, regions and autonomous provinces, provinces, municipalities, research institutes, chambers of commerce, local governmental offices, some private agencies and private subjects.

These bodies are required to provide the data and information specified in an annual statistical plan, which defines surveys, data elaborations, and project studies for a three-year period; a Prime Minister Decree approves the plan after consideration of the Interministerial Committee for economic planning (Cipe). The latest Prime Ministerial Decree, which approved the three-year plan for 2014-2016, updated for 2015-2016, was issued on 5th November 2015 (GU Serie Generale n.258, 5/11/2015).

Further information on the National Statistical System is found in the National Inventory Report and National Inventory System.

The main Sistan products, which are primarily necessary for the inventory compilation, are:

- National Statistical Yearbooks, Monthly Statistical Bulletins, by ISTAT (National Institute of Statistics);
- Annual Report on the Energy and Environment, by ENEA (Agency for New Technologies, Energy and the Environment);
- National Energy Balance (annual), Petrochemical Bulletin (quarterly publication), by MSE (Ministry of Economic Development);
- Transport Statistics Yearbooks, by MINT (Ministry of Transportation);
- Annual Statistics on Electrical Energy in Italy, by TERNA (National Independent System Operator);
- Annual Report on Waste, by ISPRA.
- National Forestry Inventory, by MIPAAF (Ministry of Agriculture, Food and Forest Policies).

The national emission inventory is a Sistan product.

The ‘National Registry for Carbon sinks’, instituted by a Ministerial Decree on 1st April 2008, is part of the Italian National System. It includes information on lands subject to activities under Article 3.3 and Article 3.4 and related carbon stock changes. In agreement with the Ministerial decree art.4, the Ministry for the Environment, Land and Sea is responsible for the management of the National Registry for Carbon sinks. The Decree also provides that ISPRA and the State Forestry Service are involved by the Ministry as technical scientific support for specific activities as defined in the relevant protocol. ISPRA is responsible for the preparation of emission and removals estimates for the LULUCF sector and for KP LULUCF supplementary information under art.7.1 of the Kyoto Protocol.

The National Registry for Carbon sinks is the instrument to estimate, following the COP/MOP decisions and in accordance with the IPCC guidelines, greenhouse gases emissions by sources and removals by

sinks in the land subject to art. 3.3 and art. 3.4 activities and to account for the net removals in order to allow the Italian Registry to issue the relevant amount of RMUs. Following the Ministerial Decree of 22.01.2013 by the Ministry of Environment, Land and Sea (MATTM), in agreement with the Ministry of Agriculture, Food and Forest Policies, the Institute for Services on Agricultural and Agro-food Market (ISMEA[21]) has been designated for the technical coordination of the section related to cropland and grazing land management of the National Registry of Carbon Sinks.

3.2.2 Inventory preparation

The Italian emission inventory is based on methodologies consistent with the IPCC guidelines, IPCC Good Practice Guidance and EMEP/EEA Guidebook (IPCC, 1997[22]; IPCC, 2006[23]; IPCC, 2000[24]; IPCC, 2003[25]; EMEP/CORINAIR, 2007[26]; EMEP/EEA, 2009[27]).

In addition, national methodologies are developed and supported by background reference materials. Emission estimates are characterized by quantitative uncertainty figures calculated at a detailed category level and for the inventory as a total, following the IPCC Good Practice Guidance; uncertainty is also used in the assessment of key categories.

The inventory preparation process takes place annually; in case of methodological changes or additional information, emissions are recalculated from 1990 onwards.

Detailed information on emission figures and estimation methodologies, including all the basic data and emission factors needed to carry out the final estimates, are provided in the National Inventory Report (NIR) which completes the stage of inventory preparation. The last report is available at the following web address http://www.isprambiente.gov.it/en/publications/reports?set_language=en.

In addition to the institutions which are part of the National Statistical System, ISPRA has established fruitful cooperation with a number of other governmental and research institutes as well as industrial associations, which helps improving some key categories of the inventory. Specifically, these activities aim at the improvement of provision and collection of basic data and emission factors, through plant-specific data, and exchange of information on scientific researches and new studies. Moreover, when in depth, investigation is needed and a high uncertainty in the estimates is present, specific sector analyses are commissioned to ad hoc research teams or consultants.

ISPRA also coordinates with different national and regional authorities and private institutions for the cross-checking of parameters and estimates as well as with ad hoc expert panels in order to improve the accuracy, completeness and transparency of the inventory.

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[21] ISMEA is a public body, providing support to public and private sector. According to DPR 31 March 2001, n. 200, ISMEA is part of the National Statistical System – SISTAN and of the National Agricultural Information System – SIAN.

22 IPCC, 1997. Revised 1996 IPCC Guidelines for National Greenhouse Gas Emission Inventories. Three volumes: Reference Manual, Reporting Manual, Reporting Guidelines and Workbook. IPCC/OECD/IEA. IPCC WG1 Technical Support Unit, Hadley Centre, Meteorological Centre, Meteorological Office, Bracknell, UK.

23 IPCC, 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.

24 IPCC, 2000. Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. IPCC National Greenhouse Gas Inventories Programme, Technical Support Unit, Hayama, Kanagawa, Japan.

25 IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. IPCC Technical Support Unit, Kanagawa, Japan.

26 EMEP/CORINAIR, 2007. Atmospheric Emission Inventory Guidebook. Technical report No 16/2007.

27 EMEP/EEA, 2009. Air Pollutant Emission Inventory Guidebook. Technical report No 9/2009.

All the reference material, estimates and calculation sheets, as well as the documentation on scientific papers and the basic data needed for the inventory compilation, are stored and archived at ISPRA.
In Table 3.2 a summary of the activity data and sources used in the inventory compilation is reported.

Table 3.2 - Main activity data and sources for the Italian Emission Inventory

SECTOR	ACTIVITY DATA	SOURCE
1 Energy		
1A1 Energy Industries	Fuel use	Energy Balance - Ministry of Economic Development Major national electricity producers European Emissions Trading Scheme
1A2 Manufacturing Industries and Construction	Fuel use	Energy Balance - Ministry of Economic Development Major National Industry Corporation European Emissions Trading Scheme
1A3 Transport	Fuel use Number of vehicles Aircraft landing and take-off cycles and maritime activities	Energy Balance - Ministry of Economic Development Statistical Yearbooks - National Statistical System Statistical Yearbooks - Ministry of Transportation Statistical Yearbooks - Italian Civil Aviation Authority (ENAC) Maritime and Airport local authorities
1A4 Residential-public-commercial sector	Fuel use	Energy Balance - Ministry of Economic Development
1B Fugitive Emissions from Fuel	Amount of fuel treated, stored, distributed	Energy Balance - Ministry of Economic Development Statistical Yearbooks - Ministry of Transportation Major National Industry Corporation
2 Industrial Processes	Production data	National Statistical Yearbooks- National Institute of Statistics International Statistical Yearbooks-UN European Emissions Trading Scheme European Pollutant Release and Transfer Register Sectoral Industrial Associations
3 Solvent and Other Product Use	Amount of solvent use	National Environmental Publications - Sectoral Industrial Associations International Statistical Yearbooks – UN
4 Agriculture	Agricultural surfaces Production data Number of animals Fertiliser consumption	Agriculture Statistical Yearbooks - National Institute of Statistics Sectoral Agriculture Associations
5 Land Use, Land Use Change and Forestry	Forest area, biomass increment and stock Biomass burnt	National Forestry Service (CFS) - National and Regional Forestry Inventory Statistical Yearbooks - National Institute of Statistics Universities and Research Institutes
6 Waste	Amount of waste	National Waste Cadastre - Institute for Environmental Protection and Research, National Waste Observatory

3.2.3 Key categories identification

A key category analysis of the Italian inventory is carried out according to the Approach 1 and Approach 2 described in the 2006 IPCC Guidelines (IPCC, 2006). According to the IPCC guidelines, a key category is defined as an emission category that has a significant influence on a country's GHG inventory in terms of the absolute level and trend in emissions and removals, or both. Key categories are those which, when summed together in descending order of magnitude, add up to over 95% of the total emissions or 90% of total uncertainty.

A quantitative analysis is carried out on the Italian greenhouse gas inventory to establish the uncertainties of different emission categories, the uncertainty of total emissions for the base year and the latest inventory year, and the so- called trend uncertainty. The uncertainty assessment helps the identification of the key categories whose effect on the total uncertainty of the inventory is the highest; furthermore, by means of such an assessment, the improvement measures can be directed so that the total uncertainty of the inventory can be lowered as effectively as possible.

Quantitative estimates of uncertainty for the Italian GHG inventory are calculated using Approach 1 as defined in the 2006 IPCC Guidelines, which provides a calculation based on the error propagation equations. National emissions are disaggregated, as far as possible, into the categories proposed in the guidelines; other categories are added to reflect specific national circumstances. Both level and trend analysis are applied to the base year and to the last submitted inventory including and excluding the LULUCF sector.

In summary, the overall uncertainty in the national total emissions, excluding LULUCF, is equal to 2.6% for the year 2015; the uncertainty in the trend between the base year and 2015 is equal to 2.0%. When considering the LULUCF sector in the analysis, the uncertainty in total GWP emissions and removals increases to 4.8% for the year 2015 and to 3.8% in the trend.

Further information on these figures is reported in the National Inventory Report.

The uncertainty figures are used to carry out a key category analysis on the inventory applying the IPCC Approach 2 which helps prioritising activities to improve inventory quality and to reduce overall uncertainty. Key categories are categories that should receive special consideration in terms of methodological aspects and quality assurance and quality control verification.

For the categories with a high uncertainty, generally, further improvements are planned whenever sectoral studies can be carried out. For example, last year, the prioritisation of improvements related to the results of uncertainty analysis led to a revision of the net carbon stock changes and further activities are planned for the LULUCF sector to improve the accuracy and reduce the overall uncertainty.

Applying category analysis to the 2015 inventory, without considering the LULUCF sector, 46 key categories were identified in total, both at level and trend. When considering emissions and removals from the LULUCF sector, the same number of key categories were identified.

Results of the key category assessment for the 2015 inventory are reported in Table 3.3. More details can be found in the National Inventory Report.

Table 3.3 - Key categories by the IPCC Approach 1 and Approach 2 (L=Level, T=Trend). Year 2015

Key categories (excluding the LULUCF sector)	
Biological treatment of Solid waste - N_2O	L2,T2
Chemical industry - CO_2 Ammonia production	T1
Chemical industry - HFCs Fluorochemical production	T2
Chemical industry - N_2O Adipic acid production	T
Chemical industry - N_2O Nitric acid production	T
Chemical industry - PFCs Fluorochemical production	L,T
Direct N_2O Emissions from Managed soils	L
Energy industries - CO_2 gaseous fuels	L,T
Energy industries - CO_2 liquid fuels	L,T
Energy industries - CO_2 solid fuels	L,T
Enteric Fermentation - CH_4	L,T
Fugitive - CH_4 Oil and natural gas - Natural gas	L,T
Fugitive - CO_2 Oil and natural gas - Oil	L1
Fugitive - CO_2 Oil and natural gas - venting and flaring	T2
Indirect N_2O Emissions from Managed soils	L
Indirect N_2O Emissions from Manure Management	L2
Manufacturing industries and construction - CO_2 gaseous fuels	L,T1
Manufacturing industries and construction - CO_2 liquid fuels	L,T
Manufacturing industries and construction - CO_2 solid fuels	L1,T
Manufacturing industries and construction - N_2O liquid fuels	T2
Manure Management - CH_4	L
Metal industry - CO_2 Iron and steel production	T
Metal industry - PFCs Aluminium production	T
Mineral industry - CO_2 Cement production	L,T
Mineral industry - CO_2 Lime production	L1
Mineral industry - CO_2 Other processes uses of carbonates	T
Non-Energy products from Fuels and Solvent Use - CO_2	L2,T2
Other sectors - CH_4 commercial, residential, agriculture biomass	L,T
Other sectors - CO_2 commercial, residential, agriculture gaseous fuels	L,T
Other sectors - CO_2 commercial, residential, agriculture liquid fuels	L,T
Other sectors - CO_2 commercial, residential, agriculture other fossil fuels	L1,T
Other sectors - CO_2 commercial, residential, agriculture solid fuels	T1
Other sectors - N_2O commercial, residential, agriculture biomass	L2,T
Other sectors - N_2O commercial, residential, agriculture liquid fuels	L2
Product uses as substitutes for ozone depleting substances - HFCs Fire protection	T2
Product uses as substitutes for ozone depleting substances - HFCs Foam blowing agents	L2,T2
Product uses as substitutes for ozone depleting substances - HFCs Refrigeration and Air conditioning	L,T
Rice cultivations - CH_4	L1
Solid waste disposal - CH_4	L,T
Transport - CH_4 Road transportation	T2
Transport - CO_2 Civil Aviation	L1,T1
Transport - CO_2 Road transportation	L,T
Transport - CO_2 Waterborne navigation	L1,T1
Transport - N_2O Road transportation	L2
Wastewater treatment and discharge - CH_4	L,T2
Wastewater treatment and discharge - N_2O	L2,T2

L1 = level key category by Approach 1
T1 = trend key category by Approach 1
L2 = level key category by Approach 2
T2 = trend key category by Approach 2
L = level key category by Approach 1 and Approach 2
T = trend key category by Approach 1 and Approach 2

Key categories (including the LULUCF sector)	
Biological treatment of Solid waste - N_2O	T2
Chemical industry- CO_2 Ammonia production	T1
Chemical industry- N_2O Adipic acid production	T
Chemical industry- N_2O Nitric acid production	T1
Chemical industry- PFCs Fluorochemical production	L2,T
Cropland Remaining Cropland - CO_2	L,T
Direct N_2O Emissions from Managed soils	L
Energy industries - CO_2 gaseous fuels	L,T
Energy industries - CO_2 liquid fuels	L,T

L1 = level key category by Approach 1
T1 = trend key category by Approach 1
L2 = level key category by Approach 2
T2 = trend key category by Approach 2
L = level key category by Approach 1 and Approach 2
T = trend key category by Approach 1 and Approach 2

Key categories (including the LULUCF sector)	
Energy industries - CO_2 solid fuels	L,T
Enteric Fermentation- CH_4	L,T
Forest Land remaining Forest Land - CO_2	L,T
Fugitive - CH_4 Oil and natural gas - Natural gas	L,T
Fugitive - CO_2 Oil and natural gas - Oil	L1
Grassland Remaining Grassland - CH_4	T2
Grassland Remaining Grassland - CO_2	L2,T
Harvest Wood Products - CO_2	T
Indirect N2O Emissions from Managed soils	L
Land Converted to Cropland - CO_2	T2
Land Converted to Forest Land - CO_2	L,T
Land Converted to Grassland - CO_2	L,T
Land Converted to Settlements - CO_2	L,T
Manufacturing industries and construction - CO_2 gaseous fuels	L,T1
Manufacturing industries and construction - CO_2 liquid fuels	L,T
Manufacturing industries and construction - CO_2 solid fuels	L1,T
Manure Management - CH_4	L
Metal industry - CO_2 Iron and steel production	T1
Metal industry - PFCs Aluminium production	T
Mineral industry - CO_2 Cement production	L,T
Mineral industry - CO_2 Lime production	L1
Mineral industry - CO_2 Other processes uses of carbonates	T1
Non-Energy products from Fuels and Solvent Use - CO_2	L2
Other sectors - CH_4 commercial, residential, agriculture biomass	L,T
Other sectors - CO_2 commercial, residential, agriculture gaseous fuels	L,T
Other sectors - CO_2 commercial, residential, agriculture liquid fuels	L,T
Other sectors - CO_2 commercial, residential, agriculture other fossil fuels	L1,T1
Other sectors - N_2O commercial, residential, agriculture biomass	L2,T
Product uses as substitutes for ozone depleting substances - HFCs Foam blowing agents	T
Product uses as substitutes for ozone depleting substances - HFCs Refrigeration and Air conditioning	L,T
Rice cultivations - CH_4	L1
Solid waste disposal - CH_4	L
Transport - CO_2 Civil Aviation	L1,T1
Transport - CO_2 Road transportation	L,T
Transport - CO_2 Waterborne navigation	L1
Wastewater treatment and discharge - CH_4	L
Wastewater treatment and discharge - N_2O	L2,T2

3.2.4 Recalculations

The entire time series from 1990 is checked and revised during the annual compilation of the national inventory.

Recalculations are made due to changes in the methodologies used to carry out emission estimates, different allocation of emissions compared to previous submissions, error corrections and the availability of new information. Recommendations from the UNFCCC reviews and other national and international processes are also followed. Explanatory information on the annual major recalculations is reported in the annual National Inventory Report.

Improvements in the calculation of emission estimates may lead to a recalculation of the entire time series of the national inventory. For example in the 2015 submission, considering the total GHG emissions without LULUCF, emission levels of the base year show a decrease in comparison with previous annual inventory submission (-0.4%) whereas emissions for the year 2014 showed an increase equal to 1.1%. Considering the national total including the LULUCF sector, the base year has increased by 0.2%, and the 2014 emission levels decreased by 0.8%.

In the last years, major changes regarded the energy sector, due to the update of CO_2 emission factors for different fuel on account of information from operators under the European emissions trading scheme, in particular coal, derived gases and natural gas. In the industrial and in the agriculture sectors, minor recalculations occurred on account of the update of different activity data and parameters. The LULUCF sector was also affected by several updates in methodology to calculate emissions and removals, in parameters and coefficients used to estimate carbon stock changes in the required pools. In the waste sector, the main revision regarded the update of waste incineration emissions based on data collected at plant level.

3.2.5 QA/QC plan

ISPRA has elaborated a QA/QC manual for the national emission inventory that describes QA/QC procedures and verification activities to be followed during the inventory compilation (ISPRA, 2013)[28]. Furthermore, specific QA/QC procedures and different verification activities implemented thoroughly the current inventory compilation, as part of the estimation process, are figured out in the annual QA/QC plan (ISPRA, 2017)[29]. These documents are available at http://www.sinanet.isprambiente.it/it/sia-ispra/serie-storiche-emissioni.

Quality control checks and quality assurance procedures, together with some verification activities, are applied to the national inventory both as a whole and at sectoral level. Future planned improvements are prepared for each sector by the relevant inventory compiler; each expert identifies areas for sectoral improvement based on his own knowledge and in response to inventory UNFCCC reviews and other kind of processes.

Feedbacks for the Italian inventory are obtained by communicating data to various institutions and/or at local level. For instance, the communication of the inventory to the European Community results in a pre-check of the GHG values before its submission to the UNFCCC, allowing possible relevant inconsistencies to be highlighted. Emission figures are also subjected to a process of re-examination once the inventory, the inventory related publications and the national inventory reports are posted on a website, specifically at www.isprambiente.gov.it.

As for official independent reviews, an agreement to conduct a bilateral review between Italy and Spain was established in 2012, with a focus on the revision of the GHG inventories of both Parties. Two in-country visits were already held; the Italian team revised part of the energy sector of Spain, specifically the categories public power plants, petroleum-refining plants, road transport and off-road, whereas the Spanish team revised the Industrial processes and solvent and other product use, and the LULUCF sectors of Italy. Aim of the review was to carry out a general quality assurance analysis of the inventories in terms of the methodologies, the EFs and the references used, as well as analysing critical cross cutting issues such as the details of the national energy balances and comparison with international data (Eurostat and IEA), use of plant-specific information.

Additionally, the Aether consultants have undertaken an official independent review of the entire Italian greenhouse gas inventory. Main findings and recommendations are reported in a final document, and

[28] ISPRA, 2013. Quality Assurance/Quality Control plan for the Italian Emission Inventory. Procedures Manual. October 2013.

[29] ISPRA, 2017. Quality Assurance/Quality Control plan for the Italian Emission Inventory. Available on line at: http://www.sinanet.isprambiente.it/it/sia-ispra/serie-storiche-emissioni

regard the transparency in the NIR, the improvement of QA/QC documentation and some pending issues in the LULUCF sector. These suggestions have been considered to improve future submissions.
In 2013, ISPRA finalised the provincial inventory at local scale for the year 2010 and updated figures for 1990, 1995, 2000 and 2005 in the framework of the Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) under the Convention on Long-range Transboundary Air Pollution (CLTRAP). Specifically, ISPRA has applied a top-down approach to estimate emissions at provincial areas based on proxy variables. Regional and local environmental agencies and authorities checked out the results; data are available at the following ISPRA web address: http://www.sinanet.isprambiente.it/it/sia-ispra/inventaria. The provincial inventory for the year 2015 is under finalization.
The inventory is also presented to a Technical Committee on Emissions (CTE), coordinated by the Ministry for the Environment, Land and Sea, where all the relevant Ministries and local authorities are represented; within this context, emission figures and results are shared and discussed. Especially in the last years, there has been an intensification of the activities in order to establish national policies and measures to meet the 2020 EU target and implement national programmes for the post-Kyoto period. In this regard, and as a basis for emission scenarios, the importance of the emission inventory is primary.
Moreover, from 2011, a report concerning the state of implementation of commitments to reduce greenhouse gases emissions, and describing emission trend and projections, is prepared by IMELS in consultation with other relevant Ministers. The report is annexed to the economy and financial document (DEF) to be annually approved by the Government.

Expert peer-reviews of the national inventory also occur annually within the UNFCCC process, and their results and suggestions can provide valuable feedback on areas where the inventory should be improved.
Moreover, at European level, experts from various Member States for critical sectoral categories undertake voluntary reviews of the European inventory.
Comparisons between national activity data and data from international databases are usually carried out in order to identify and explain the main differences.
The quality of the inventory has also been improved through the organization and participation in sector-specific workshops.
A specific procedure undertaken to improve the inventory was the establishment of national expert panels (in particular on road transport, land use change and forestry and energy sectors) which involve, on a voluntary basis, different institutions, local agencies and industrial associations cooperating to improve activity data and emission factors accuracy.
In addition to these expert panels, ISPRA participates in technical working groups within the National Statistical System. These groups, named "*Circoli di qualità"*, coordinated by the National Institute of Statistics, are constituted by both producers and users of statistical information with the aim of improving and monitoring statistical information in specific sectors such as transport, industry, agriculture, forest and fishing. As reported in previous sections, these activities improve the quality and details of basic data, as well as enable a more organized and timely communication.
A proper archiving and reporting of the documentation related to the inventory compilation process is also part of the national QA/QC programme. All the material and documents used for the inventory preparation are stored at the Institute for Environmental Protection and Research.

Information relating to the planning, preparation, and management of inventory activities are documented and archived. A master documentation catalogue is generated for each inventory year and it is possible to track changes in data and methodologies over time. Specifically, the documentation includes:

- electronic copies of each of the final inventory report and drafts, electronic copies of the final CRF tables and drafts;
- electronic copies of all the final, linked source category spreadsheets for the inventory estimates (including all spreadsheets that feed the emission spreadsheets);
- results of the reviews and, in general, all documentation related to the corresponding inventory year submission.

After each reporting cycle, all database files, spreadsheets and electronic documents are archived as 'read-only' mode.

A 'reference' database is also compiled every year to increase the transparency of the inventory. This database consists of a number of records that references all documentation used during the inventory compilation, for each sector and submission year, the link to the electronically available documents and the place where they are stored as well as internal documentation on QA/QC procedures.

3.3 National registry

In March 2006, Italy started operating a national registry under Article 19 of Directive 2003/87/EC of the European Commission establishing the European Emission Trading Scheme (EU ETS). This registry is conceived for the administration of emissions allowances allocated to operators participating to the EU ETS and it is developed according to the UN Data Exchange Standards document. Therefore, in October 2008, after an initialization process and a go-live phase with the UNFCCC, the registry established under Directive 2003/87/CE also became part of the Kyoto system of registries, ensuring the precise tracking of holdings, issuances, transfers, cancellations and retirements of allowances and Kyoto units.

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

The consolidated platform which implements the national registries in a consolidated manner (including the registry of the EU) is called the "Union registry" and was developed together with the new EU registry on the basis of the following modalities:

1. Each Party retains its organization designated as its registry administrator to maintain the national registry of that Party and remains responsible for all the obligations of Parties that are to be fulfilled through registries;
2. Each Kyoto unit issued by the Parties in such a consolidated system is issued by one of the constituent Parties and continues to carry the Party of origin identifier in its unique serial number;

3. Each Party retains its own set of national accounts as required by paragraph 21 of the Annex to Decision 15/CMP.1. Each account within a national registry keeps a unique account number comprising the identifier of the Party and a unique number within the Party where the account is maintained;
4. Kyoto transactions continue to be forwarded to and checked by the UNFCCC Independent Transaction Log (ITL), which remains responsible for verifying the accuracy and validity of those transactions;
5. The transaction log and registries continue to reconcile their data with each other in order to ensure data consistency and facilitate the automated checks of the ITL;
6. The requirements of paragraphs 44 to 48 of the Annex to Decision 13/CMP.1 concerning making non-confidential information accessible to the public is fulfilled by each Party through a publicly available web page hosted by the Union registry;
7. All registries reside on a consolidated IT platform sharing the same infrastructure technologies. The chosen architecture implements modalities to ensure that the consolidated national registries are uniquely identifiable, protected and distinguishable from each other, notably:
    - With regards to the data exchange, each national registry connects to the ITL directly and establishes a secure communication link through a consolidated communication channel (VPN tunnel);
    - The ITL remains responsible for authenticating the national registries and takes the full and final record of all transactions involving Kyoto units and other administrative processes such that those actions cannot be disputed or repudiated;
    - With regards to the data storage, the consolidated platform continues to guarantee that data is kept confidential and protected against unauthorized manipulation;
    - The data storage architecture also ensures that the data pertaining to a national registry are distinguishable and uniquely identifiable from the data pertaining to other consolidated national registries;
    - In addition, each consolidated national registry keeps a distinct user access entry point (URL) and a distinct set of authorisation and configuration rules.

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

A complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of the EU and all consolidating national registries. This description includes:

- Readiness questionnaire
- Application logging
- Change management procedure
- Disaster recovery
- Manual Intervention
- Operational Plan

- Roles and responsibilities
- Security Plan
- Time Validation Plan
- Version change Management

The documents above are annexed to the 2013 National Inventory Report submission.

A new central service desk was also set up to support the registry administrators of the consolidated system. The new service desk acts as second level of support to the local support provided by the Parties. It also plays a key communication role with the ITL Service Desk with regards notably to connectivity or reconciliation issues.

3.3.1 Description of how the Italian registry performs functions defined in the annexes to decisions 13/CMP.1 and 5/CMP.1, and conformity with the requirements of the technical standards for data exchange (DES)

a) *The name and contact information of the registry administrator designated by the Party to maintain the national registry*

The Italian Registry is administrated by ISPRA (national Institute for Environmental Protection and Research) under the supervision of the national Competent Authority for the implementation of the European directive 2003/87/EC, jointly established by the Ministry for Environment, Land and Sea and the Ministry for Economic Development. ISPRA, as Registry Administrator, is responsible for the management and functioning of the Registry, including Kyoto protocol obligations.

The contact person is: Mr Riccardo Liburdi
address: Via Vitaliano Brancati 48 – 00144 Rome – Italy
telephone: +39 0650072544
e-mail: riccardo.liburdi@isprambiente.it

No change of name or contact occurred since the last National Communication report.

b) *The names of the other Parties with which the Party cooperates by maintaining their national registries in a consolidated system*

Italy maintains its national registry in a consolidated manner with all the Parties that are also EU Member States and with the European Union, sharing the same platform hosted and facilitated by the European Commission.
No change of cooperation arrangement occurred since the last National Communication report.

c) *A description of the database structure and capacity of the national registry*

The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries.

During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the Data Exchange Standard (DES). All tests were executed successfully and lead to successful certification on 1 June 2012.

In 2016, new tables were added to the database for the implementation of the CP2 functionalities.

Versions of the Union registry released after 6.1.6 (the production version at the time of the last NC 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. Furthermore, no change to the capacity of the national registry occurred since the last National Communication report.

The database model, including the new tables, has been provided along with NIR submission for year 2016.

d) *A description of how the national registry conforms to the technical standards for data exchange between registry systems for the purpose of ensuring the accurate, transparent and efficient exchange of data between national registries, the clean development mechanism registry and the transaction log (decision 19/CP.7, par. 1)*

The overall change to a Consolidated System of EU Registries triggered changes to the registry software and required new conformance testing. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries.

During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the Data Exchange Standard (DES). All tests were executed successfully and lead to successful certification on 1 June 2012.

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 each release of a new version in Production. Annex H testing is carried out every year. No other change in the registry's conformance to the technical standards occurred since the last National Communication report.

The most recent test results have been provided along with NIR submission for year 2016.

e) *A description of the procedures employed in the national registry to minimize discrepancies in the issuance, transfer, acquisition, cancellation and retirement of ERUs, CERs, tCERs, lCERs, AAUs and/or RMUs, and replacement of tCERS and lCERs, and of the steps taken to terminate transactions where a discrepancy is notified and to correct problems in the event of a failure to terminate the transactions*

The overall change to a Consolidated System of EU Registries also triggered changes to discrepancies procedures, as reflected in the updated *manual intervention document* and the

operational plan. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries.
No change of discrepancies procedures occurred since the last National Communication report.

f) An overview of security measures employed in the national registry to prevent unauthorized manipulations and to prevent operator error and of how these measures are kept up to date

The overall change to a Consolidated System of EU Registries also triggered changes to security, as reflected in the updated *security plan*. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries.
In 2016, the mandatory use of hard tokens for authentication and signature was introduced for registry administrators. No other change regarding security occurred since the last National Communication report.

g) A list of the information publicly accessible by means of the user interface to the national registry

Publicly available information is provided via the Union registry at the national homepage https://ets-registry.webgate.ec.europa.eu/euregistry/IT/public/reports/publicReports.xhtml
All non-confidential information required by Decision 13/CMP.1 annex II.E paragraphs 44-48, is publicly accessible with the following exceptions:

- paragraph 45(d)(e): account number, representative identifier name and contact information is deemed as confidential according to Annex III and VIII (Table III-I and VIII-I) of Commission Regulation (EU) No 389/2013;
- paragraph 46: no Article 6 (Joint Implementation) project is reported as conversion to an ERU under an Article 6 project did not occur in the specified period;
- paragraph 47(a)(d)(f): holding and transaction information is provided on an account type level, due to more detailed information being declared confidential by article 110 of Commission Regulation (EU) No 389/2013.

No change to list of publicly available information occurred since the last National Communication report.

h) The Internet address of the interface to its national registry

The Italian registry can be accessed at the following URL:
https://ets-registry.webgate.ec.europa.eu/euregistry/IT/index.xhtml
No change of the registry internet address occurred since the last National Communication report.

i) A description of measures taken to safeguard, maintain and recover data in order to ensure the integrity of data storage and the recovery of registry services in the event of a disaster

The overall change to a Consolidated System of EU Registries also triggered changes to data integrity measures, as reflected in the updated *disaster recovery plan*. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. No change of data integrity measures occurred since the last National Communication report.

j) The results of any test procedures that might be available or developed with the aim of testing the performance, procedures and security measures of the national registry undertaken pursuant to the provisions of decision 19/CP.7 relating to the technical standards for data exchange between registry systems

The consolidated EU system of registries successfully completed a full certification procedure in June 2012. Notably, this procedure includes connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the Data Exchange Standard (DES). This included a full Annex H test. All tests were executed successfully and led to successful certification on 1 June2012.

On 2 October 2012, a new software release (called V4) including functionalities enabling the auctioning of phase 3 and aviation allowances, a new EU ETS account type (trading account) and a trusted account list went into Production. The trusted account list adds to the set of security measures available in the Union Registry. This measure prevents any transfer from a holding account to an account that is not trusted. Version 4 was only a minor iteration and changes were limited to EU ETS functionality and had no impact on Kyoto Protocol functions in the registry. However, each new release of the registry is subject to both regression testing and tests related to new functionalities. These tests include thorough testing against the DES and are carried out prior to the relevant major release of the version to Production. The site acceptance tests are carried out by quality assurance consultants on behalf of and assisted by the European Commission. Annex H testing is carried out on an annual basis.

The most recent test results have been provided along with NIR submission for year 2016.

4 POLICIES AND MEASURES[30]

4.1 Policy making process

In the most recent years, actions taken by Italy to mitigate climate change have been driven by the commitments undertaken under:

- the Kyoto Protocol target and its amendment ('Doha amendment');
- the so called "EU Climate and Energy Package" for the period 2013-2020;
- the EU INDC and the so called "2030 EU Climate and Energy Framework" for the period 2021-2030.

4.1.1 The Kyoto Protocol and its amendment ('Doha amendment')

Under the Kyoto Protocol, the EU-15[31] has agreed to reduce its greenhouse gas (GHG) emissions by 8% in the period 2008–2012 (commitment period) compared to base year levels and and to distribute the reduction effort between the Member States through the so called "EU burden sharing agreement".
In the framework of the EU Burden Sharing Agreement, Italy has committed to reduce its GHG emissions by 6.5% below base-year levels (1990) over the first commitment period, 2008-2012. After the review of the initial report of Italy under the Kyoto Protocol (FCCC/IRR/2007/ITA) the Kyoto objective has been established as 483.26 $MtCO_2$/year for each year of the "commitment period".

At the end of the first commitment period, Italy had reduced its GHG emissions by 4.6% below base-year levels. During the true-up period, for fulfilling commitments under Article 3.1 of the Kyoto Protocol[32], Italy undertook adequate actions to achieve compliance.

Moreover, to ensure reductions after 2012, the EU and its Member States have committed to the 'Doha Amendment to the Kyoto Protocol', adopted on 8 December 2012. In Particular, the EU and its Member States have established to reduce their collective emissions to 20% below their levels in 1990 during the commitment period 2013-2020, as reflected in the Doha Amendment.. The target is to be fulfilled jointly with Iceland[33].

4.1.2 The "Climate and Energy Package" and the Effort Sharing Decision n. 406/2009/EC

The 8th and 9th March 2007 conclusion of the European Council named "Integrated Energy and Climate Change Package" (IECCP) committed the European Member States to achieve by 2020 the following targets:

- 20% reduction of EU GHG emissions compared to 1990. This reduction could be raised to 30% with a global agreement for the period post 2012.
- 20% reduction in energy use to be achieved by improving energy efficiency.
- 20% use of renewable energy

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[31] Until 1 May 2004 the Member States of the EU were 15 (Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, Netherlands, Austria, Portugal, Finland, Sweden, United Kingdom). After 1 May 2004 thirteen new Member States joined the Union (Bulgaria, Croatia, Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia).
[32] http://unfccc.int/kyoto_protocol/true-up_process/items/9023.php
[33] NIR 2017

- 10% use of biofuels in the transport sector.

This comprehensive set of legislation acts, also known as the 'Climate and Energy package' or "20/20/20 package", was agreed at EU level to reach those objectives and is being implemented. The most relevant European legislation acts are:

- *Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing directive 2001/77/EC and 2003/30/EC:* this Directive also subdivides the 20% renewable target between the EU Member States. According to that, by 2020 the 17% of the national final energy consumption of Italy should come from renewable sources.
- *Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the community*: this Directive revises and strengthens the EU Emissions Trading Scheme (EU ETS) already in place since 2005, which commits to an overall EU reduction of 21% of emissions compared to 2005 levels from the industrial sector.
- *Decision n. 406/2009/EC of the European Parliament and of the Council of 23 April 2009 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 (ESD*): by 2020 Italy shall reduce the GHG emissions by 13% *compared to 2005 levels, in all the sectors not covered by the EU ETS, such as transport, civil, agriculture and waste sectors.*
- *Directive 2012/27/EC of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC:* this Directive establishes a common framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union's 2020 20 % headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date.

To monitor progress and assess compliance towards the targets set by Directive 2009/29/CE and by Decision 406/2009/CE, starting from year 2013 national emissions and projections should be divided in two main sectors: EU ETS and all other sectors (non-ETS).

4.1.3 The European Union Emission Trading Scheme - ETS sector

Directive 2003/87/EC established an Emissions Trading Scheme (EU-ETS), as the instrument to fulfil the EU reduction target under the Kyoto protocol for what concerns the industrial sector.

Its application started with a first 'pilot' phase as of 2005 to 2007, unlinked to the reaching of the Kyoto commitment, and then applied from 2008-2012 in order to contribute to the reaching of the Kyoto target. For what concerns the Kyoto period 2008-2012, Table 4.1 shows verified emissions submitted by ETS operators by sector in the second trading period (2008-2012) and the difference between the verified emissions and ex ante allocation.

Table 4.1 - Emissions and allocations for ETS sectors for the years covered by Kyoto Protocol

	2008	2009	2010	2011	2012
	Mt CO_2	Mt CO_2	Mt CO_2	Mt CO_2	Mt CO_2
Verified EU ETS operators emissions	220.7	184.9	191.5	190.0	179.1
Allocation (*)	201.6	201.6	201.6	201.6	201.6

	2008	2009	2010	2011	2012
Difference between verified emissions and allocation	19.1	-16.7	-10.1	-11.6	-22.5
Allowed use of CERs/ERUs	30.2	30.2	30.2	30.2	30.2

(*) Note: the table does not report the annual allocation change from year to year but the average annual cap

This directive has been amended by the Directive 2008/101/CE to include the aviation sector and by Directive 2009/29/CE, which introduces substantive changes in the scheme for stationary installations during the period 2013-2020. One of the most important changes relates to the EU wide cap setting procedure, as the new system is no longer based on national-cap setting but on a single EU-wide declining cap.

The EU-wide cap is determined according to a linear reduction path arriving at a reduction of 21% below reported 2005 emissions in 2020. The starting point of such path is the mid-point of the 2008-12 period, while the starting level is the average annual total quantity of allowances issued by Member States pursuant to Commission Decisions on Member States' national allocation plans for the period 2008-12. This path implies a decrease of the EU wide cap of 1.74% annually. Among the other significant changes it has to be underlined:

- auctioning has become the main allocation method and it's applied as the only allocation method for the power sector,
- Manufacturing sectors are allocated via benchmarks set as the average EU 10% best CO_2 performance per unit of production taking the years 2007-2008 as a basis for data.
- the commitment and trading period is extended from 5 to 8 years in order to provide for more certainty to industry,
- Other activities (such as the production of nitric, adipic, glyoxal and glyoxylic acid, the production of ammonia, aluminium) and greenhouse gases (nitrous oxide and perfluorocarbons) are included in the scheme.

National and international aviation, only including flights between airports located in the European Economic Area (EEA), has been included in ETS starting from 2012.

For the third trading period (2013-2020) EU ETS sectors, covering almost 45% of EU GHG emissions[34], will need to reduce emissions by 43% compared to 2005 levels[35] but no disaggregation of the objective at Member State level has been foreseen and an assessment of emissions of operators subject to ETS at national level is therefore only possible *ex post*.

4.1.4 Sectors under the Effort Sharing Decision (ESD)

As mentioned above, under the Effort Sharing Decision (Decision No 406/2009/EC) Italy has to reduce GHG emissions by 13% compared to 2005 levels. On 26th March 2013, the European Commission adopted a Decision (2013/162/EU) on determining Member States' annual emissions allocation for the years from 2013 to 2020. Italy's targets are reported in Table 4.2. In the table, two series of figures are reported as ESD targets for the period 2017-2020 have been revised in 2017 by Decision No 1471/2017 EU.

[34] https://ec.europa.eu/clima/sites/clima/files/factsheet_ets_en.pdf

[35] http://www.consilium.europa.eu/it/policies/climate-change/reform-eu-ets/

Table 4.2 – ESD 2013-2020 targets for Italy

	2013	2014	2015	2016	2017	2018	2019	2020
ITALY ESD Target - (with GWPs of 2006 IPCC guidelines) Decision 162/2013 EU and Decision 634/2013 EU	308.2	306.2	304.2	302.3	300.3	298.3	296.4	294.4
ITALY ESD Target - Decision 1471/2017 EU and Decision 634/2013 EU	308.2	306.2	304.2	302.3	298.3	295.8	293.4	291.0

4.1.5 The "2030 EU Climate & Energy Framework"

On the 12th December 2015, UNFCCC Decision 1/CP.21 adopted the Paris Agreement, a new international agreement aimed at reducing GHG emissions with a view of *"holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change"* (Article 2.a, Paris Agreement).

Decision 1/CP.21 also welcomes the submission of Intended Nationally Determined Contributions (INDCs). The European Union submitted an INDC committing its Member States to reduce its overall GHG emissions by at least 40% by 2030, compared to 1990 levels. The EU INDC, which was translated into a NDC following the ratification and entry into force of the Paris Agreement, is in line with the so called "2030 EU Climate and Energy Framework" defined in October 2014. The new Framework contains the following binding targets to be reached by 2030:

- at least 40% reduction in GHG emissions compared to 1990 (-43% and -30% by 2030, compared to 2005 levels, for EU ETS sectors and ESD sectors, respectively);
- at least 27% of energy consumption from renewable sources;
- at least 27% of energy efficiency improvements[36].

The GHG reduction objective translates into two objectives for ETS and non-ETS sector. As previously underlined, the ETS reduction will be applied uniformly throughout the EU with a declining EU wide emissions cap that will decrease annually by 2.2% up to 2030. The legislative act implementing such a revision is expected to be agreed by the end of 2017 (revised Directive 2003/87/CE).

Concerning non-ETS sectors, on the 20th July 2016 the European Commission presented an Effort Sharing Regulation, as a follow-up of the previous EU Effort Sharing Decision (ESD): under the ESR proposal Italy is assigned a 33% emission reduction target in non-ETS sectors to be achieved by 2030 compared to 2005 levels.

Furthermore, on the 20th of June 2016, an additional proposal for a regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry (LULUCF) into the 2030 Climate and Energy Framework was advanced by the EU Parliament and Council, to implement EU commitments under the Paris agreement on climate change. The European Council's guidance on including LULUCF into the EU's 2030 Climate and Energy Framework is also reflected in the EU's Nationally Determined Contribution. As for LULUCF, it was added that "policy on how to include Land Use, Land Use Change and Forestry into the 2030 greenhouse gas mitigation framework will be established as soon as technical conditions allow and in any case before 2020". The Paris Agreement, in its Article 4,

[36] https://ec.europa.eu/clima/policies/strategies/2030_en

indicates that the contribution from land use and forests will be critical in reaching "a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases".

As pointed out in this proposal, the implementation of the current LULUCF Decision (529/2013/EU) is under way and will deliver improved accounting systems by 2020. However, without a legal framework consolidating this implementation and defining the applicable rules for the period post-2020, the way in which LULUCF would be included in the overall framework could be heterogeneous across the EU. Accordingly, the objective of this proposal is to determine how the LULUCF sector will be included into the EU climate policy framework, as of 2021[37].

The two legislative acts deriving from the proposals on effort sharing and LULUCF are now in the last phases of negotiations between the EU institutions.

4.1.6 National decision-making process related to climate change policies

The Ministry of the Environment, Land and Sea (IMELS) is responsible for elaborating the national plan for GHG emissions reduction to be proposed for adoption to the Inter-Ministerial Committee for Economic Planning - CIPE (see paragraph 2.2.1).
The financial support and legislative instruments to implement the plan are identified through the Financial Law and are allocated to the central and local bodies on the basis of the respective competences.

Law N. 79/2016, the Ratification of the Doha amendment to the Kyoto Protocol", establishes under its article 5 and according to article 12 of 525/2013/EU (the Monitoring Mechanism Regulation), the National system for policies, measures and emissions projections. The National Institute for Environmental Protection and Research (ISPRA) is responsible of the system and, in cooperation with IMELS, collects all the information and data from the competent Ministries. Article 1 of the Decree implementing law N. 79 (9th December 2016), reports the list of information and data that are to be sent by the competent ministries to IMELS and ISPRA and also the timing for providing such information.

4.1.7 Monitoring and evaluation of progress with climate policies and measures

According with law No 79 (article 6), IMELS ensures the collection of information related to GHG emissions and other information concerning climate changes. IMELS also updates the document on the state of implementation of commitments to reduce GHG emissions, through an annex to the Financial Law.
The monitoring and evaluation of progress on policies and measures to cut greenhouse emissions are also reported in the documents submitted, every two years, by Member States to the European Commission under the Monitoring Mechanism Regulation[38].
Moreover, the Manager for Energy Services (GSE) sends to the European Commission the "Progress Report Under Art. 22 of the 2009/28/EU Directive" every two years, where an ex post assessments of the most relevant national measures related to renewable energy use and energy efficiency are reported. The

[37] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52016PC0479
[38] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32013R0525

document is available at the following address : https://ec.europa.eu/energy/en/topics/renewable-energy/progress-reports[39].

4.2 Overview on policies and measures

This section gives a description of the main policies and measures that have had or are expected to have a direct or indirect effect on the reduction of greenhouse gas emissions in Italy.
The potential emissions reduction has been assessed up to 2030. The policies and measures hereinafter described are divided into two types:

- Measures implemented up to the end of 2014 and minimal efficiency standards for buildings adopted in 2015 ;
- Measures planned at 31st May 2017. The measures envisaged as planned are consistent with the ones reported in the 2017 National Energy Strategy (SEN 2017[40]), but the assessment of impacts in terms of expected reductions is not yet available for all policies and measures. For this reason and as further described in Chapter 5, a With Additional Measures (WAM) scenario has not been performed in this Communication.

4.3 Cross Cutting policies

4.3.1 National Action Plan for Renewable Energy 2010 and Legislative decree 28/2011

In January 2007, the Commission published a Renewable Energy Roadmap outlining a long-term strategy and in 2009 the EU adopted Directive 2009/28/EC aiming at increasing the average renewable share across the EU to 20% by 2020. Such Directive sets mandatory national targets for the overall share of energy from renewable sources in gross final consumption of energy: the national target for Italy is 17%.. EU countries are free to decide their own preferred 'mix' of renewable sources, allowing them to take account of their different potentials. They had to present National Action Plans (NAPs) based on indicative trajectories to the European Commission by 30 June 2010, followed by progress reports to be submitted every two years. The objective expressed in the form of a share of energy from renewable sources relative to total consumption in transport, electricity and heating and cooling in 2020 also takes into account the effects of other policy measures addressing energy efficiency.
The Directive 2009/28/EU has been transposed by the Legislative Decree N. 28 of 3rd March 2011. The decree defines the mechanisms, the incentives and the institutional, financial and legal tools necessary to achieve the 2020 targets regarding the renewable energy use. The decree also provides for a substantial reorganization of existing incentive schemes, in particular in the field of green certificates and white certificates system, both described below.

[39] In the 2015 submission, please find the folder "Member State progress reports translated into English" and then, inside the folder, the file "Report 2015 Italy-EN".

[40] http://www.sviluppoeconomico.gov.it/index.php/it/energia/strategia-energetica-nazionale

4.3.2 Decree 28th December 2012 - Conto Termico ("Thermal/Heat Account")

The 28th December 2012 decree, the so called "Conto Termico" decree, implements the incentive scheme introduced by Legislative Decree 28/2011; in particular, it encourages small-scale energy efficiency measures in public sector buildings and the production of thermal energy from renewable sources (in both public and private sectors).

The measures covered by the decree are: building shells, replacement of heating plants with more efficient ones and replacement or installation of equipment using renewable energy.

The incentives are identified based on the energy saving achievable for the building and on energy production from renewable sources.

At the beginning of 2016, a revision of the Thermal/Heat Account has been introduced. The new legislation is now fully complementary to the Tax deductions (described below). In addition to the introduction of new energy efficiency measures, the scope of eligible subjects has been expanded and the size of eligible plants has been increased. In addition, the direct access procedure was simplified, the incentive disbursement period decreased, and the one-off payment limit increased. First results show more success than the first Thermal/Heat Account.

4.3.3 Directive 2012/27/EC – Energy Efficiency and Legislative Decree 102/2014

The Directive 2012/27/UE establishes a EU wide common framework for the promotion of energy efficiency, without setting mandatory targets but at the same time pointing out measures in the areas of energy-supply and energy end-use.

The most relevant provisions are the ones related to the renovation of buildings in the public sector, the metering and accounting of energy efficiency, the promotion of heating and cooling (the impact on heat generation), processing, transmission and distribution of energy.

The Directive 2012/72/EU has been transposed by the Legislative Decree N. 102/2014. Articles 5 and 6 of the decree envisage that from 2014 to 2020 measures should be undertaken to redevelop the buildings of central administration. The decree establishes a "New fund for Energy Efficiency". This fund will grant loans with subsidized rates to public and private entities to implement energy efficiency measures.

Moreover, in July 2014 an energy efficiency plan "PAEE 2014 - Piano di Azione per l'Efficienza Energetica"[41] has been approved by the Government. The PAEE reports the national energy efficiency objectives and all the measures put in place to achieve them. In particular, the plan proposes to strengthen the measures already implemented (in particular the "White Certificates"). The plan is available online: https://ec.europa.eu/energy/sites/ener/files/documents/2014_neeap_it_italy.pdf.

4.3.4 The White Certificates system

The White Certificates or Energy Efficiency Titles (EETs) system represents a cross cutting policy aimed at promoting energy efficiency and delivering emissions reductions in all end-use energy sectors: industrial, residential, and tertiary. The system was firstly introduced in July 2001 by means of two ministerial decrees. The history of this measure was described in detail in paragraph 4.3 of the 5NC. The system

[41] https://ec.europa.eu/energy/sites/ener/files/documents/2014_neeap_it_italy.pdf

introduces and enforces energy saving targets for electricity and natural gas distributors.

In December 2012, the so called “White Certificate Decree” was issued, concerning the determination of national quantitative targets of energy savings that must be pursued by distribution companies for electricity and gas from 2013 to 2016, and the expansion of the White Certificates mechanism. The decree also defines the criteria, the conditions and the procedures to implement energy efficiency measures in end-use energy and transfers competences to the GSE from 2013 concerning the management, assessment and certification of energy saving projects carried out under white certificates.

Table 4.3 - National target for primary energy savings

REVISED TARGET FOR THE ITALIAN WHITE CERTIFICATE SYSTEM 2013-2016 (Mtoe/Year)

Year	Electricity distributors	Gas distributors
2013	3.03	2.48
2014	3.71	3.04
2015	4.26	3.49
2016	5.23	4.28

The certification of energy savings produced by each project is made via the issue of Energy Efficiency Titles (EETs). 1 EET is equivalent to 1 Mtoe of energy savings.

The eligible projects are: re-phasing of electric systems, electric motors and their applications, lighting systems, reduction of electricity leaking, switching from electricity to other fuels when this produces primary energy savings, reduction of electricity consumption for heating purposes, reduction of electricity consumption for air conditioning, high efficient electric appliances, high efficient office equipment, switching from other fuels to electricity when this produces primary energy savings, reduction of primary energy consumption in industrial processes, reduction of primary energy consumption for heating, ventilation and air conditioning system, promotion of end-use technologies fuelled by renewable sources, electric and gas-fuelled vehicles, information campaigns to raise awareness and promote energy savings.

A further extension of the White Certificates system objective until 2030 is foreseeable because the decree 102/2014 highlights that White Certificates are the relevant measure to achieve the energy efficiency target. This extension has been considered as a planned measure.

4.3.5 “Fondo Rotativo Kyoto” (“Kyoto Revolving Fund”)

The “Fondo Rotativo di Kyoto” is a plan originally designed to promote public and private investment for energy efficiency in the building sector and in the industrial sector, and to promote small high-efficiency systems for the production of electricity, heating and cooling, use of renewable sources in small plants, the sustainable forest management and the promotion of innovative technologies in the energy sector. The Fund provides long term lending at low interest rate: the loans reimbursed by the operator are reused in other projects.

In June 2012, the Fund was re-oriented to finance private corporate “green” investment. An eligibility criterion to access the Fund was to create new jobs hiring young people under 35y.

In June 2015, the resources of the Fund have been re-allocated for the increase of the energy efficiency of public schools. The energy efficiency target is the improvement of two energy efficiency classes. Both

works for replacement of equipment and for building envelopes are financed. The loans can also be granted for reducing the seismic risks of the public schools subject to energy efficiency improvements.
The interest rate is 0,25% and the loan duration is 20 years. The Fund is currently open and the deadline for financing requests is 30 June 2018.

4.3.6 The Kyoto mechanisms

For the first commitment period, the project-based Kyoto Protocol Mechanisms (Joint Implementation (JI) and Clean Development Mechanism (CDM))[42] played a role in meeting the Italian target under the Protocol and operators' commitments under Directive 2003/87/CE. The supplementarity principle embodied in the Kyoto Protocol was interpreted by the EU and its Member States as the possibility to use CERs/ERUs up to 50% of the GHG emissions reduction efforts.
Under the EU ETS Italian operators have been allowed to use CERs/ERUs up to 15% of the total quantity of allowances to be allocated. Considering that such quantity is equal to 201.6 $MtCO_2$/year, the maximum quantity of CERs/ERUs to be used by operators under Directive 2003/87/CE is equal to 30.2 $MtCO_2$/year. In order to respect the supplementarity principle, the maximum quantity of CERs/ERUs to be used by the Government to meet its Kyoto Protocol target is limited to the difference between the 50% of the GHG emissions reduction efforts[43] and the quantity of CERs/ERUs allowed to ETS operators, to date a ceiling of 12.9 Mt/year.
The credits from project-based mechanisms used for the first commitment period and financed by the Italian Ministry for the Environment Land and Sea through the ICF (Italian Carbon Fund), CDCF (Community Development Carbon Fund) and BioCF (BioCarbon Fund) are reported in the table below.
For the second commitment period, an amount of credits from project-based mechanisms would be voluntary cancelled by the Italian Ministry for the Environment Land and Sea to offset emissions from events hosted by the Italian government in order to enhance mitigation ambition, according to decision 1/CP.19, paragraph 5(c), and decision 1/CP.21.

Table 4.4 - Quantitative contribution of Kyoto mechanisms for the first commitment period

Kyoto mechanism	Total projected quantities for the first commitment period (Gg CO_2 equivalent)
Total for all Kyoto mechanisms	*10.15*
International emissions trading	*2.0*
All project based activities	
joint implementation	*0.15*
clean development mechanism	*8.0*

The table does not include credits used by ETS operators to comply with their surrender obligation under the EU ETS.

4.3.7 Ecodesign of energy-using products

The directive 2005/32/CE has established the first eco-design requirements for energy-using products. This directive has been transposed into the national legal system with the legislative decree 201/2007. In the 2009 the Energy-related-Products Directive 2009/125 / EC - ErP –has amended the Directive

2005/32/EC and through specific implementing regulations has set a framework related to the eco-design requirements for all products that use energy, except for those destined for the transport sector. This is the first directive that covers the entire life cycle of the product

4.3.8 Structural funds 2007-2013

This policy has been described in detail in the 5NC (see paragraph 4.3 and, in particular, table 4.3). Measures foresee a EU contribution in investments focused on the improvement of energy efficiency, the development of renewable energies and the improvement of transport networks and waste management. Although financial resources were exhausted, the effects of such funds are still in place.

4.3.9 Global Covenant of Mayors for Climate and Energy

The Global Covenant of Mayors is the result of the merging between the world's main initiatives of cities and local governments committed to undertake a transition towards a low emission and climate resilient economy. On October 15th, 2015, the Covenant of Mayors and the Mayors Adapt initiatives merged into the New Covenant of Mayors for Climate and Energy.

In the framework of the Global Covenant of Mayors for Climate and Energy, signatories are request to set targets for 2030 and to undertake the preparation and submission of a Sustainable Energy and Climate Action Plan (SECAP) to turn their commitment into specific actions, measures and projects. The SECAP is the key document in which the Global Covenant signatory outlines how it intends to reach its CO_2 reduction target and adaptation actions and/or strategies by 2030, also outlining means and provisions to achieve the targets, as well as time frames and assigned responsibilities.

The Covenant of Mayors was an initiative launched by the European Commission to endorse and support the voluntary efforts deployed by local authorities in the implementation of sustainable energy policies. It played an important role in mobilising local and regional actors around the fulfilment of the EU's climate and energy targets for 2020. By the end of 2017, a number of 3,298 local authorities have signed the Covenant of Mayors with a view of submitting a SEAP (Sustainable Energy Action Plan). Following the beginning of the new phase under the Global Covenant of Mayors, some signatories are now in the process of submitting a SECAP (Sustainable Energy and Climate Action Plan).
Through their participation to the above initiative, Italian municipalities achieved a number of positive results, in particular by increasing local political attention on the issues of energy efficiency, renewable energy, sustainable mobility, waste, and establishing channels to provide information to citizens.
At the same time, the following problems have emerged:

- difficulties in ensuring compliance with the commitments arising from the accession to the Covenant of Mayors (e.g. the submission of SEAPs within one year from the signature of the covenant);
- lack of human and financial resources to achieve objectives;
- Identification, planning and implementation of actions in all key areas, which will lead to the objective of reducing CO2 emissions (especially for smaller municipalities).

For these reasons, the Ministry for the Environment will provide in the future increasing support to the Communities participating to the initiative, by:

- supporting technical work concerning the preparation of baseline inventories (e.g. identification of a common set of data-bases for energy consumption, homogenization of software for inventory calculations)
- providing guidelines and handbooks for public administrations concerning issues such as energy audits of buildings, EU funding, energy performance contracting, preparation of joint SEAPs;
- Establishing a web site providing examples of good practices and experiences of various Italian subjects.

The same provisions are also supposed to apply to SECAPs within the new Global Covenant.

The Compact of Mayors was a global coalition of mayors and city officials pledging to reduce local greenhouse gas emissions enhance resilience to climate change, and to track their progress transparently. The Compact was launched in September of 2014 by UN Secretary-General Ban Ki-moon and his Special Envoy for Cities and Climate Change, Michael R. Bloomberg. The Compact was activated under the leadership of the global city networks — C40 Cities Climate Leadership Group (C40), ICLEI – Local Governments for Sustainability (ICLEI) and the United Cities and Local Governments (UCLG) — and with support from UN-Habitat, the UN's lead agency on urban issues[44].

On January 1st, 2017, the New Covenant of Mayors for Climate and Energy and the Compact of Mayors merged into the Global Covenant of Mayors for Climate and Energy to act as a unique platform worldwide in the next years.[45]

4.4 Policies in Energy Sectors

The Energy production and transformation sector is included in the Emission Trading Scheme. Emissions from this sector are also influenced by other measures that traditionally can be grouped into four main measures:

- Use of renewable energy
- Cogeneration
- Improving the efficiency for electricity and thermal use of thermoelectric power plants
- Improving of energy efficiency in industry

4.4.1 Energy Industries

4.4.1.1 Renewable Energy Sources

In Italy, the electricity production by renewable use has registered a sizeable increase in the period 2010-2013, growing from about 76.9 to 108.9 GWh.

This growth was driven by the financial incentives in the form of feed-in-tariffs, in particular for photovoltaic production. The incentive for photovoltaic production has now been greatly reduced and increase rate in production is now much lower. Feed-in-tariffs are still operative for new biogas production.

[44] https://www.compactofmayors.org/history/

[45] http://www.globalcovenantofmayors.org/about/history-compact-of-mayors/

The thermal renewable sources have a relevant role in achieving the IECCP targets, as well. Heat consumption represents the largest share of our energy consumption, both in the civil and industrial sectors (approximately 45% of total final consumption). Thermal renewable sources are generally more efficient and less expensive than the electric ones, either in terms of cost per tonne of CO2 avoided or cost per kWh of final energy produced, involving the significant benefits of saving fossil fuels for the final consumer (e.g. through biomass heating) and for the country as a whole (by reducing imports).
The development of renewable thermal energy use over the past five years has occurred in line with the objectives (5.4 Mtoe in 2010) and was driven by measures regarding energy efficiency, tax deductions or white certificates.
The most relevant measures implemented and planned to achieve the renewable target are reported below.

The Green Certificates system

Green Certificates (GCs) are tradable instruments that GSE grants to qualified renewable-energy power plants (IAFR qualification) which have been commissioned before 31 December 2012 as per Legislative Decree 28/2011.
The number of certificates issued is proportional to the electricity generated by the plant/system and varies depending on the type of renewable source used and of project (new, reactivated, upgraded, renovated system/plant).
The Green Certificates support scheme is based on the legislation which requires producers and importers of non-renewable electricity to inject a minimum quota of renewable electricity into the power system every year.
Green Certificates represent proof of compliance with the renewable quota obligation: each Green Certificate is conventionally worth 1 MWh of renewable electricity. Green Certificates are valid for three years: those issued in respect of electricity generation in a given year (reference year) may be used towards compliance with the obligation also in the following two years. In order to fulfil their obligation, producers and importers may inject renewable electricity into the grid or purchase an equivalent number of Green Certificates from green electricity producers.
Green Certificates incentive mechanism was replaced as of 1st January 2016 by other supporting mechanisms outlined below.

The All-Inclusive Feed-in tariff

The All-Inclusive Feed-in tariff is a support system based on granting a fixed charge to renewable energy installations in the energy function electric grid (feed in tariff). This rate is applicable only to facilities of less than 1 MW (200 kW for wind) of power and includes both an incentive (differentiated by technology) and the remuneration for the energy fed into the grid. The rate is all-encompassing and is recognized for a variable period depending by technology. This system has been replaced all other incentives schemes for small installations.

Ministerial Decree of 6th July 2012

Through Ministerial Decree of 6th July 2012, changes were made to the incentives for electrical renewable energy (excluding photovoltaic). In particular, new plants starting from 1st January 2013 are no longer subject to the "Green Certificates" and the "All-Inclusive Feed-in" tariffs, which were replaced by a new scheme, deemed less expensive for end-users, people and companies. The main changes introduced by the decree concern the way of access to incentives that are now divided into three parts depending on type and power of plants:

- Direct access to incentives: for new or fully reconstructed or restarted plants below a threshold level; the system is very similar to current "all inclusive" tariff;
- Register enrolment: for new or fully reconstructed or restarted plants that have power greater than the "Direct access" level but lesser than the auction level;
- Auction: for new or fully reconstructed or restarted plants with power greater than a certain threshold value.

In the following table, the threshold for the access to the different incentives divided by type of renewable energy sources are reported:

Table 4.5 – Ministerial Decree of 6th July 2012 - Incentives scheme

Source	Direct access	Register	Auction
Wind - on shore	1-≤60kW	>60kW-≤5MW	>5MW
Wind - offshore	1-≤60kW		>5W
Hydroelectric	1-≤50kW	>50kW-≤10MW	>10MW
Hydroelectric (art.4, c. 3, b)	1-≤250kW	>250kW-≤10MW	>10MW
Oceanic (sea waves)	1-≤60kW	>60kW-≤5MW	
Geothermal	1kW-≤20MW		>20MW
Geothermal (art.4, c. 3, f)	1kW-≤5MW		
Biomass (art.8, c. 4, a) e b)	1-≤200kW	>200kW-≤5MW	>5MW
Biomass (art.8, c. 4, c) e d) from waste water treatment sludge, biogas and bio-liquid		1kW- ≤5MW	>5MW
Biogas	1-≤100kW	>100kW-≤5MW	>5MW

Source: FIRE – Federazione Italiana per l'uso Razionale dell'Energia

The Decree also covers the procedures under which plants already in service and supported under the Ministerial Decree of 18 Dec. 2008 shall pass from the green certificates scheme to the new support schemes in 2016.

A following decree, dated 23rd June 2016, establishes new procedures for supporting electricity generation by RES-E plants (other than photovoltaic ones) with a capacity of at least 1 kW. The incentives covered by the Decree apply to new, totally rebuilt, reactivated, repowered/upgraded or renovated plants which will be commissioned on or after 1 January 2013.

The "Conto Energia" (Energy Account) – Feed-in scheme

The “Conto Energia” is a support system that provides constant support to electricity produced by solar photovoltaic and thermodynamic, for a fixed period (20 years for photovoltaic systems, solar systems and 25 years for thermodynamic) through a tariff for all energy produced by the plants (feed in premium). The system has exhausted the available financial allowances in mid-2013.

Table 4.6 – Summary of implemented policies and measures in the energy sector – Renewable energy sources

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (Kt CO2 eq.)	
							2020	2030
1	Third "Conto Energia" (art.3 paragraph 1, decree 6 august 2010) and Fourth "Conto Energia" (Decree 5 May 2011)	Supporting the expansion of photovoltaic plants through feed in tariffs until a maximum capacity of 8000 MW	CO2	Economic	Implemented 2010	Ministry of economic development	2300	-
2	Third "Conto Energia": photovoltaic (art.3 paragraph 2, decree 6 august 2010)	Supporting the expansion of photovoltaic plants through feed in tariffs until a maximum capacity of 3000 MW	CO2	Economic	Implemented 2010	Ministry of economic development	900	-
3	Green Certificate - budget law 2008	Green Certificate increased every year by 0,75% for 2007 - 2012 and establishment of "all-inclusive" rate for plants <1 Mwe	CO2	Economic	Implemented 2009	Ministry of economic development	4000	-
4	European regional development fund (ERDF), National Strategic Framework 2008-2013 - increase of renewable energy in electricity production	Supporting system for RES with Regional operative program (POR) and Interregional operative program (POIN)	CO2	Economic	Implemented 2008	Ministry of economic development	1400	-
Total effect of implemented policies							**8600**	

Table 4.7 – Summary of planned policies and measures in the energy sector – Renewable energy sources

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (Kt CO2 eq.)	
							2020	2030
25	New measure to promote and support renewable energy sources for electricity (RES-E) - photovoltaic	Renewable energy - photovoltaic: supporting the expansion of photovoltaic and concentrated solar power plants (CSP) through feed in tariffs until a maximum capacity of 40 GW. (Current installed capacity in 2015 18 GW, total new capacity 2016-2030: 22+2 GW)	CO2	Economic	Planned 2020	Ministry of Economic Development		8568
26	New measure to promote and support renewable energy sources for electricity (RES-E) - - wind	Renewable energy - Wind: promotion of new plants and repowering of existing ones up to a maximum of 16 GW of installed power (current installed capacity in 2015 9.2 GW)	CO2	Economic	Planned 2018	Ministry of Economic Development	-	4229

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (Kt CO2 eq.)	
							2020	2030
27	New measure to promote and support renewable energy sources for electricity (RES-E) - Biomass	Renewable energy - Biomass: further extension of incentives so that existing plants run up to 2030. New bioenergy (agriculture and urban waste and secondary product) with incentives only for small plants capacity < 70 kW	CO2	Economic	Planned 2018	Ministry of Economic Development	-	To be estimated
28	New measure of promoting and supporting renewable energy sources for electricity (RES-E) - Other renewables	Renewable energy - Other: review of auction rules and mechanisms for hydro, geothermal energies and high efficiency cogeneration	CO2	Economic	Planned 2018	Ministry of Economic Development	-	To be estimated
30	2017 National Grid Development Plan - Grid upgrade	Development of the national electricity transmission and distribution network to allow the increase of the Distributed Generation (DG) - the effect of this measure is distributed in all PAMs regarding electricity consumption	CO2	Planning	Planned 2020	TERNA - Manager for the electricity transmission grids	-	IE

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (Kt CO2 eq.)	
							2020	2030
31	2017 National Grid Development Plan - Smart grid	Increasing flexibility of electricity network for the management of production from RES - the effect of this measure is included in measures 25 and 26	CO2	Planning	Planned 2020	TERNA - Manager for the electricity transmission grids	-	IE
Total effect of planned policies								**12797**

4.4.1.2 Cogeneration and District Heating

Cogeneration is currently supported by incentive schemes, rewarding both the production of heat and the production of electricity. In particular, all cogeneration plants benefit from the White Certificate system while cogeneration from renewable energy sources are additionally entitled to receive incentive to reward the green electricity produced.

In the field of high-efficiency cogeneration, in accordance with the provisions of the new directive on energy efficiency, further measures of a regulatory nature will be introduced in addition to the incentive scheme in force, in order to facilitate this technology that has significant potential of primary energy savings. In this sector, Italy already has a historically high use in the industrial sector, with many existing plants from medium to large size. Public support can point to the development of new facilities, in particular of small dimensions, but especially should aim to the revamping of existing installations, structures and technologies towards higher-yielding processes.

The heating demand in the residential sector has been the most relevant factor for the development of district heating; however, it is still possible to exploit an increase in thermal energy distributed through district heating networks, equal to approximately 30%. In order to develop this potential, it will be essential to adapt and strengthen the tools available today to encourage the new construction and expansion of the urban heating infrastructure. This measure is considered as planned.

In the following paragraphs, planned policies and measures for this sub-sector are reported:

Coal phase out

As planned measure, the gradual coal phase out by 2025 has also been envisaged. This measure included as a political choice in the National Energy Strategy 2017 should be implemented taking into account an adequate capacity replacement, the development of the electricity grid and the preservation of the employment.

Enhancement of natural gas supply and network

Italy is the third European market for natural gas consumption (about 67 billion cubic meters in 2015), with a dependence on 'Imports higher than the European average (about 90% compared to a Community average of 70%) due to that reason the energy security is important at national level. The development of liquefied natural gas (LNG) through methane vessels is an opportunity to improve the natural gas supply flexibility and to deal with possible security and resilience problems of the Italian gas system. Furthermore, 35 billion Bcm of natural gas long-term contracts will expire by 2020, with the terms of renegotiation not yet been defined. For those reasons, it is important to plan a diversification of the possible sources of import.

The distribution of natural gas in the Sardinia has been also envisaged with the development of terminals for gas vessels, small coastal depots and a medium and high-pressure distribution network. These measures are reported as planned.

Bio-refineries

The European Directive 1513/2015 promotes the transition towards low GHG emissions fuels and foresees a minimum share of advanced biofuels as urban waste biologics, agricultural waste, animal

waste, etc. To achieve that target, the refinery of Venezia Porto Marghera has been converted into a bio refinery; the same process is currently on-going for the plant located in Gela.

In Tables 4.8 impacts of implemented policies and measures within this sector are reported and in table 4.9 impacts of planned ones.

Table 4.8 – Summary of implemented policies and measures in the energy sector – Cogeneration and District Heating

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
5	White certificates - decree December 2007 - CHP	Supporting CHP and district heating plants for 2008-2012	CO2	Economic	Implemented 2008	Government, GSE and electricity and gas distributors	970	-
6	National Strategic Framework 2007-2013 - ERDF	Supporting CHP and energy savings with POR (Operative Regional Programs) and POIN (Operative Regional Programs)	CO2	Economic	Implemented 2007	Regions	240	-
Total effect of implemented policies							**1210**	

Table 4.9 – Summary of planned policies and measures in the energy sector – Cogeneration and District Heating

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
29	Coal phase out	Gradual phase-out of coal-fired installations subject to system adequacy (adequate replacement capacity) and measures to preserve employment (still available 3280MW in 2030)	CO2	Planning	Planned 2020	Ministry of Economic Development	-	7758
32	Development of district heating network	30% development of the district heating (renewable energy and high efficiency cogeneration)	CO2	Planning	Planned 2018	Municipalities	-	.
33	Installation of two news LNG terminals	LNG terminals with a capacity of 4 bcm annual	CO2	Planning	Planned 2018	Ministry of Economic Development	-	-
34	Natural gas in Sardinia	Development of terminals for gas vessels, small coastal storage area and a medium and high pressure distribution network	CO2	Planning	Planned 2017	Ministry of Economic Development	-	-

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
35	Reconversion of refinery industry	Conversion of at least another 1 or 2 refineries (beyond Porto Marghera) to bio-refineries	CO2	Planning	Planned 2018	Ministry of Economic Development	-	-
Total effect of planned policies								**7758**

4.4.1.3 Thermoelectric power plants

The liberalization of the electricity sector brought in by Legislative Decree 79/99 started a deep refurbishment of the power generation sector. The decree had the main purpose of reducing the dominant position of Enel, the former state monopolist, by forcing it to sell part of its generation capacity to new entrants.

Subsequent Decree 4 August 1999 identified the plants that had to be sold to new entrants and specified those that had to be converted from fuel oil steam plants to new combined cycle gas turbine plants (CCGT) using natural gas. This last provision was intended to increase the overall efficiency in power generation and to reduce CO_2 emissions of the energy supply sector. Out of a total capacity of 15,000 MW to be divested, 9,400 MW were forced to be converted to CCGT.

Law 55 of 9 April 2002 was introduced to simplify the authorization procedure for the construction and operation of power plants with a capacity of over 300 MW. From 2002 to the end of 2006, the Ministry of Economic Development issued 45 authorizations for a new overall capacity of 21,400 MWe; among these, 23 authorizations (amounting to 9,897 MW) were issued according to the new procedure brought in by law 55/02.

Law 239 of 23 August 2004 introduced some important changes in the energy sector. One of its main purposes was to speed up the authorization process for the construction of new power plants and energy infrastructures, particularly grid lines.

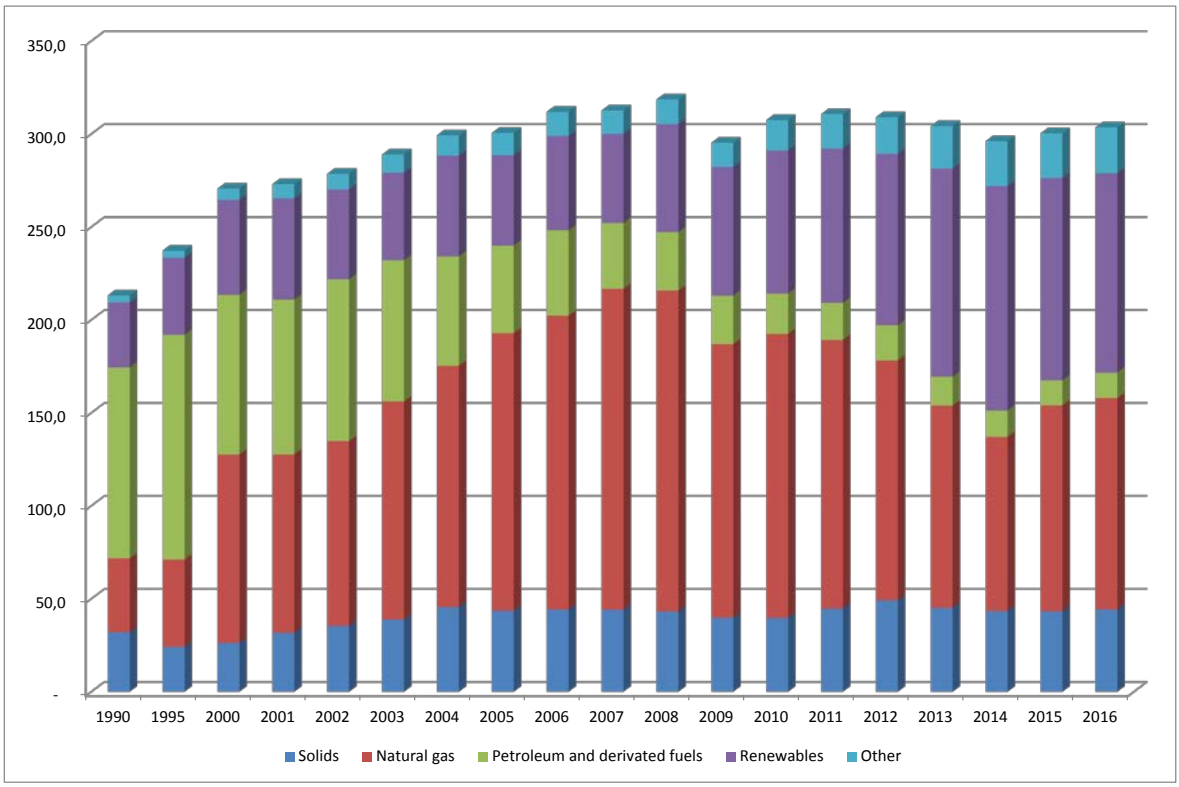
Since the entry into force of law 239/04, new energy infrastructures for approximately 2,300 MW have been developed and new CCGT plants for about 3,200 MW have been constructed, which led to consistent emissions reductions.

The overall effect of these substitutions was the decline of emissions from electricity production in thermoelectric plants from 708 g/kWh in 1990 to 489 g/kWh in 2015.

The decline in the specific emissions, essentially due to an increase in the overall efficiency in the thermoelectric production and a decline in the carbon content of the fuel used in the power plants, has contributed to limit the increase of the emissions due to the increase of the overall thermoelectric production.

From 2000 to 2016, in Italy, an increase in the use of natural gas and a decrease in the use of petroleum derived fuels use were registered. Other energy sources are quite stable, as shown in Figure 4.1.

Figure 4.1 - Electricity production (TWh) by energy source



Source: ISPRA elaboration of TERNA data

4.4.2 Manufacturing Industry and Construction

Policies affecting CO_2 emissions in the industry sector are generally designed to improve industrial energy efficiency. All the policies implemented or planned are reported in table 10.

The main instrument is represented by the White Certificates system which is aimed at promoting energy efficiency and deliver emissions reductions in all the energy end-use sectors. The implementation of directive 2006/32/CE on energy end use efficiency and energy services in the industrial sector and the Action Plan 2007 impose new targets for White Certificates to 2016, and an extension of the scheme is envisaged up to 2030.

Another important initiative introduced by the Government concerns the replacement of existing inefficient electric motors with high efficient ones. This measure can help to achieve substantial CO_2 emissions reductions, although engines with high purchase price, as well as the lack of information about their energy saving potential, represent main obstacles to their diffusion.

The Budget laws 2007 and 2008 therefore provide for tax credits for high efficiency electric engines and inverters. European regulations 640/2009 and 641/2009, related to Legislative decree 201/2007 (directive 2005/32/CE) imposed minimum efficiency requirements on new electric motors and pumps, with a gradual introduction between 2011 and 2017.

In 2015, in Italy, 63.5% of emissions from this sector were subject to ETS while 36.5% were accounted for under the ESD.

Table 4.10 - Summary of implemented policies and measures in the industry sector

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020*	2030
7	White certificates - decree December 2007 - Industry	Supporting electric energy savings for the period 2008-2012	CO2	Economic	Implemented 2008	GSE- Manager for Energy Service	2020	-
8	Eco-design of energy-using products - Legislative decree 201/07 (transposition of directive 2005/32/EC-first regulations)	Installation of highly efficient electric motors and inverters through minimum mandatory standards	CO2	Regulatory	Implemented 2008	Italian Regulatory Authority for Electricity Gas and Water	1920	-
9	European regional development fund (ERDF), National Strategic Framework 2008-2013 - Electric energy saving in the energy industry sector	Supporting electric energy saving with POR (Operative Regional Programs) and POIN (Operative INterregional Programs)	CO2	Economic	Implemented 2008	Regions	660	-
Total effect of implemented policies							**4600**	

Table 4.11 - Summary of planned policies and measures in the industry sector

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020*	2030
36	Further extend of energy saving targets (White certificates 2020-2030)	Energy efficiency measures in industry ETS and non-ETS up to 2.2 Mtoe saved	CO2	Economic	Planned 2018	GSE- Manager for Energy Service	3700	4400
Total effect of planned policies							**3700**	**4400**

4.4.3 Civil (Residential and Tertiary)

The package of policies deployed in this sector aims to improve energy efficiency through specific actions targeted at both existing and new buildings and appliances. Improving the energy efficiency of buildings and reducing the related emissions have become priorities in the last few years.

The implementation of directive 2002/91/CE on Energy Efficiency has been an opportunity to introduce stricter energy requirements and to promote the diffusion of renewable energy sources in the building sector. The Directive lays down requirements on the application of minimum standards for the energy performance of new buildings and on the performance of large existing buildings undergoing major renovation. The directive also requires the provision of energy performance certificates when buildings are constructed, sold or rented out. The directive has been transposed by legislative decree 102/2005 subsequently amended by legislative decree 311/2006 to strengthen buildings thermal demand requirements. The new law can be applied to new and existing buildings subject to major renovation[46] and provides for some important measures. Amongst the main provisions, the following obligations are worth mentioning:

- installation of technical blinds for solar protection and insulation of new buildings and buildings subject to overall renovation (limited to buildings over 1000 m^2);
- laying down of all the necessary works to allow the connection of new buildings (and buildings subject to major renovation) to district heating systems, when existing (and not further than 1 km) or planned;
- installation of solar thermal systems that cover at least 50% of hot water demand for all new buildings and in case of replacement or renovation of the existing heating system;
- installation of PV systems (with a power capacity to be defined in a subsequent ministerial decree) in all new buildings and in existing buildings with a total floor area over 1000m^2.

Directive 2010/31/EC recasts the European Energy Performance of Buildings Directive (EPBD) (transposed into national law with the decree 63/2013). This measure defines mandatory standards for new buildings, in particular, article 9 foresees that by 31 December 2020, all new buildings will be nearly zero- energy buildings and after 31 December 2018, new buildings occupied and owned by public authorities will be nearly zero-energy buildings

The transposition of this directive has raised the requirement on new buildings and mad it consistent in all regions.

An important contribution will also come from the application of the Inter-ministerial Decree 26 June 2015 "Application of energy performance calculation methodologies and definition of minimum requirements and requirements for buildings.

There are also minimal efficiency requirements on new domestic appliances (TV, refrigerator, lamps, etc.), with a gradual introduction between 2009 and 2015. Those standards take into account the European regulations 644/2009, 278/2009 242/2009 243/2009 and 1275/2008 and are put into practice by the Legislative decree 201/2007 (directive 2006/32/CE).

Consistent reductions are also expected from the introduction of other regulations for energy efficiency standards for new energy-consuming products introduced by law 201/2007 (transposition of directive

[46] As regards the minimum energy performance requirements of existing buildings subject to major renovation, the decree applies only in case of large buildings of over 1000 m2 and in case of expansion of existing buildings (over 20%). The decree applies only partially to existing buildings under the 1000m2 threshold.

2005/32/CE).

A tax rebates system allows, in a 10-year time, the recovery of up to 55%/65% of capital expenses for high efficiency appliances or building shell improvements. It is extended and modified on an annual basis with the annual state budget law. In order to promote energy efficiency interventions in the civil sector and to minimize system costs at the same time, an optimization of the tax deduction mechanism is foreseen.

The most significant improvements concern a differentiation between the percentage of deductible expenditure and/or the duration of the refund, in proportion to the actual saving produced by the intervention, orienting the mechanism to radical interventions on the building (Deep renovation) and coupling the instrument with other incentive mechanisms, with specific reference to measures for anti-seismic construction.

Table 4.12 - Summary of implemented policies and measures in the civil (residential and tertiary) sector

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020*	2030
11	Building Regulation (Legislative decree 192/05 as amended by legislative decree 311/06)	Minimum mandatory standards on new and existing buildings (Energy Efficiency)	CO2	Regulatory	Implemented 2006	Municipalities, Ministry of Economic Development;	3610	-
12	Tax deduction for energy saving in buildings - Budget law 2007, Budget law 2008 and Budget law 2009	Supporting energy savings in existing buildings through tax deduction of 55%	CO2	Fiscal	Implemented 2008	Ministry of Finance	1050	-
13	White certificates - decree December 2007 - Commercial	Supporting energy savings 2008-2012 (Energy Efficiency)	CO2	Economic	Implemented 2008	GSE- Manager for Energy Service	3120	-
14	Legislative decree 201/07 (transposition of directive 2005/32/EC) - Increase efficiency of appliances in residential sector	First regulation on mandatory energy efficiency standards for energy-using products	CO2	Regulatory	Implemented 2008	Ministry of Economic Development	2600	-
15	National Strategic Frame-work 2007-2013 - ERDF - Residential energy saving	Supporting electric energy saving with POR (Operative Regional Programs) and POIN (Operative Interregional	CO2	Economic	Implemented 2007	Regions	420	-

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020*	2030
		Programs) in buildings						
24	Minimum requirement for building (Inter-ministerial decree June 26th, 2015)	Application of the minimum energy performance requirements for buildings. These requirements apply to public and private buildings, whether they are new buildings or existing buildings subject to restructuring	CO2	Regulatory	Implemented 2015	Ministry of Economic Development		4000
Total effect of implemented policies							**10800**	**4000**

Table 4.13 - Summary of planned policies and measures in the civil (residential and tertiary) sector

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020*	2030
37	Energy efficiency in residential building with tax deduction	Restructuring for thermal insulation in residential buildings, 0.5% annual renovation rate, to be achieved through an improved tax deduction scheme (65-55-36%) based on expected saving.	CO2	Fiscal	Planned 2018	Ministry of Finance, Ministry of Economic Development	385	1569
38	Energy efficiency in residential building - upgrade entire building - tax deduction	Restructuring for thermal insulation in residential buildings, 0.5% annual renovation rate, focused on "deep renovation" to be achieved through the remodelling of the tax deduction (The assessment of the impact of this measure has not been finalized yet because the implementation involves public and private resources. It has still to be decided the type of instrument and the extent of public support)	CO2	Fiscal	Planned 2018	Ministry of Finance, Ministry of Economic Development	-	-

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020*	2030
39	Energy efficiency in residential building - measure for supporting low income families	Introduce title portability or structuring an incentive system integrated with energy redevelopment	CO2	Economic	Planned 2020	Ministry of Finance	-	-
40	Energy efficiency in residential building - provision to rebuild housing including seismic upgrade	Link the instrument with other incentive mechanisms by introducing measures for anti-seismic building	CO2	Economic	Planned 2020	Ministry of Economic Development	-	-
41	Energy efficiency in tertiary building	Restructuring for thermal insulation in tertiary buildings, including very low emission building for central administration (The assessment of the impact of this measure has not been finalized yet because the implementation involves public and private resources. It has still to be decided the type of instrument and the extent of public support)	CO2	Fiscal	Planned 2017	Regions, Ministry of Economic Development	894	-

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020*	2030
42	Promoting energy saving in building (public, domestic, tertiary): insulation, replacement windows and boilers, installation of heat pumps and solar thermal panels (Legislative decree 28/2011)	Investments of air conditioning systems (cooling and heating) in the residential sector, restructuring of the service sector's buildings. Installation of gas and electric heating pumps, high efficiency boilers and floor heating system. Replacement of appliances (The assessment of the impact of this measure has not been finalized for 2030 because the implementation involves public and private resources. It has still to be decided the type of instrument and the extent of public support)	CO2	Economic	Planned 2017	GSE- Manager for Energy Service	4080	-
Total effect of planned policies							**5359**	**1569**

4.4.4 Transport

This section provides policies and measures for the transport sector to achieve energy savings, GHG reductions and sustainable transport systems.
Transport sector consumes approximately one third of EU's total energy demand and this demand is almost entirely met by oil. While the transition to low-emission alternative energy in transport has already begun, spurred also by the proposal for the Renewable Energy Directive on the promotion of the use of energy from renewable sources (COM/2016/0767 final), the sector is significantly lagging behind other sectors for a number of reasons, including the lack of strong incentives to innovate in energies and technologies needed for the long-term low carbon policies as well as infrastructure issues related to electrification. The latter issue is currently addressed via the implementation of the Alternative Fuel Directive (DAFI) and the provisions foreseen in the review of the Energy Performance of Building Directive.

In detail, the directive DAFI 2014/94/UE establishes a common framework of measures for the deployment of low carbon fuels infrastructure in the Union in order to minimize dependence on oil and to mitigate the environmental impact of transport. This Directive sets out minimum requirements for the building-up of recharging points for electric vehicles and refueling points for natural gas (LNG and CNG) and hydrogen, to be implemented by means of Member States' national policy frameworks, as well as common EU technical specifications for such recharging and refueling points.

Regarding implemented measures, in line with the aims identified by the National Strategic Framework 2007-2013, infrastructural measures (high capacity and high speed networks, and improvement of regional networks for commuting) and management measures regarding the enhancement of the road urban public transport network have been implemented.
Furthermore, the effect of EU Regulation (EC) No 443/2009 establishing CO2 emissions performance requirements for new passenger cars has to be considered. The Regulation aims to achieve the overall objective of the European Community of 120 g CO2/km as average emissions for the new car fleet (130 gCO2/km vehicle efficiency plus -10 gCO2/km from additional reduction tools as biofuel use).
In order to promote the mandatory use of biofuels, a minimum quota of biofuels was set to 5.75% of the total sold from 2010 onwards, while Legislative Decree 28/2011 established a 10% objective of biofuel use for transport by 2020. The effect of the existing measures for the post-2020 period is included in the reference scenario.

Moreover the planned measures envisaged are the following ones:

- Promoting and supporting the development of charging infrastructure for electric vehicles;
- Intermodal measures regarding shifting from private road traffic to busses and railways (Modal shift of about 10% in 2030 to public transport, car-pooling, bikes and walking) and shifting goods transport from the road to the sea and railways; management measures supporting efficiency in private road transport and improving road circulation in the urban areas.
- It is planned a new EU Regulation, to be approved before 2020, that will set a more ambitious target post 2020.

- National measures to promote and support the diffusion of low carbon fuels and electrical vehicles;
- A further expansion of electrical vehicles car fleet, depending on the provisions to be included in the upcoming EU Regulation on new cars.
- Increase in bio fuels use to over 10% of road fossil fuels consumption, including bio methane;

It is emphasized that in the transport sector national estimates include only domestic flights and shipping; to reduce the emissions from national shipping it is planned to promote the use of LNG as a fuel and the availability of electrical connection at ports for all ships. In the case of aviation, national authorities have no control of the plane emissions that are subject to international licensing procedure. Italy supports the EU policy within ICAO to promote all available technologies for fuel efficiency and other operational practices so to stabilize GHG emissions from airplanes. Additionally the bio-refineries that are planned to be operating in Italy, see section on energy industry, will have the technical capability to produce also biofuels for airplanes.
Explanations on how Italy is addressing international transport emissions is provided in the paragraph below, in accordance with the UNFCCC reporting guidelines on NCs.

4.4.4.1 Aviation and marine bunker fuels

According to Article 2.2 of the Kyoto Protocol on aviation and marine bunker fuels, each Annex I Party shall identify the steps it has taken to promote and/or implement any decisions by the International Civil Aviation Organisation (ICAO) and International Maritime Organisation (IMO) to limit and reduce associated emissions.
As part of the European Union, Italy supported the European Commission's proposal to incorporate aviation into the EU Emissions Trading System (ETS), which was approved in 2008 (Directive 2008/101/CE). In order to prevent negative effects on the EU's relationship with other countries, it urged that implications in the area of international law, by ICAO, should be taken into account. Directive 2008/101/CE sets a cap for CO_2 allowances and establishes that a certain quantity of allowances is allocated through auctioning. In order to prevent double regulation and not prejudge the ICAO process, the ETS directive is currently applied to flights leaving and departing in airports located in the European Economic Area (EEA).
As regards the maritime sector, on 28 June 2013 the European Commission adopted a Communication[47] setting out a strategy to progressively include GHG emissions from maritime transport into EU's policy for reducing its overall emissions. The strategy consists of the following consecutive steps:

- establishing a system for monitoring, reporting and verifying (MRV) of CO_2 emissions;
- setting reduction targets for the maritime transport sector;
- applying further measures, including market-based instruments, in the medium to long term.

Relating to the first of these three steps, the Commission proposed a Regulation[48] of the European

[47] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Integrating maritime transport emissions in the EU's greenhouse gas reduction policies. COM (2013) 479 final.
[48] Proposal for a Regulation of the European Parliament and of the Council on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport and amending Regulation (EU) No 525/2013. COM (2013) 480 final.

Parliament and of the Council establishing an EU-wide MRV system for large ships.

This proposal addresses emissions released by ships above 5,000 gross tons during their voyages from the last port of call to a port under the jurisdiction of a Member State, and from a port under the jurisdiction of a Member State regardless of their flag. According to the proposed Regulation, ship owners will have to monitor and report the verified amount of CO_2 emitted by their ships on voyages to, from and between EU ports. Owners will also have to provide certain other information, such as data to determine the ships' energy efficiency. These rules are designed to support a staged approach towards setting global energy efficiency standards for existing ships, as supported by several members of the International Maritime Organisation, and it is proposed that they start applying from 1 January 2018.

An impact assessment of the economic effects on third countries of this proposal concluded that based on the pass-through of costs and savings in maritime transport and on the price building mechanisms in different sectors, measurable increases of commodity prices (with transport costs being only an insignificant element of the commodities' prices) are expected to have minor effects[49]. In the impact assessment, several policy options – from an MRV system to levies and to emission trading schemes – were assessed.

Given the large cost-effective abatement potential of the sector, the above-mentioned emission reductions would lead to net cost savings for the maritime transport sector. Other expected impacts are the creation of additional jobs in ship yards and the maritime supply industry as well as health benefits due to reduced emissions of SO_X, NO_X and particulate matter.

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

Table 4.14 - Summary of implemented policies and measures in the transport sector

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020*	2030
16	Infrastructural measures - Increase of high capacity and high speed rail networks	High Capacity and High Speed rail. Regional networks for passengers	CO2	Planning	Implemented 2008	Ministry of transport	5700	-
17	National Strategic Framework 2007-2013 - FESR - increase public transportation in urban area	Intermodal infrastructure projects: expansion of metropolitan railways/ subway	CO2	Planning	Implemented 2007	Ministry of transport	1280	-
18	Emission standard for new car (Regulation (EC) No 443/2009)	Fleet update at 120 g CO2/km in 2015 and 95 g CO2/km in 2020	CO2	Regulatory	Implemented 2008	Ministry of Economic Development	10200	-
19	Legislative decree 128/05(transposition of directive 2003/30/EC) - mandatory use of biofuels	Mandatory use biofuels (target 4.5% to 2012)	CO2	Regulatory	Implemented 2008	Ministry of Economic Development	1490	-
20	Legislative Decree 28/2011 (transposition of directive 2009/28/EC) - Mandatory use of biofuels	Mandatory use biofuels (target 10% to 2020)	CO2	Regulatory	Implemented 2014	Ministry of Economic Development	1580	-
Total effect of implemented policies							**20250**	

Table 4.15 - Summary of planned policies and measures in the transport sector

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020*	2030
43	Measure of promoting and supporting the development of charging infrastructure	Transposition of DAFI 2014/94/EU directive define and implement the plan for the development of alternative fuels infrastructure: electric car charging stations and natural gas filling stations. (The impact is included in the measures related in the alternatives fuels vehicles)	CO2	Regulatory	Planned 2017	Industries association and local authorities (Companies)	-	-
44	Modal shift from private cars to public buses and walking	Modal shift of about 10% of car transportation demand in 2030 to public transport, car-pooling, bikes and walking	CO2	Planning	Planned 2017	Ministry of Transport	1310	4248
45	Promoting and supporting renewal of car fleet with low carbon fuels	Speed up the replacement of vehicle fleet with new vehicles, including CNG cars (up to 1.7 million), LPG cars (up to 2.7 million), CNG vans (up to 1 million).	CO2	Economic	Planned 2017	Ministry of Economic Development	1220	3180

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020*	2030
46	Promoting and supporting renewal of car fleet with electrical vehicles	Speed up the replacement of car vehicle fleet with electric cars up to about 3 million vehicles.	CO2	Economic	Planned 2018	Ministry of Economic Development, Ministry of Finance (Government); Municipalities (Local)	460	2372
47	Promoting and supporting renewal of car fleet: further expansion of electrical vehicles	Increase the electrical vehicles to more than 10% of fleet by 2030, including cars (0.8 million) and electric vans (0.5 millions) (The assessment of the impact of this measure has not been finalized yet because the implementation involves public and private resources. It has still to be decided the type of instrument and the extent of public support)	CO2	Economic	Planned 2025	Ministry of Finance, Ministry of Environment	IE	IE
48	Expansion of use of biofuel over 10% of road fossil fuels consumption, including bio-methane	Biofuels promotion: consumption in the transport sector of bio-methane and about advanced biofuels through the conversion of refineries and / or traditional biodiesel plants (The assessment of the impact of this measure has not been finalized yet because the	CO2	Economic	Planned 2021	Ministry of Economic Development, Ministry of Finance		

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020*	2030
		implementation involves public and private resources. It has still to be decided the type of instrument and the extent of public support)						
49	Promotion of LNG in transport	Expansion of LNG heavy duty trucks up to 30% of the fleet and LNG ships up to 50% of total national fuel consumption	CO2	Fiscal	Planned 2018	Ministry of Economic Development, Ministry of Finance	160	1800
Total effect of planned policies							**3150**	**11600**

4.5 Policies in non-Energy Sectors

4.5.1 Industrial Processes

For the industrial processes sector, the reduction of N2O emissions in plants due to the production of nitric acid has been taken into account. This measure can result in significant reductions in process emissions from the industrial sector, with a relatively small cost.

In the production of nitric acid, the most advanced technology is provided by SCR (Selective Catalytic Reduction) systems for the treatment of process gases, which has been installed by the main production plants in Italy. This activity has been included in the Emission Trading Scheme starting from 2012. Therefore, this measure has been included in the WM scenario.

Table 4.16 – Summary of policies and measures in the industrial processes sector

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.) 2020
10	Reduction of emissions of N2O from nitric acid production	Significant reductions in process emissions from nitric acid production plants due to the application of BAT (Best Available Technology)	N2O	Voluntary	Implemented 2010	Industrial plant	740

Source: ISPRA

It is important to underline that the 36.5% of emissions of the "Manufacturing industries and construction" for Italy are related to ESD sector.

4.5.2 Agriculture

In the last years, the role of agriculture in climate change mitigation has been emphasised. In this context, the reform of the Common Agricultural Policy (CAP) has a relevant role. In 2008, the CAP has been reinforced by the Health Check, which strengthens the gradual shift from a financial support linked to production towards decoupled direct aids, through a strengthening of the rural development policy and the increasing integration of environmental considerations, including climate change.

Therefore, payments for farmers consider the respect of environmental laws and other types of legislation. Thus, the incentives for intensive production have reduced. On the other hand, main emission reduction activities are predominantly or exclusively supported by two rural development measures: farm modernisation (code 121) and agri-environment (code 214). Some activities support the modernisation of farms through energy efficient equipment and buildings, and promoting biogas production[50]. This picture has been also assessed by ISPRA in the 21 regional Rural Development Plans (RDPs), where measure

[50] European Commission (2009), Commission staff working document. The role of European agriculture in climate change mitigation. SEC (2009) 1093 final (http://ec.europa.eu/agriculture/climate_change/sec2009_1093_en.pdf)

code 214 is most likely to contribute with N_2O emission reductions. In 2008, a report[51] prepared by the Ministry of Agriculture (MIPAAF) in the framework of the Rural Development Network has assessed qualitatively the contribution of Rural Development Plans (RDPs) in terms of their mitigation potential. Moreover, in 2009, the CAP Health Check targets have been included in the RDPs[52]. In 2010, some general information on the number of RDPs that have considered climate change targets (15 RDPs) or all 6 Health Check targets (3 RDPs), is available[53].

The reduction measures, which are presented below, have also been considered in CAP reforms, characterized by a progressive reinforcement for integrating environmental legislation. A special attention is given for example to the Nitrates Directive (monitoring of water quality; designation of nitrate vulnerable zones; and, establishment of codes of good agricultural practice).

In 2013, political agreement on the reform of the CAP 2014-2020[54] was reached. The agreement provides for an amendment to the payment ecological (greening). Between 2014 and 2020, over EUR 100 billion will be invested to help farming meet the challenges of soil and water quality, biodiversity and climate change:

- 30% of direct payments will be linked to three agricultural practices beneficial for the climate and environment: crop diversification (there is no obligation for diversification of crops for arable land less than 10 hectares), maintaining permanent grassland (there is no obligation for arable land less than 15 hectares and for permanent crops) and conserving 5%, and later 7%, of areas of ecological interest as from 2018 or measures considered to have at least equivalent environmental benefits.
- At least 30% of the rural developments programmes' budget will have to be allocated to agri-environmental measures, support for organic farming or projects associated with environmentally friendly investment or innovation measures.
- Agri-environmental measures will become agri-environment-climate payments and will be stepped up to complement greening practices. These programmes will have to set and meet higher environmental protection targets (guarantee against double funding).

According to the European Commission[55], in the period up to 2020, the new CAP is going to invest around EUR 37.5 billion (as a sum of total allocation of Direct Payments and Rural Development for the period 2014-2020) in Italy's farming sector and rural areas. This amount will be distributed between rural development programs and direct payments as follows. In the period 2014-2020, the EU budget for measures benefiting agricultural producers and the economy of its rural areas will be a total of around EUR 10.4 billion (plus co-financing from public and private funds), increasing Italy's rural development envelope compared to the period 2007-2013. The total budget available for direct payments in Italy for the period 2014-2020 amounts to more than EUR 27 billion.

Although there are, by definition, differences in the Rural Development Programs (RDPs) priorities from one region to another, from an analysis of the information reported in the 21 regional RDPs for 2014-2020, most of the Italian regional programs are looking to target public support at enhancing the

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[51] MIPAAF (2008), "Il contributo dei piani di sviluppo rurale e della condizionalità alla mitigazione dei cambiamenti climatici e al loro adattamento. Rete Rurale Nazionale 2007-2013 Italia", November 2008

[52] See the publication "The Contribution of Rural Development Programmes in Mitigating Greenhouse Gas Emissions in Italy" Climate Change and the Sustainable Use of Water Resources - Climate Change Management 2012, pp 367-387

[53] MIPAAF (2010), "Le nuove sfide della PAC e le misure di rilancio dell'economia nei programmi di sviluppo rurale 2007-2013 – Aprile 2010. Rete Rurale Nazionale 2007-2013" (www.reterurale.it)

[54] http://ec.europa.eu/agriculture/cap-post-2013/index_en.htm

[55] European Commission, 2016. CAP in your country: ITALY (https://ec.europa.eu/agriculture/cap-in-your-country_en)

competitiveness of agricultural production systems and of agro-industry enterprises; support investments in sustainable energy; promote climate change adaptation and protecting the environment and increasing the quality of life and economic diversification in rural areas[56]. In particular, considering the measures planned to achieve the objectives of "reducing greenhouse gas and ammonia emissions from agriculture" and "fostering carbon conservation and sequestration in agriculture and forestry", established by the European Commission, 15 RDPs supported investments in knowledge transfer and information actions (art. 14 of European Regulation N. 1305/2013), 13 RDPs have provided support to advisory services, farm management and farm relief services (art 15 of European Regulation N. 1305/2013) and 3 RDPs have explicitly indicated the objective of reducing greenhouse gas and ammonia gas emissions (measure related to investments in physical assets – art 17 of European Regulation N. 1305/2013)[57]. Regarding the measure on agro-climate-environmental payments (art. 28 of European Regulation N. 1305/2013), aimed at preserving and promoting the necessary changes in agricultural practices that contribute favourably to the environment and the climate, Emilia Romagna, Lombardy and Piedmont regions have planned investments concerning the distribution of livestock effluents, aimed at reducing ammonia emissions; while Lazio and Umbria have planned a measure to maintain/increase the organic matter of the soil through the use of organic additives with valuable organic matter[58].

Emissions of nitrous oxide from agricultural soil: emission reduction from the Agricultural soil source is mainly related to the rationalisation in the use of fertilizers. RDPs 2007-2013 are contributing with this emission reduction measure (code 214). In order to achieve the objective, it is essential to consider ongoing efforts to raise awareness on the code of agricultural practice (such as fertiliser application limits and spreading conditions, manure storage methods, livestock density limits and crop rotation requirements), and the integrated production of agricultural property and organic farming. However, when considering organic farming[59] as an instrument for climate change mitigation, both the amount of emission per hectare and per unit of production have to be considered[60]. RDPs 2014-2020 are contributing through this emission reduction measure (Agri-environment-climate - art. 28 of European Regulation N. 1305/2013).

Emissions of methane from manure management: electricity generation from animal waste has increased in Italy up to 1067.2 GWh in 2015, marking an increase of 8% with respect to 2014 (almost 5 times the value of 2010), thanks to the support provided by the feed-in prices granted by Resolution no. 6/92 of the Inter-ministerial Price Committee (CIP 6/92) and the renewable quota obligation for electricity producers/importers established by the Legislative Decree of March 16, 1999, No. 79, and subsequent legislations.

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[56] See note 22
[57] ISMEA/RRN (2017), "Analisi dei bandi regionali per gli interventi che concorrono alla realizzazione delle Focus Area 5D e 5E" (http://www.reterurale.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/16780)
[58] See note 24
[59] Some studies show contrasting results of emissions per unit of product in organic farming, particularly regarding methane. A German study (referenced by PICCMAT final report) shows lower GHG emissions per unit of product in organic farming than conventional methods for wheat, pig and milk production, while results for beef production are more ambiguous due to the variety of production system.
[60] European Commission (2009), Commission staff working document. The role of European agriculture in climate change mitigation. SEC (2009) 1093 final (http://ec.europa.eu/agriculture/climate_change/sec2009_1093_en.pdf)

Moreover, as established by Ministerial Decree of 18 December 2008, the Ministry of Economic Development has approved incentives for the production of electric power from renewable energy. A special tariff (called "*All-Inclusive Feed-In Tariff*") for small agro-energetic facilities (in operation after 31/12/2007) of less than 1 MW feed with biogas, biomass or vegetal oil, has been fixed. Instead, for facilities of more than 1 MW a multiplying factor of 1.8 for estimating green certificates is contemplated, specifically for facilities using agricultural biomass. In section 4.4 (renewable energy sources), the recent legislation on these issues is described. In 2015, methane from biogas recovery has contributed to reduce methane emissions from manure management by 18%. Further intervention may be required for the coming years in order to sustain this trend, and to extend the covering of animal waste storage systems, equipped with devices allowing collection and use of biogas, not only to new farms but also to major existing ones.

Table 4.17 – Summary of policies and measures in the agriculture sector

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (Mt CO2 eq.)
							2020
21	Nitrogen fertilizer	Rationalization in the use of nitrogen fertilizer	N2O	Regulatory	Implemented 2007	Ministry of Agriculture	790
22	Animal storage	Recovery of biogas from animal storage system	CH4	Regulatory	Implemented 2007	Ministry of Agriculture	400

Source: ISPRA

4.5.3 Waste sector

Emissions reduction in the waste sector is mainly related to the improvement of waste management regarding the composition of waste disposed to landfills. In fact, the Landfill European Directive 1999/31/EC has been transposed at the national level by Legislative Decree 13 January 2003 n. 36 and applied to Italian landfills since July 2005, although the effectiveness of the policies will be significant in the future. This implies a continuous updating of the regulatory system. Consequently, in the following years, the Ministry of the Environment has issued some decrees (Legislative Decree 30 December 2008, n. 208 and Ministerial Decree 25 June 2015) on the waste acceptance criteria in landfills since the composition of these waste is strongly changed and is still evolving.

For the waste sector two measures are proposed:

- Compliance with separate collection targets and biodegradable waste disposed to landfills:
  - fulfilment of the deadlines set for MSW separate collection;
  - fulfilment of the deadlines set for biodegradable waste sent to landfill.
- Only bio-stabilized waste disposed to landfills: a further measure regards the pre-treatment of all the biodegradable wastes which will be disposed to landfills, encouraging the anaerobic digestion of MSW also in co-digestion with other type of waste such as sludge from municipal waste water treatment plants and animal waste. This practice will also increase the energy recovery from the biogas production.

Table 4.18 - Summary of policies and measures in the waste sector

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (Mt CO2 eq.)
							2020
23	Increase separate collection of urban waste	Compliance with separate collection targets and reduction of biodegradable waste disposed of into landfills	CH4	Regulatory	Implemented 2008	Regions	3700

Source: ISPRA

4.5.4 Land use, land-use change and forestry (LULUCF)

The emissions and removals from LULUCF sector are excluded from Effort Sharing Decision n. 406/2009/EC.

Based on an agreement by the Council and the European Parliament, Decision n. 529/2013/EU sets out accounting rules and information concerning actions applicable to GHG emissions and removals from the LULUCF sector, with the aim of a future inclusion of the LULUCF sector in the Union's emission reduction commitment. Decision 529/2013/EU also requires Member States to draw up and transmit to the Commission information on their current and future LULUCF actions to limit or reduce emissions and maintain or increase removals resulting from the activities referred to in Article 3.1, 3.2 and 3.3 of abovementioned Decision (*Afforestation, Reforestation and Deforestation* (*ARD*), *Forest Management (FM), Cropland Management (CM), Grazing Land Management (GM), Wetland Drainage and Rewetting (WDR), and Revegetation* (RV)). This Decision provides for accounting rules applicable on a mandatory basis to the activities of afforestation, reforestation, deforestation and forest management, as well as to the activities of grazing land management and cropland management, subject to specific provisions with a view to improving Member States' reporting and accounting systems during the first accounting period (2013-2020). This Decision also provides for accounting rules applicable on a voluntary basis to revegetation and wetland drainage and rewetting activities. National reports and other information related to LULUCF actions submitted following the abovementioned Decision are publicly available on the web-repository of the EU GHG Monitoring Mechanism Regulation (MMR)[61].

In 2016, the European Parliament and the Council have released a proposal for the inclusion of emissions and removals from LULUCF into the 2030 climate and energy framework. The objective of the abovementioned proposal is to determine how the LULUCF sector will be included into the EU climate policy framework, as of 2021; up to this date, constraints for the EU and each Member State on this sector are provided by the Kyoto Protocol. The key point of the proposed LULULCF regulation is the "no-debit rule": for the period from 2021 to 2025 and from 2026 to 2030, each Member State shall ensure that emissions do not exceed removals, calculated as the sum of total emissions and removals on their

[61] http://cdr.eionet.europa.eu/it/eu/mmr/lulucf/

territory in the land accounting categories (i.e. *afforested land, deforested land, managed cropland, managed grassland, managed forest land*). In addition, the proposed Effort Sharing Regulation includes a new "flexibility" which allows for a limited use of net removals from certain LULUCF accounting categories, while ensuring no debits occur in the LULUCF sectors, to account for Member State compliance towards the targets in the non-ETS sectors if needed. The proposed cap, for Italy, is about 11 Mt for the entire period 2021-2030.

In the following paragraphs, a description of the LULUCF sector in Italy is given.

Definition of forest and national circumstances

Under the Kyoto Protocol reporting, forest is defined by Italy using the same definition applied by the Food and Agriculture Organization of the United Nations for its Global Forest Resource assessment (FAO FRA 2000). This definition is consistent with definition given in Decision 16/CMP.1. Forest is a land with following threshold values for tree crown cover, land area and tree height:

a. a minimum area of land of 0.5 hectares;
b. tree crown cover of 10 per cent;
c. minimum tree height of 5 meters.

Forest roads, cleared tracts, firebreaks and other open areas within the forest as well as protected forest areas are included in forest. Plantations, previously not included in areas subject to art. 3.3 and 3.4 activities of the Kyoto Protocol, have been classified as forest and reported under the appropriate KP-LULUCF activities.

Total forest area, in 2015, was equal to 9,305 kha, equal to about 30% of the national territory.

A steady increase since the 70's has to be noted: forest expansion rate was about 78 kha y^{-1} in 2000 and it was 53.8 kha y^{-1} in 2010. Concerning ownership, the following table shows the amount of public and private forest land.

Table 4.19 - Amount of public and private forest land

	Forest area (1000 hectares)			
FRA 2015 Categories[62]	**1990**	**2000**	**2005**	**2010**
Public ownership	2,549	2,811	2,942	3,032
Private ownership	5,041	5,558	5,817	5,996
...of which owned by individuals	*4,442*	*4,898*	*5,126*	*5,284*
...of which owned by private business entities and institutions	*599*	*660*	*691*	*712*
...of which owned by local communities	*0*	*0*	*0*	*0*
...of which owned by indigenous / tribal communities	*0*	*0*	*0*	*0*
Other types of ownership	0	0	0	0
TOTAL	7,590	8,369	8,759	9,028

[62] FAO FRA 2015, Italy Country report: http://www.fao.org/3/a-az245e.pdf

Elected activities under Article 3.4 of the Kyoto Protocol

Italy has elected *cropland management* (CM) and *grazing land management* (GM) as additional activities under Article 3.4. Following the Decision 2/CMP.7, *forest management* (FM) has to be compulsorily accounted as an activity under Article 3.4, for the second Commitment Period of the Kyoto Protocol (2013-2020).

According to the latest submission under the Kyoto Protocol, the annual average estimate of net removals related to activities under art. 3.3 is equal to 6.29 $MtCO_2$.

Afforestation and *reforestation* areas have been estimated on the basis of data from the Italian National Forest Inventories (IFN1985, IFNC2005 and the on-going INFC2015). *Deforestation* data have been detected by the surveys carried out in the framework of the NFIs (with reference to the years 2005 and 2012); administrative records at NUT2 level collected by the National Institute of Statistics related to deforested area have been used for the period 1990-2005.

The definition of forest management is interpreted in using the broader approach as described in the 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (2013 KP Supplement, IPCC, 2014). All forests fulfilling the definition of forest, as given above, are considered as managed and are under forest management. The total Italian forest area is eligible under *forest management* activity, since the entire Italian forest area has to be considered as managed forest lands. Concerning deforestation activities, in Italy land use changes from forest to other land use categories are allowed in very limited circumstances, as stated in art. 4.2 of the Law Decree n. 227 of 2001.

Lands subject to *cropland management* activity are consistent with the cropland lands in the UNFCCC reporting. CM data have assessed on the basis of the inventory of land use (IUTI[63]) data. The same activity data deduced for UNFCCC reporting (*cropland* category) were therefore used to report for *cropland management.*

Land subject to grazing land management have been assessed on the basis of the definition included in the Annex to the decision 16/CMP.1[64]. Lands under GM in Italy are those predominantly covered by herbaceous vegetation (introduced or indigenous) for a period longer than five years, used for grazing or fodder harvesting and /or under practices to control the amount and type of vegetation. In the latest national GHG inventory submission, only the area related to the 'improved grazing land' has been reported; this area corresponds to lands subject to inspections and certifications procedures, in accordance with the EU Regulations[65] on organic production, as well as by the Rural Development Regulations related to the organic farming measure. Data of grazing lands managed with organic practices has been derived from the National System on Organic Farming (SINAB, http://www.sinab.it/) of the Ministry of Agriculture, Food and Forest Policies (MIPAAF).

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[63] Detailed description of IUTI is included in the 2017 National Inventory Report, Annex 10: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/10116.php

[64] Grazing land management is the system of practices on land used for livestock production aimed at manipulating the amount and type of vegetation and livestock produced.

[65] Commission Regulation (EC) n. 889/2008: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R0889&from=EN; Council Regulation (EC) n. 834/2007: http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=URISERV:f86000&from=IT; Council Regulation (EEC) n. 2092/91: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31991R2092:EN:HTML

[65] Regulation (EEC) n. 2078/92: http://ec.europa.eu/agriculture/envir/programs/evalrep/text_en.pdf; Council Regulation (EC): n. 1257/1999 http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31999R1257&from=en; Council Regulation (EC) n. 1698/2005: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32005R1698&from=en; Regulation (EU) n. 1305/2013: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0487:0548:EN:PDF

Article 3.3

Changes in forest area were detected on the basis of national forest inventories data.

The following afforestation/reforestation activities that occurred or could have occurred on or after 1990 are included in the reporting of these activities:

- planted or seeded croplands;
- planted or seeded grasslands;
- abandoned arable lands which are naturally forested, through planting, seeding and/or the human-induced promotion of natural seed sources.

In Italy, all land use categories (cropland, grazing land, forest) are to be considered as managed; therefore, any land use change occurs between managed lands and, consequently, is direct human-induced. Afforested/reforested areas are to be considered legally bound by national legislation. Extensive forest disturbances have been rare in Italy, except for wildfires. Land-use changes after damage do not occur; concerning wildfires, national legislation (Law n. 353 of 2000, art.10.1) doesn't allow any land use change after a fire event for 15 years. Harvesting is regulated through regional rules, which establish procedures to follow in case of harvesting. Although different rules exist at regional level, a common denominator is the requirement of an explicit written communication with the localization and the extent of area to be harvested, existing forest typologies and forestry treatment. Concerning deforestation activities, in Italy land use changes from forest to other land use categories (i.e. in construction of railways the last years) are allowed in very limited circumstances, as stated in art. 4.2 of the Law Decree n. 227 of 2001, and have to follow several administrative steps before being legally permitted. In addition, the clear-cutting practice is not allowed (Law Decree n. 227 of 2001, art. 6.2).

Article 3.4

The whole forest area in 1 January 1990 was under forest management, since Italy considers all forest land managed, and, therefore, human-induced.

Italian forest resources are totally legally bound; the two main constraints, provided by the laws n. 3267 of 1923 and n. 431 of 1985, compel private and public owners to strictly respect limitations concerning use of their forest resources. As a matter of fact, each exploitation of forest resources must not compromise their perpetuation and, therefore, any change of land use is forbidden, for hydro-geological, landscape and environmental protection (the same limitations apply also to burnt areas, following the law n. 353 on forest fires approved in 2000). Consequently, unplanned cuttings are always forbidden, and local prescriptions fix strict rules to be observed for forestry.

For the second Commitment Period of the Kyoto Protocol, Italy has submitted information on Forest Management Reference Level (FMRL[66]), as required by the Decision 2/CMP.6. The FMRL is the averages of the projected forest management (FM) data series for the period 2013-2020, taking account of policies implemented before mid-2009, with emissions/removals from harvested wood product (HWP) using the

[66] Submission of information on forest management reference levels by Italy:
http://unfccc.int/files/meetings/ad_hoc_working_groups/kp/application/pdf/awgkp_italy_2011.pdf
Communication of 11 May 2011 regarding harvested wood products value by Italy:
http://unfccc.int/files/meetings/ad_hoc_working_groups/kp/application/pdf/awgkp_italy_corr.pdf

first order decay functions (A), and assuming instant oxidation (B). When constructing the FMRL, for Italy, the following elements were considered:

a. removals or emissions from forest management as shown in GHG inventories and relevant historical data:

The historical data used for the calculation of the FMRL come from Italy's 2011 national inventory report submission. GHG emissions and removals from FM are provided from 1990 to 2008 for living biomass (above- and below-ground), dead organic matter and GHG emission sources (i.e. forest wildfires). The FMRL includes above- and below-ground biomass and dead organic matter, which is consistent with pools reported in the GHG inventory.

b. age-class structure:

the used age structure is based on the latest national forest inventory (INFC 2005), which shows that most even-aged forests in Italy are within the 21–80-year age classes, with the majority being between 21–40 years.

c. forest management activities already undertaken:

indirectly considered through the use of the latest available forest time series data (from national forest inventory and other country statistics), and the estimation of the evolution of harvest demand by 2020 based on macroeconomic drivers and policies and legislative provisions adopted by April 2009. These policies are those included in the baseline scenario of the EU model PRIMES, which is the starting point of the projections for the FMRL. Policies adopted after 2009 are factored out.

d. projected forest management activities under business as usual:

through the estimation of the evolution of harvest demand by 2020 based on macroeconomic drivers and the application of policies implemented by April 2009 and legislative provisions adopted by April 2009.

e. continuity with the treatment of forest management in the first commitment period:

Italy has elected forest management among the additional activities of art. 3.4 under the Kyoto Protocol for the first CP, and FM is a mandatory reporting requirement for the second CP.

With regards to pools and gases included in the reference level, aboveground and belowground biomass, dead organic matter and HWP are included in the FMRL. Non-CO_2 GHGs from forest wildfires are also included in the submission. Italy has decided not to account for the soil carbon stock changes from activities under Article 3.4, providing transparent and verifiable information to demonstrate that soils pool is not a source in Italy, as required by par. 21 of the annex to decision 16/CMP.1.

Italy is one of the member States of the EU for which the JRC of the European Commission developed projections in collaboration with two EU modelling groups:

- G4M, from the International Institute for Applied Systems Analysis (IIASA)
- EFISCEN (European Forest Information Scenario Model) from the European Forest Institute (EFI)

The projection provided annual estimates of emissions and removals for forest management up to 2020 for the above- and below-ground biomass carbon pools. The G4M model relies on spatial data, provided by Italy. The main forest and forest management parameters (e.g. age-class structure, increment and historical harvest) were taken from NFIs. EFISCEN uses as data input the forest area data from NFIs scaled to match the forest area reported in the national inventory report (the forest land remaining forest land area, from which the deforested area is deducted, and the forest management area) and provides

projections on basic forest inventory data (stem wood volume, increment, age-class structure, as well as carbon in forest biomass and soil.

To estimate the FMRL, the emissions and removals estimated by the models for the time series 2000 to 2020 were calibrated/adjusted using historical data from the Party for the period 2000–2008. In this post-calibration, a constant offset is added to models' results for 2000–2020 to match the average historical data provided by each country for the period 2000–2008 to ensure consistency with national historical data in terms of the absolute level of emissions and removals and coverage of pools and gases.

Future harvest demand under a 'business as usual' scenario was derived from macroeconomic drivers (e.g. gross domestic product, population) and policies enacted in Italy. This information is used as data input to the GLOBIOM (Global Biomass Optimization Model) model, which projects demand for timber. Italy's projected harvesting rate (for both timber and fuel wood) is 16,879,000 m^3 by 2020.

Only biomass pools and emissions from biomass burning have been projected assuming a constant net change, for the period 2009–2020, equivalent to the historical average change reported for the period 2000–2008. Policies and measures that were implemented before mid-2009 have been considered in Italy's FMRL. Continuation of current forest management regarding timber is assumed.

All energy policies implemented at the EU and national levels are taken by the PRIMES model as input values for estimating wood fuel demand driven by these policies, combined with the expected global market effects (for the GLOBIOM model). The future demand for wood for material use (i.e. timber not bioenergy) is projected by GLOBIOM as compared to a base year (2000) based on GDP and population growth, which drive demand for timber. Outputs of PRIMES and GLOBIOM are further used as input to estimate emissions related to HWP pool. Although forest management policies are not used by models as input parameters, the impact of these policies is integrated in the projection process through increment and harvesting rates, and changes in age-class structure. Wood energy demand is derived from an analysis of country-specific policies implemented by April 2009. The increase of harvesting rates for wood for energy will result in more intensive forest management, moving toward the lower rotation lengths of the ranges provided.

The FMRL has been subjected to a technical assessment (TA), carried out by UNFCCC expert, and the FMRL value has been inscribed in the Appendix to Decision 2/CMP.7. The FMRL for Italy is equal to -22,166Mt CO_2 eq. per year applying a first-order decay function for harvested wood products (HWP) and to –21,182 Mt CO_2 eq. per year assuming instantaneous oxidation of HWP.

According to Decision 2/CMP.7, methodological consistency between the FMRL and reporting for forest management during the second commitment period of the Kyoto Protocol has to be ensured, applying technical correction if necessary. Therefore, to ensure methodological consistency between the FMRL and reporting for Forest Management during the second commitment period, Italy is going to apply a technical correction, consistently with the requirements of decision 2/CMP.7, annex, paragraph 14 and guidance of the 2013 KP Supplement (IPCC, 2014, par. 2.7.6.3).

Methods for carbon stock change and GHG emission and removal estimates

Methods for estimating carbon stock changes in forests (for Article 3.3 *afforestation/reforestation* and Article 3.4 *forest management*) are the same used for the UNFCCC GHG inventory: a growth model, For-est[67], is used to estimate the net change of carbon in the reporting pools: aboveground and belowground

[67] Federici S, Vitullo M, Tulipano S, De Lauretis R, Seufert G, 2008. An approach to estimate carbon stocks change in

biomass, dead wood and litter, and soils as soil organic matter. Additional information on the methodological aspects may be found in "Federici et al., 2008"; some specific parameters (i.e. biomass expansion factors, wood basic densities for aboveground biomass estimate, root/shoot ratios) used in the estimation process are the same reported in the above-mentioned article; in other cases (i.e. dead wood or litter pools), different coefficients have been used to deduce the carbon stock changes in the pools, on the basis of the results of the II National Forestry Inventory and according to the national definition of forest. The model has been applied at regional scale (NUTS2) because of the availability of forest-related statistical data: model input data for the forest area, per region and inventory typologies, were the Italian forest inventories (NFI1985, NFI2005), while the results of the first phase of the NFI2015 were used in forest area assessment. Following the main findings of 2011 UNFCCC review process, Italy has decided not to account for the soil carbon stock changes from activities under Article 3.4, providing[68] transparent and verifiable information to demonstrate that *soils* pool is not a source in Italy, as required by par. 21 of the annex to decision 16/CMP.1. Concerning carbon stock changes resulting from *deforestation* activities, due to a lack of detailed information on the land use of the deforested area, a conservative approach was applied, assuming that the total deforested area is converted into settlements. Carbon stock changes related to the forest land areas, before deforestation activities, have been estimated, for each year and for each pool (living biomass, dead organic matter and soils), on the basis of forest land carbon stocks deduced from the model For-est. In addition, it should be noted that land use changes due to wildfires are not allowed by national legislation (Law Decree 21 November 2000, n. 353, art.10, comma 1). The loss, in terms of carbon, due to deforested area is computed assuming that the total amount of carbon, existing in the different pools before deforestation, is lost.

GHG emissions from biomass burning have been estimated for forest fires and for fires affecting cropland and grassland areas. In particular, emissions from forest fires have been calculated on the basis of a detailed database, collecting data related to any fire event occurred in Italian regions, reporting, for each fire event, the burned area, the forest typology (27 classes in line with the NFI nomenclature), the scorch height [m] and the fire's type (crown, surface or ground fire).

Methods for estimating carbon stock changes for lands subject to cropland management activity are the same as those used for the UNFCCC greenhouse gas inventory: details are given in the National Inventory Report (ISPRA, 2017, par. 6.3.4). In line with the 2013 KP Supplement (IPCC, 2014) and 2006 IPCC Guidelines (IPCC, 2006), carbon stock changes have been estimated only for the living biomass of perennial woody crops, on the basis of carbon gains and losses, computed applying a value of biomass C stock at maturity. Tier 1 method has been followed for dead wood and litter, assuming that the abovementioned pools are at equilibrium, and no carbon stock changes are occurring. Soils carbon stock changes have been assessed to be not occurring, as no management changes can be documented. CO_2 emissions from cultivated organic soils subject to CM activity have been estimated, based on activity data FAOSTAT database[69].

Carbon stock changes related to land subject to grazing land management have been estimated, assuming no changes in carbon stocks in the living biomass pool, as well as for dead wood and litter

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forest carbon pools under the UNFCCC: the Italian case. iForest 1: 86-95 URL: http://www.sisef.it/iforest/

[68] ISPRA, 2017. National Inventory Report 2017 – Italian greenhouse gas inventory 1990-2015. ISPRA

[69] The area of cultivated organic soils have been assessed through the stratification of different global datasets: - the area covered by organic soils have been defined by extracting the Histosols classes from the Harmonized World Soil Database; - the cultivated area has been identified from the global land cover dataset, GLC2000, using the three "cropland" classes.

pools, further assuming that the above-mentioned pools are at equilibrium. Changes in carbon stocks in mineral soils have been estimated on the basis of country specific SOC_{ref}[70].

National Registry for forest carbon sinks

Several activities have been implemented and carried out in the framework of the national registry for carbon sinks; the *inventory of land use* (IUTI) has been completed, resulting in land use classification, for all national territory, for the years 1990, 2000, 2008 and 2012. Time series related to the areas to be included into the different IPCC categories have been assembled using IUTI data, and the data assessed by the national forest inventories (1985, 2005, 2012). Verification and validation activities have been undertaken and the resulting time series have been discussed with the institutions involved in the data providing (i.e. National Forest Service, Ministry of Agricultural, Food and Forestry Policies (MIPAAF), Forest Monitoring and Planning Research Unit (CRA-MPF)).

Concerning deforestation activities, an ad hoc survey carried out in the framework of the NFIs (with reference to the years 2005 and 2012) has allowed the assessment of the deforestation. Also, the estimation of non-CO_2 emissions from forest fires have been modified, taking into account the fire intensity (assessed through the scorch height) and the forest typologies affected by fire.

4.6 Costs analysis

An ex-post assessment of the costs of implemented policies and measures is available in the "Progress report under art. 22 of the 2009/28/EU directive" (see paragraph 4.1.7). In the tables below are reported the main results for the Heating Account, White Certificaates and Tax deduction policies.

Table 4.20 Summary of overall results in the years 2013-2014 for the Thermal/Heat Account

	Number of incentives 2013-2014 MEUR
Public administrations	4.3
Private parties	24.48
TOTAL	*28.78*

Source: GSE

[70] The assessment of the country specific SOCref has been carried out using the following layers: Climatic Zone layer, Corine Land Cover 2006, italian soil map (Costantini et al., 2013). The country specific SOCref have been stratifies into three macroareas in Italy: north (78.5 t C ha-1), center (71.3 t C ha-1) and south (46.2 t C ha-1).

Table 4.21 Summary of overall results in the years 2009-2014 for the White Certificates

	Average price of EES (EUR/EES) [71]	Total annual support (EUR)				
Reference year		*Solar collectors*	*Electrical heat pumps*	*Small cogeneration systems for space heating and cooling*	*District heating systems*	*Centralised heating and cooling systems*
2014	108.18	1 021 03	2 380	1 076 961	10 832 141	9 433 985
2013	101.41	2 034 082	1 521	1 781 46	19 894 005	7 166 340
2012	92.88	21 880 578	37 988	1 151 433	5 649 519	2 903 893
2011	95.49	4 141 497	25 687	2 026 011	20 252 570	1 023 366
2010	85.14	3 195 730	4 421	219 917	1 705 184	596 831
2009	74.46	2 257 627	0	0	0	0

Source: GSE

Table 4.22 Tax deductions of 55-65% by type of project (EUR)

	2010	2011	2012	2013
Solar panels for hot water production (Article 1(346) of Law No 296/2006)	194.000.000	115.600.000	88.000.000	106.000.000
Replacement of space heating systems (estimate limited to the use of RES systems) (Article 1(347) of Law No 296/2006)41	91.659.480	55.890.710	62.684.639	92.800.265

Source: GSE

About planned measures a preliminary aggregate assessment is reported in the 2017 National Energy Strategy:

- Energy efficiency 110 billion euros;
- Renewable energy 35 billion euros;
- networks and infrastructures 30 billion euros.

4.7 Summary of policies and measures

A summary of implemented and planned measures are reported in the tables below.

[71] White Certificates: Energy Efficiency Titles - EETs

Table 4.23- Summary of implemented policies and measures – CO2

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
8	Eco-design of energy-using products - Legislative decree 201/07 (transposition of directive 2005/32/EC- first regulations)	Installation of highly efficient electric motors and inverters through minimum mandatory standards	CO2	Regulatory	Implemented 2008	Italian Regulatory Authority for Electricity Gas and Water	1920	-
11	Building Regulation (Legislative decree 192/05 as amended by legislative decree 311/06)	Minimum mandatory standards on new and existing buildings (Energy Efficiency)	CO2	Regulatory	Implemented 2006	Municipalities, Ministry of Economic Development;	3610	-
12	Tax deduction for energy saving in buildings - Budget law 2007, Budget law 2008 and Budget law 2009	Supporting energy savings in existing buildings through tax deduction of 55%	CO2	Fiscal	Implemented 2008	Ministry of Finance	1050	-
14	Legislative decree 201/07 (transposition of directive 2005/32/EC) - Increase efficiency of appliances in residential sector	First regulation on mandatory energy efficiency standards for energy-using products	CO2	Regulatory	Implemented 2008	Ministry of Economic Development	2600	-
16	Infrastructural measures - Increase of high capacity and high speed rail networks	High Capacity and High Speed rail. Regional networks for passengers	CO2	Planning	Implemented 2008	Ministry of transport	5700	-

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
18	Emission standard for new car (Regulation (EC) No 443/2009)	Fleet update at 120 g CO2/km in 2015 and 95 g CO2/km in 2020	CO2	Regulatory	Implemented 2008	Ministry of Economic Development	10200	-
19	Legislative decree 128/05(transposition of directive 2003/30/EC) - mandatory use of biofuels	Mandatory use biofuels (target 4.5% to 2012)	CO2	Regulatory	Implemented 2008	Ministry of Economic Development	1490	-
20	Legislative Decree 28/2011 (transposition of directive 2009/28/EC) - Mandatory use of biofuels	Mandatory use biofuels (target 10% to 2020)	CO2	Regulatory	Implemented 2014	Ministry of Economic Development	1580	-
24	Minimum requirements for building (Inter-ministerial decree June 26th, 2015)	Application of the minimum energy performance requirements for buildings. These requirements apply to public and private buildings, whether they are new buildings or existing buildings subject to restructuring	CO2	Regulatory	Implemented 2015	Ministry of Economic Development		4000
Total effect of implemented policies							**28150**	**4000**

Table 4.24- Summary of implemented policies and measures – N2O

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)
							2020
10	Reduction of emissions of N2O from nitric acid production	Significant reductions in process emissions from nitric acid production plants due to the application of BAT (Best Available Technology)	N2O	Voluntary	Implemented 2010	Industrial plant	740
21	Nitrogen fertilizer	Rationalization in the use of nitrogen fertilizer	N2O	Regulatory	Implemented 2007	Ministry of Agriculture	790
Total effect of implemented policies							**1530**

Table 4.25- Summary of implemented policies and measures – CH_4

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)
							2020
22	Animal storage	Recovery of biogas from animal storage system	CH4	Regulatory	Implemented 2007	Ministry of Agriculture	400
23	Increase separate collection of urban waste	Compliance with separate collection targets and reduction of biodegradable waste disposed of into landfills	CH4	Regulatory	Implemented 2008	Regions	3700
Total effect of implemented policies							**4100**

Table 4.26- Summary of planned policies and measures – CO_2

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
25	New measure to promote and support renewable energy sources for electricity (RES-E) - photovoltaic	Renewable energy - photovoltaic: supporting the expansion of photovoltaic and concentrated solar power plants (CSP) through feed in tariffs until a maximum capacity of 40 GW. (Current installed capacity in 2015 18 GW, total new capacity 2016-2030: 22+2 GW)	CO2	Economic	Planned 2020	Ministry of Economic Development		8568
26	New measure to promote and support renewable energy sources for electricity (RES-E) - - wind	Renewable energy - Wind: promotion of new plants and repowering of existing ones up to a maximum of 16 GW of installed power (current installed capacity in 2015 9.2 GW)	CO2	Economic	Planned 2018	Ministry of Economic Development	-	4229
27	New measure to promote and support renewable energy sources for electricity (RES-H) - Biomass	Renewable energy - Biomass: further extension of incentives so that existing plants run up to 2030. New bioenergy (agriculture and urban waste and secondary product) with incentives only for small plants capacity < 70 kW	CO2	Economic	Planned 2018	Ministry of Economic Development	-	To be estimated

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
28	New measure to promote and support renewable energy sources for electricity (RES-H) - Other renewables	Renewable energy - Other: review of auction rules and mechanisms for hydro, geothermal energies and high efficiency cogeneration	CO2	Economic	Planned 2018	Ministry of Economic Development	-	To be estimated
29	Coal phase out	Gradual phase-out of coal-fired installations subject to system adequacy (adequate replacement capacity) and measures to preserve employment (still available 3280MW in 2030)	CO2	Regulatory	Planned 2020	Ministry of Economic Development	-	7758
30	2017 National Grid Development Plan - Grid upgrade	Development of the national electricity transmission and distribution network to allow the increase of the Distributed Generation (DG) - the effect of this measure is distributed in all PAMs regarding electricity consumption	CO2	Planning	Planned 2020	TERNA - Manager for the electricity transmission grids	-	IE
31	2017 National Grid Development Plan - Smart grid	Increasing flexibility of electricity network for the management of production from RES - the effect of this measure is included in measures 25 and 26	CO2	Planning	Planned 2020	TERNA - Manager for the electricity transmission grids	-	IE

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
32	Development of district heating network	30% development of the district heating (renewable energy and high efficiency cogeneration)	CO2	Planning	Planned 2018	Municipalities	-	.
33	Installation of two news LNG terminals	LNG terminals with a capacity of 4 bcm annual	CO2	Planning	Planned 2018	Ministry of Economic Development	-	-
34	Natural gas in Sardinia	Development of terminals for gas vessels, small coastal storage area and a medium and high pressure distribution network	CO2	Planning	Planned 2017	Ministry of Economic Development	-	-
35	Reconversion of refinery industry	Conversion of at least another 1 or 2 refineries (beyond Porto Marghera) to bio-refineries	CO2	Planning	Planned 2018	Ministry of Economic Development	-	-
36	Further extend of energy saving targets (White certificates 2020-2030)	Energy efficiency measures in industry ETS and non-ETS up to 2.2 Mtoe saved	CO2	Economic	Planned 2018	GSE- Manager for Energy Service	3700	4400

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
37	Energy efficiency in residential building with tax deduction	Restructuring for thermal insulation in residential buildings, 0.5% annual renovation rate, to be achieved through an improved tax deduction scheme (65-55-36%) based on expected saving.	CO2	Fiscal	Planned 2018	Ministry of Finance, Ministry of Economic Development	385	1569
38	Energy efficiency in residential building - upgrade entire building - tax deduction	Restructuring for thermal insulation in residential buildings, 0.5% annual renovation rate, focused on "deep renovation" to be achieved through the remodelling of the tax deduction (The assessment of the impact of this measure has not been finalized yet because the implementation involves public and private resources. It has still to be decided the type of instrument and the extent of public support)	CO2	Fiscal	Planned 2018	Ministry of Finance, Ministry of Economic Development	-	-
39	Energy efficiency in residential building - measure for supporting low income families	Introduce title portability or structuring an incentive system integrated with energy	CO2	Economic	Planned 2020	Ministry of Finance	-	-

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
		redevelopment						
40	Energy efficiency in residential building - provision to rebuild housing including seismic upgrade	Link the instrument with other incentive mechanisms by introducing measures for anti-seismic building	CO2	Economic	Planned 2020	Ministry of Economic Development	-	-
41	Energy efficiency in tertiary building	Restructuring for thermal insulation in tertiary buildings, including very low emission building for central administration (The assessment of the impact of this measure has not been finalized yet because the implementation involves public and private resources. It has still to be decided the type of instrument and the extent of public support)	CO2	Fiscal	Planned 2017	Regions, Ministry of Economic Development	894	-
42	Promoting energy saving in building (public, domestic, tertiary): insulation, replacement windows and boilers, installation of heat pumps and solar thermal panels	Investments of air conditioning systems (cooling and heating) in the residential sector, restructuring of the service sector's buildings. Installation of gas and electric heating pumps,	CO2	Economic	Planned 2017	GSE- Manager for Energy Service	4080	-

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
	(Legislative decree 28/2011)	high efficiency boilers and floor heating system. Replacement of appliances (The assessment of the impact of this measure has not been finalized for 2030 because the implementation involves public and private resources. It has still to be decided the type of instrument and the extent of public support)						
43	New measure to promote and support the development of charging infrastructure	Transposition of DAFI 2014/94/EU directive define and implement the plan for the development of alternative fuels infrastructure: electric car charging stations and natural gas filling stations. (The impact is included in the measures related in the alternatives fuels vehicles)	CO2	Regulatory	Planned 2017	Industries association and local authorities (Companies)	-	-

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
44	Modal shift from private cars to public buses and walking	Modal shift of about 10% of car transportation demand in 2030 to public transport, car-pooling, bikes and walking	CO2	Planning	Planned 2017	Ministry of Transport	1310	4248
45	Promoting and supporting renewal of car fleet with low carbon fuels	Speed up the replacement of vehicle fleet with new vehicles, including CNG cars (up to 1.7millions), LPG cars (up to 2.7 million), CNG vans (up to 1 million).	CO2	Economic	Planned 2017	Ministry of Economic Development	1220	3180
46	Promoting and supporting renewal of car fleet with electrical vehicles	Speed up the replacement of car vehicle fleet with electric cars up to about 3 million vehicles.	CO2	Economic	Planned 2018	Ministry of Economic Development, Ministry of Finance (Government); Municipalities (Local)	460	2372
47	Promoting and supporting renewal of car fleet: further expansion of electrical vehicles	Increase the electrical vehicles to more than 10% of fleet by 2030, including cars (0.8 million) and electric vans (0.5 millions) (The assessment of the impact of this measure has not been finalized yet because	CO2	Economic	Planned 2025	Ministry of Finance, Ministry of Environment	IE	IE

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
		the implementation involves public and private resources. It has still to be decided the type of instrument and the extent of public support)						
48	Expansion of use of biofuel over 10% of road fossil fuels consumption, including bio-methane	Biofuels promotion: consumption in the transport sector of bio-methane and about advanced biofuels through the conversion of refineries and / or traditional biodiesel plants (The assessment of the impact of this measure has not been finalized yet because the implementation involves public and private resources. It has still to be decided the type of instrument and the extent of public support)	CO2	Economic	Planned 2021	Ministry of Economic Development, Ministry of Finance		
49	Promotion of LNG in transport	Expansion of LNG heavy duty trucks up to 30% of the fleet and LNG ships up to 50% of total national fuel consumption	CO2	Fiscal	Planned 2018	Ministry of Economic Development, Ministry of Finance	160	1800

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
Total effect of planned policies							**12209**	**38124**

4.8 Summary of policies and measures no longer in place

In table 4.27 below, policies and measures that are no longer in place are reported.
Those measures have been reported in the sectorial table and considered in the WM scenario because they still have a mitigation impacts at 2020.

Table 4.27 - policies and measures no longer in place

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
1	Third "Conto Energia" (art.3 paragraph 1, decree 6 august 2010) and Fourth "Conto Energia" (Decree 5 May 2011)	Supporting the expansion of photovoltaic plants through feed in tariffs until a maximum capacity of 8000 MW	CO2	Economic	Implemented 2010	Ministry of economic development	2300	-
2	Third "Conto Energia: photovoltaic (art.3 paragraph 2, decree 6 august 2010)	Supporting the expansion of photovoltaic plants through feed in tariffs until a maximum capacity of 3000 MW	CO2	Economic	Implemented 2010	Ministry of economic development	900	-
3	Green Certificate - budget law 2008	Green Certificate increased every year by 0,75% for 2007 - 2012 and establish an All-Inclusive rate for plants <1 Mwe	CO2	Economic	Implemented 2009	Ministry of economic development	4000	-
4	European regional development fund (ERDF), National Strategic Framework 2008-2013 - increase of renewable energy in electricity production	Supporting system for RES with Regional operative program (POR) and Interregional operative program (POIN)	CO2	Economic	Expired 2008	Ministry of economic development	1400	
5	White certificates - decree December 2007 - CHP	Supporting CHP and district heating plants for 2008-2012	CO2	Economic	Expired 2008	Government, GSE and electricity and gas distributors	970	

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
6	National Strategic Framework 2007-2013 - ERDF	Supporting CHP and energy savings with POR (Operative Regional Programs) and POIN (Operative Regional Programs)	CO2	Economic	Expired 2007	Regions	240	-
7	White certificates - decree December 2007 - Industry	Supporting electric energy saving for the period 2008-2012	CO2	Economic	Expired 2008	GSE- Manager for Energy Service	2020	
9	European regional development fund (ERDF), National Strategic Framework 2008-2013 - Electric energy saving in the energy industry sector	Supporting electric energy saving with POR (Operative Regional Programs) and POIN (Operative Interregional Programs)	CO2	Economic	Expired 2008	Regions	660	
13	White certificates - decree December 2007 - Commercial	Supporting energy savings 2008-2012 (Energy Efficiency)	CO2	Economic	Implemented 2008	GSE- Manager for Energy Service	3120	-
15	National Strategic Frame-work 2007-2013 - ERDF - Residential energy saving	Supporting electric energy saving with POR (Operative Regional Programs) and POIN (Operative Interregional Programs) in buildings	CO2	Economic	Expired 2008	Regions	420	
17	National Strategic Framework 2007-2013 - FESR - increase public transportation in urban	Intermodal infrastructure projects: expansion of metropolitan railways/ subway	CO2	Planning	Implemented 2007	Ministry of transport	1280	-

PaMs number	Name of PAM	Target and/or activity affected	GHG affected	Type of instrument	Status and start year of implementation	Implementing entity or entities	TOTAL GHG Reduction (kt CO2 eq.)	
							2020	2030
	area							
Total effect of policies no longer in place							**17310**	

4.9 Minimization of adverse effects in accordance with art.2 paragraph 3 of the Kyoto Protocol

Each Annex I Party shall also provide information on how it strives to implement policies and measures under Article 2 of the Kyoto Protocol in such a way to minimize adverse effects, including adverse effects of climate change, effects on international trade, and social environmental and economic impacts on other Parties under Article 4, paragraphs 8 and 9, of the Convention, taking into account Article 3 of the Convention.

The Kyoto Protocol was adopted in pursuit of the ultimate objective of the Convention, and hence its full implementation is intended to contribute to preventing dangerous anthropogenic interference with the climate system. Ambitious mitigation goals are necessary to ascertain a future for all countries.

Adverse impacts on developing countries are reduced if global temperature increase is limited below to 2 degrees Celsius, if dependence on fossil fuels decreases, and if Annex I Parties are able to develop low-carbon energy systems and reduce fossil fuel consumption.

The European Union actively undertakes a large number of activities bringing positive impacts on third countries and their ability to tackle climate change, specifically through capacity building and technology transfer activities.

Climate policies in Italy are formulated and implemented in a way that minimise the potential adverse impacts on specific sectors of economic activity, industrial sectors or other Parties to the Convention, including the adverse effects on the international trade, social, environmental and economic impacts in developing countries. As concerns domestic action, mitigation measures included in the national climate change strategy do not focus exclusively on CO_2 from fossil fuels, but cover all sectors of economic activity which are related with GHG emissions or with carbon sinks.

Furthermore, Italy has ensured that measures implemented to increase the differentiation of energy sources do not contradict the full liberalization of its energy markets. In particular, the promotion of natural gas consumption improves the safety of energy supply of the country, while new commercial relationships are developed with those countries from which natural gas is imported (e.g. Russia, Algeria, etc.).

Other policies and measures might have potential positive impacts on third countries[72]. The flexible mechanisms under the Kyoto Protocol, as tools incorporated into the Protocol to share efforts in reducing greenhouse gases, ensure that investment is made where the money has optimal GHG-reducing effects, thus ensuring minimal impact on the world economy and enhancing the development of new commercial relationships between developed and developing countries. At European level, changes to subsidies under the EC Common Agricultural Policy (CAP) now link payments to environmental, food safety and animal welfare standards, not to agricultural production volume. This encourages responsible agricultural practices. In addition, expectations are that the worldwide use of biomass in the energy supply will increase considerably in the coming decades. Countries and producers will see opportunities for new activities; at the same time, there is a growing concern that this must not be at the expense of other

[72] For more information please see the chapter 13 Information on minimization of adverse impacts in accordance with Article 3, paragraph 14 of the National Inventory Report 2017.
http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/10116.php

important values for nature, environment and society. To accommodate these feelings, criteria will be needed that indicate whether biomass has been produced in a responsible manner.
Updated information on the minimization of adverse impacts in accordance with art.3 paragraph 14 of the Kyoto Protocol is reported in the National Inventory Report transmitted to the UNFCCC in the framework of the 2017 annual inventory submission.

5 PROJECTIONS AND EFFECTS OF POLICIES AND MEASURES[73]

5.1 Introduction

During 2016, the Head of Government Office has started and coordinated a process to develop the national reference scenario. This process involved:

- Ministry of Environment, Land and Sea; Ministry of Economic Development; Ministry of Economy and Finance; Ministry of Agriculture; Ministry of Transport and Infrastructures;
- ISPRA – National Institute for Environmental Protection and Research (linked to the Ministry of Environment); ENEA – National Agency for New Technologies, Energy and Sustainable Economic Development (linked to the Ministry of Economic Development); ISTAT – National Institute of Statistics; The Italian Regulatory Authority for Electricity, Gas and Water – the independent regulatory body of the energy markets and the integrated water services;
- Public/private companies as
    - GSE – a State-owned company which promotes and supports renewable energy sources and energy efficiency. GSE is the parent company of:
        - Acquirente Unico (AU) – Supply to domestic sector and small enterprises;
        - Gestore dei Mercati Energetici (GME) – Manager of power and gas markets;
        - Ricerca sul Sistema Energetico (RSE) – Research on electrical energy production, distribution and consumption;
    - SNAM – responsible for the construction and management of natural gas infrastructure (transportation, storage and regasification);
    - TERNA – responsible for national electricity grid's operation, maintenance and development.

The achievement of this inter-ministerial process has been the development of a National Reference Scenario, reported here as With Measures (WM) scenario. The scenario takes into account the evolution of the national energy system and it considers only policies in force on December 31st, 2014 and minimal standards for building efficiency measure which was adopted in June 2015. The same assumptions used by the European Commission for PRIMES 2016 Reference scenario are adopted in the WM scenario. The base year for the projections is 2015, by the last emission inventory data submitted to UNFCCC.

The scenario has been produced with the partial equilibrium model TIMES (The Integrated MARKAL-EFOM1 System / EFOM Energy Flow Optimization Model), a model generator for local, national or multi regional economies finalized to the analysis of whole energy systems (electricity generation and consumption, heat distribution, transports, industries, civil, etc.). The model belongs to the family of MARKAL (Market Allocation, http://www.iea-etsap.org/web/Markal.asp) models, the so-called "3e models" (energy, economy, environment), and was developed by the International Energy Agency (IEA) under the program Energy Technology Systems Analysis Program (ETSAP). This model is recognized by the International Panel on Climate Change (IPCC).

The energy system thus simulated is composed by a number of different sectors and subsectors (e.g. electricity production, industrial activities, residential buildings, etc.), each one consisting of a set of

[73] Lead authors: Antonio Caputo (ISPRA), Emanuele Peschi (ISPRA). Contributing authors (ISPRA): Mario Contaldi (ISPRA), Riccardo De Lauretis (ISPRA), Eleonora Di Cristofaro (ISPRA), Barbara Gonella (ISPRA), Monica Pantaleoni (ISPRA), Daniela Romano (ISPRA), Ernesto Taurino (ISPRA), Marina Vitullo (ISPRA).

technologies connected by input-output linear relationships. Inputs and outputs can be energy carriers, materials, emissions or requests for services. TIMES is a bottom-up, demand-driven model in which each technology is identified by technical and economic parameters and the production of a good is conditioned to the effective demand by end-users.

The structure of energy scenarios is defined by variables and equations determined by input data constituting the regional database. The database contains qualitative and quantitative data describing the interaction between different components of the energy system.

TIMES identifies the optimal solution to provide energy services at the lowest cost, producing simultaneously investments in new technologies or using more intensively the available technologies in each region defined by the user. For example, an increase in electricity demand for residential use can be satisfied with a more intensive use of available power plants or through the installation of new power plants. Model choices are based on the analysis of technological characteristics of available alternatives, the cost of of energy supply and environmental criteria and bounds.

CO_2 emissions are directly calculated by the model implemented by ISPRA using IPCC "reference approach" methodology and national Emission Factors. The modelling approach avoids, in principle, the so called "double counting effect" for the implementation of policies, so the model evaluates the impacts and interactions among measures as a package. The model outcomes indicate the mix of technologies and primary emission sources fulfilling the commodity demands of the reference scenario at the lowest possible cost.

The model considers the effect of the average temperature change taking into account the dynamic of degree days as in PRIMES 2016.

The emissions from non-energy sources and other energy related GHGs different from CO_2 have been evaluated by the family of spreadsheet models used by ISPRA for the V and VI NCs to UNFCCC.

The overall GHGs emissions and the share between ETS and non-ETS sectors are the results of the mentioned models implemented by ISPRA.

A "With Additional Measures" (WAM) scenario has not been carried out in this Communication, because the new National Energy Strategy ("SEN 2017")[74], which includes new planned PaMs, has only been adopted in November 2017: accordingly, the subsequent new scenario could not be reported in this submission due to time constraints. Moreover, consistency had to be ensured with the National Communication submitted in 2017 by the European Union, which relied on previous communications made by Member States to the European Commission pursuant to Regulation No 525/2013/EC, Art. 13 and Art. 14.

A "Without Measures" (WOM) scenario, calculated with the same methodology of WM scenario, could not be included either, as most data on PaMs are not available starting from 1990 and, especially, since many structural changes occurred in the period 2000-2007 linked to technological changes and fuel shifts, so that it is not possible to determine how the energy system would have evolved without those changes. In this regard, fuel shifts toward low carbon fuels for electricity generation (since 1990 there has been a steady increase of natural gas share and a corresponding decrease of oil products share, see Figure 5.151) or the introduction of combined cycle plants (since 2000) are among the most important factors that make it impossible to evaluate how the national emissions would have evolved without any measure. Nevertheless, it is possible to perform emission projections without measures entered into force

[74] http://www.sviluppoeconomico.gov.it/index.php/it/energia/strategia-energetica-nazionale

since 2007 by interpolating the estimated impact of PaMs up to 2030 and adding such impact to WM projections. Moreover, the emission projections of WM scenarios reported in the previous National Communications (mainly in the fourth one) could supply esteems of emissions without the measures implemented after 2000 (see par 5.6).

5.2 WM scenario

5.2.1 Main assumptions

The WM scenario was elaborated in 2016 and projections include all PaMs implemented or adopted up to the end of 2014 and minimal efficiency standards for buildings adopted in 2015. The base year for projections is 2015. The projected years are 2020, 2025, 2030, and 2035. The main assumptions of the scenario are:

- GDP: economic growth from 2015 to 2020 with average annual rate of +0.71%. For the period 2020-2025 the average annual rate is +1.18%, and for period 2025-2035 is +1.19%, in accordance with PRIMES 2016;
- energy: reduction of energy consumption and increase of renewable sources toward EU 2030 targets;
- population: increase up to 2030 with an average annual rate of 0.37% since 2015 in accordance with PRIMES 2016.

The scenario takes into account a recovery from the economic crisis that has hit all national activities, and it also considers the development of low carbon technologies and efficiency improvement. The main driving variables used for projections of demand for energy services in the end-use sectors, are:

- industry: gross value added (GVA) and, for some sub-sectors, physical productions;
- tertiary: GVA;
- residential: demographic trends (mainly population and number of households), increase in the number of appliances per household and growing demand for summer cooling;
- electricity generation: continuation of the ongoing growth of renewable sources;
- transport: dynamics of active population (along with assumptions about mobility per capita) and goods exchange, fleet renewal with low emissions engines.

5.2.1.1 General Economic Parameters

Table 5.1 shows actual and projected values for GDP and GVA.

As already mentioned, the GDP growth is assumed from 2015 with an average year rate of +0.71% up to 2020, following the recovery from the economic crisis. The GDP values for 2020 and following projected years are those provided by PRIMES 2016 for the Reference Scenario. Among the factors that motivate this "prudent" vision up to 2020, there is the slow recovery of gross value added in the industrial sector that has incurred in the most relevant reduction of activity during the economic crisis period. This lower rate is mainly due to the rigidity of the Italian industrial structure, characterized by a low average size of companies and by a competitive disadvantage in the high-tech sectors[75]. In future years, tertiary sector

[75] ENEA, L'Italia nella competizione tecnologica internazionale, Quinto rapporto, Sintesi e scenari generali, 2006;

will grow at a higher rate, further increasing its role in the Italian economy.

Table 5.2 shows the energy and carbon international prices which are all following increasing trends according with the same assumption made in PRIMES2016 for the Reference Scenario.

The increase in carbon price is particularly steep during the period 2015-2035, while the foreseen growth for energy prices is much slower.

Table 5.1 – Actual (up to 2015) and projected GDP, and GVA

billion € 2010 constant prices basis	2010	2015**	2020	2025	2030	2035
GDP	1,605	1,547	1,603	1,699	1,803	1,942
Average annual rate (%)		-0.72%	0.71%	1.18%	1.19%	1.50%
GVA – industry*	312	292	300	311	324	342
Average annual rate (%)		-1.31%	0.58%	0.69%	0.83%	1.11%
GVA – tertiary	1,063	1,033	1,110	1,186	1,264	1,370
Average annual rate (%)		-0.57%	1.46%	1.32%	1.29%	1.61%
GVA – agriculture	28	24	25	26	27	27
Average annual rate (%)		-2.99%	0.78%	0.55%	0.34%	0.44%

*including Constructions and excluding: Manufacture of coke and refined petroleum products; Electricity, gas, steam and air conditioning supply; Water supply; sewerage, waste management and remediation activities

**2015 data are those made public by ISTAT in march 2016 and differ slightly by the most recent review, anyhow the difference is small enough not to influence the model results

Table 5.2 – Energy and carbon international prices

		2010	2015	2020	2025	2030	2035
Coal prices	€ 2010 / toe	132	80	100	119	143	152
Oil prices	€ 2010 / toe	434	337	524	595	655	683
Gas prices	€ 2010 / toe	286	271	337	365	397	423
Carbon price	€ 2010 / t CO_2	10	7	14	22	32	40

5.2.1.2 Population and transport

The population grew significantly from 2005 to 2015 with annual average rate of 0.46%. The annual growth rate from 2015 to 2020 is 0.41%. The average annual rate for the following years is quite stable around 0.34% up to 2035 (Table 5.3). For the period 2020-2030, the projected population is the same as in PRIMES 2016.

Table 5.3 – Population

	2005	2010	2015	2020	2025	2030	2035
2007 IV NC	58,462	58,531	58,471	58,123			
2009 V NC	58,462	60,190	61,130	61,160			
2013 VI NC (BR1)	58,462	60,340	61,138	61,634	61,986	62,129	
2015 BR2	58,064	59,707	61,640	62,500	63,080	63,680	64,350
2017 VII NC (BR3)	57,875	59,190	60,800	62,065	63,118	64,229	65,333

Centro Europa Ricerche, Crisi delle esportazioni: quello che la lira ci aveva nascosto, Rapporto CER 4/2004; Confindustria, Tendenze dell'industria italiana, 2004, Editore SIPI Srl, Roma.

The change in past years' population figures, with reference to previous submissions, is due to the last decennial Census by National Statistical Institute, published at the end of 2012, that pointed out lower population levels than those previously estimated for 2011 to about 59,365 thousand.

Table 5.4 shows data of transport demand for passengers and freights. The expected activity scenario for transport shows a steady growth from 2015 to 2030 following the recovery from the economic crisis as confirmed by data for 2015 and provisional data for recent years. The transport demand increases up to 2020 compared to 2015 with annual rate of 2.5% for passengers and 5.2% for goods. After 2020, up to 2035, the annual rate becomes more stable around 0.7% for passengers and 1.0% for goods.

Table 5.4 – Transport demand for passengers and freights

		2010	2015	2020	2025	2030	2035
Passenger person kilometers	billion pass-km, excluding civil aviation	919	901	1,017	1,055	1,094	1,126
Freight ton kilometers	billion ton-km>50km, only national vectors	211	225	289	306	323	337

Source: ISPRA

The next table shows the number of person per household adopted for GHG projections in residential sector. As for the average floor space, a constant value of 102.5 m^2 has been used for the whole period of projections.

Table 5.5 – Inhabitants per household

	2010	2015	2020	2025	2030	2035
Inhabitants/Household	2.40	2.40	2.44	2.42	2.40	2.37

Source: ISPRA

5.2.2 The European context

Italy is a EU Member State and its 2015 GHGs emissions account for about 10.0% of European Union's (EU 28) actual emissions[76]. Many mitigation policies as well as monitoring commitments are coordinated at EU level.

Under the overall commitment of 20% reduction of GHG compared to 1990 levels by 2020, concerning non-ETS emissions, Italy is committed to reduce its emissions in the non-ETS sector of 13%[77] by 2020 with respect to 2005 level under Decision n. 406/2009/EC (the so-called "Effort Sharing Decision" ESD). The emissions and removals from LULUCF sector are excluded from Effort Sharing Decision n. 406/2009/EC. More details on 2020 targets are reported in the Chapter 4.

In October 2014, the European Commission has presented a Communication on the "Climate and Energy Package 2030" to the European Council of the Head of States and Government. In the same meeting the European Council has approved conclusions that include a quantified reduction target for the 2030 horizon. The main target set by those conclusions is the endorsement of a binding EU-wide GHG

[76] Data from CRF, year 2015, of National Inventory Submission 2017 of European Union and Italy to the UNFCCC Secretariat.

[77] ETS sectors contribute for a collective reduction of 21% of emissions compared to 2005. As also explained in Chapter 4, the ETS cap is not attributed to Member States but it's managed at EU level and declines in order to achieve the target

reduction of at least 40% of domestic emissions by 2030, with reference to 1990 level. To that aim, the Council conclusions indicate that the target will be delivered collectively by the EU with the reduction in ETS and non-ETS sectors amounting to 43% and 30% by 2030 compared to 2005, respectively. The Council Conclusions also include an EU-wide target for renewable sources of 27% and an indicative target of 27% for the energy efficiency (energy savings compared with the business-as-usual scenario). This last target will be reviewed in 2020 having in mind a 30% target.

Following the above-mentioned Council conclusions, the European Parliament and the Council have proposed a legislative package for the non-ETS sector, which would require Italy to reduce GHG emissions by 33%, compared to 2005 levels within 2030; a proposal on the inclusion of emissions and removals from LULUCF into the 2030 Climate and Energy Framework has been also presented. In particular, the proposed legislative package includes a new flexibility which allows for a limited use of net removals from certain LULUCF accounting categories, while ensuring no debits occur in the LULUCF sectors, to account for Member State compliance towards the targets in the non-ETS sectors if needed. The proposed cap, for Italy, is about 11 Mt CO_2eq. for the entire 2021-2030 period.

As for the European monitoring and reporting mechanisms, Decision No. 525/2013/EC establishes the following commitments:

- ensuring the timeliness, transparency, accuracy, consistency, comparability and completeness of reporting by the Union and its Member States to the UNFCCC Secretariat;
- reporting and verifying information concerning commitments of the Union and its Member States pursuant to the UNFCCC, Kyoto Protocol and related decisions adopted and evaluating progress towards meeting those commitments;
- monitoring and reporting all anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol on substances that deplete the ozone layer in the Member States.

In particular, article 14 of Decision No. 525/2013/EC foresees, by 15 March 2015 and every two years thereafter, that Member States shall report to the European Commission national projections of anthropogenic greenhouse gas emissions by sources and removals by sinks, organized by gas or group of gases (HFCs and PFCs) listed in Annex I and by sector. Those projections shall include quantitative estimates for a sequence of four future years ending with 0 or 5 immediately following the reporting year. National projections shall take into consideration any policies and measures adopted at Union level.

5.2.3 Consumption of primary and final energy

The total primary energy supply (TPES), estimated according to Eurostat methodology, will be about 150.4 in 2030 with an average yearly decrease rate of -0.2% since 2015.

TPES started to decrease since 2005, before the economic crisis, while in the period 1990-2005 it has constantly increased with an annual average equal to +1.4%.

The share of natural gas increased constantly since 1990 counterbalancing the corresponding decrease of oil share. In the last years, it is also evident the growing role of renewable energies.

Figure 5.2 shows the projections of gross inland consumption according to the present NC and previous NCs and BRs. Relevant changes can be observed in the estimated total energy consumption between the previous 6th NC (WM and WAM scenarios with base year 2010) and the updated one due to the extension of the economic crisis and the adoption of new measures. Between the NC6 and NC7 scenarios, there

were those carried out for the 2nd Biennial Report (WM and WAM scenarios with base year 2013). As it can be noted, the recent outlook on recovery from the economic crisis is reflected in projections reported in the WM scenario.

Figure 5.1 – Fuel mix of TPES, historic data

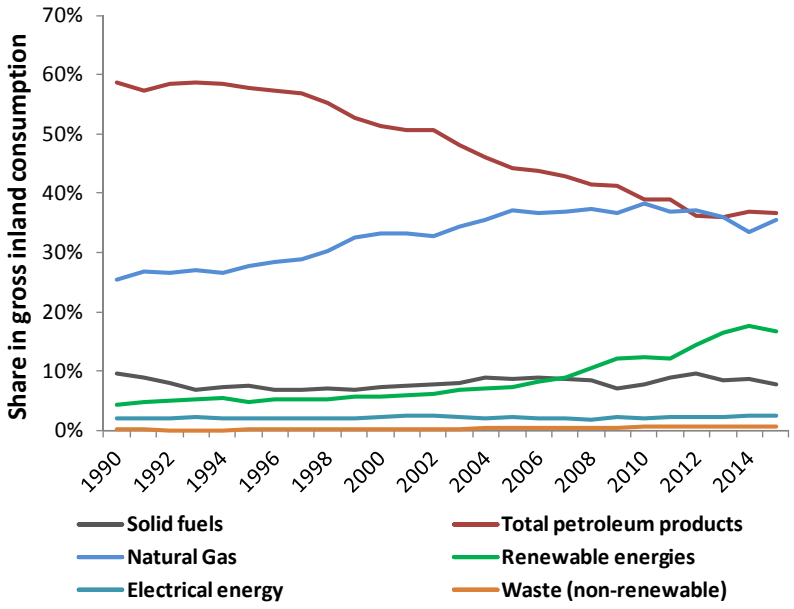
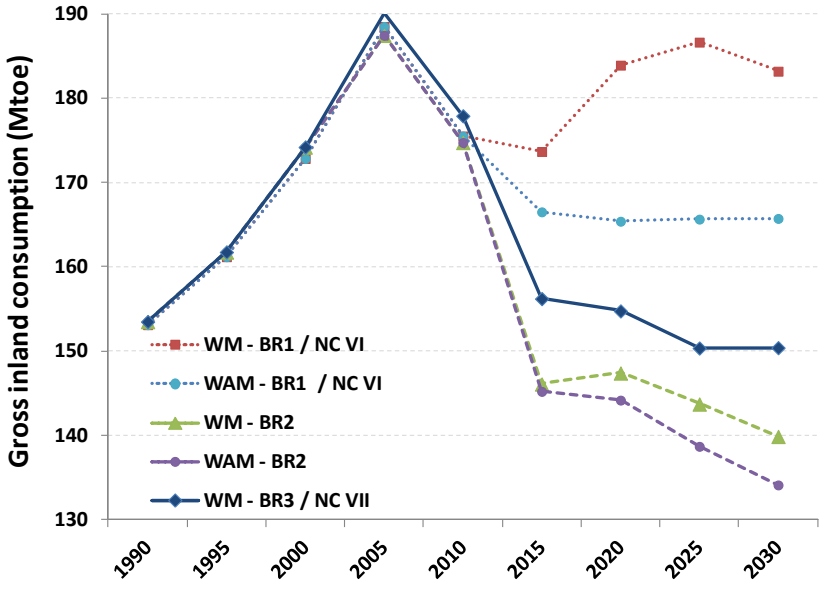


Figure 5.2 – Actual and projected gross inland consumption, Mtoe



Note: energy consumption estimated according to Eurostat methodology

Source: ISPRA

It should also be noted that in 2014 ISTAT carried out a specific national survey on family energy consumption that showed much higher biomass consumption levels for domestic heating compared to previous estimates. For this reason, the whole time-series has been reviewed: for example, with regard to year 2010, biomass consumption has increased by almost 4 Mtoe, while for more distant years the increase is less than 2 Mtoe.

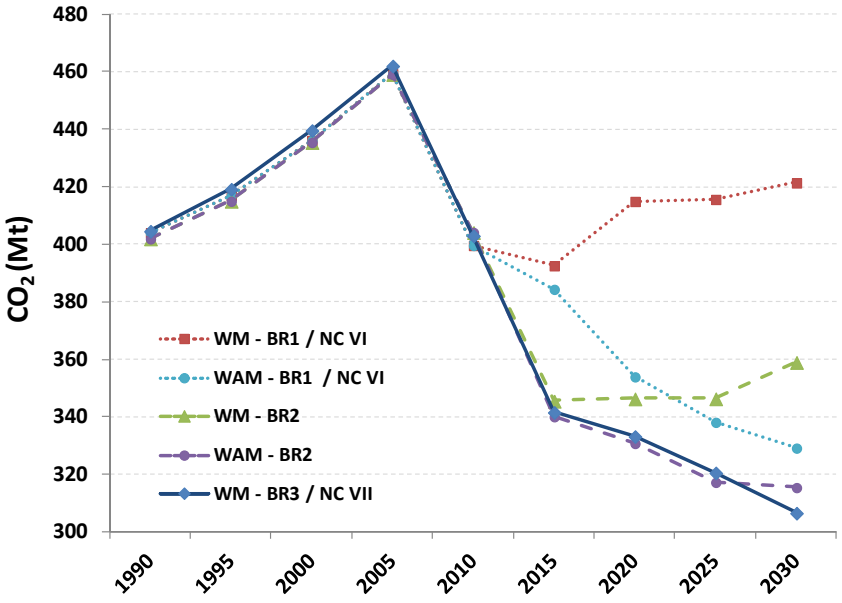
5.2.4 GHG Emissions

Based on the above-mentioned parameters, the model jointly computes energy supply and CO_2 emissions, while other GHGs and non-energy GHG emissions are calculated on the basis of the estimated evolution of activity data and average emission factors. Emissions up to 2015 are inventory data as submitted to UNFCCC in 2017.

As can be seen in Figure 5.3, final results show remarkable emission reductions in 2010 and 2015, and then a further slight decrease. The reduction in emissions is due to many different factors, some of them structural and other only temporary. The most important are:

- higher than expected share of renewable in TPES, due to anticipated development of photovoltaic production and diffusion of biomass for heating;
- increased efficiency of electricity generation, with the entry into service of many combined cycle plants;
- reduced fuel consumption in transportation due to high fuel prices and low activity levels;
- sharp reduction of energy consumption in industrial sector due to the economic crisis and structural changes in production;
- increase in efficiency of final end-use devices.

Figure 5.3 – Actual and projected CO_2 emissions from energy sector



Note: net emission are the physical emissions in the Italian territory excluding the emission reductions due to flexible mechanism.

Source: ISPRA

Table 5.6 shows the WM scenario projections up to 2035. Emissions are disaggregated by source of emissions sector.

Table 5.6 – WM Scenario's GHG emissions, disaggregated by source of emission sector ($MtCO_2$ eq.)

	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
FROM ENERGY USES, of which:	**420.6**	**435.5**	**455.1**	**476.5**	**417.6**	**354.2**	**346.6**	**333.5**	**319.1**	**313.2**
Energy industries	138.9	142.2	153.0	160.9	134.7	105.9	99.5	92.6	78.3	74.3
Industry	86.0	85.7	83.5	80.0	61.4	52.6	52.2	51.2	52.2	52.9
Transport	102.7	114.8	124.1	128.0	115.1	106.0	104.4	102.7	103.5	102.9
Residential and Commercial	69.8	69.6	73.9	87.7	88.9	74.1	74.7	71.7	70.2	68.2
Agriculture (energy use)	9.1	9.6	8.9	9.3	8.1	7.7	7.6	7.4	7.3	7.1
Other	14.0	13.7	11.7	10.7	9.5	8.0	8.3	7.9	7.7	7.7
FROM OTHER SOURCES, *of* which:	**99.3**	**95.6**	**97.8**	**102.9**	**87.4**	**78.8**	**79.2**	**73.5**	**72.9**	**70.7**
Industrial Processes + F-gas	40.5	38.2	38.8	45.7	34.6	30.0	33.5	29.9	30.3	30.6
Agriculture	35.6	35.6	34.9	32.7	30.5	30.0	30.5	30.6	30.6	30.3
Waste	23.3	21.8	24.1	24.6	22.4	18.8	15.2	13.1	12.0	9.8
TOTAL	**519.9**	**531.1**	**552.9**	**579.4**	**505.0**	**433.0**	**425.8**	**407.0**	**392.0**	**383.9**

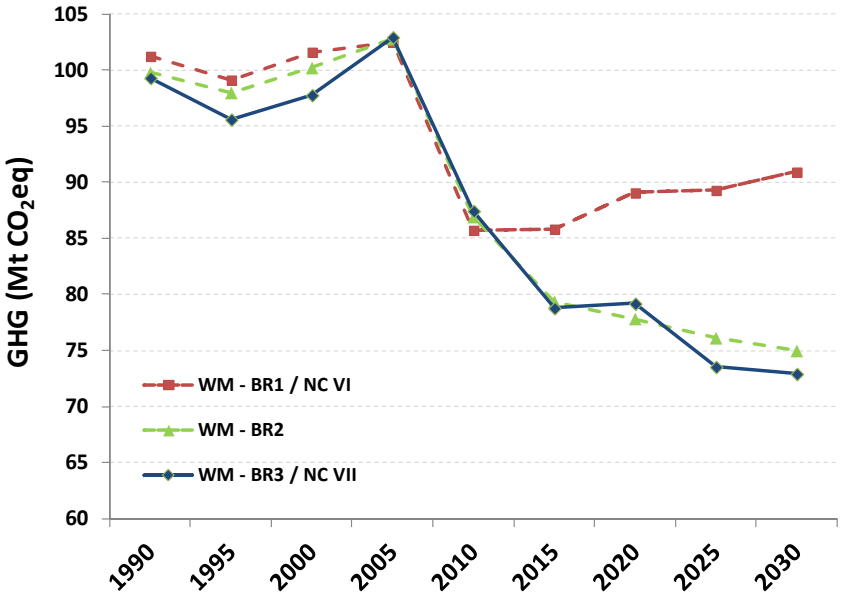
Source: ISPRA

Sector by sector analysis for the period 2015 - 2030 shows that:

- a notable shrink of emissions in energy industries is projected from 2015 to 2035 (-29.9%) mainly due to emissions reduction by power sector; in this sector, emissions are directly linked to the electricity production by fossil fuels, that outpaced the efficiency improvements up to 2008; the relevant expansion of renewable production after 2008 contributed to the emissions reduction. The emissions reduction observed in the projected years is due to further increase of thermoelectric efficiency, increase of renewable share, and fuel shift toward low carbon fuels;
- in the transport sector, the projected emissions will decrease by 2.9% from 2015 to 2035 as results of implemented measures, notwithstanding the increasing transport demand;
- civil sector shows a relevant decrease of emissions in the period 2015-2035 (-7.9%) mainly due to the efficiency increase of buildings; the emissions increase in the past is mainly linked to the expansion of services and residential building stock (second and third houses); increased house size and higher indoor temperature played an important role. In projection years, planned policies have a significant effect and are successful in curbing emissions;
- industrial emissions register a deep decrease in the period 2005 – 2015 (-34%); this reduction is due in part to the contraction of economic activities and in part to the structural change and increase of efficiency, whose effects can be seen in the projected emissions too. Indeed, in the period 2020-2035 industrial emissions are more or less stable even if the GVA is increasing;
- emissions from waste sector show the highest rate of reduction from 2015 to 2035 (-48.1%) mainly due to the decrease of waste disposal in landfills.

In figure 5.4 the emissions of CO_2 from non-energy sectors and other GHGs (CH_4, N_2O, and NF_3) from energy and non-energy sectors are reported. It can be noted that emissions reduction was sharp between 2005 and 2015. According to the scenario, the projected emissions will further decrease by 10.3% from 2015 up to 2035. The overall trend represents the combination of different trends, such as a quite stable trend of emissions for industrial process, solvent and agriculture, and a sizeable reduction of GHGs emissions from the waste sector.

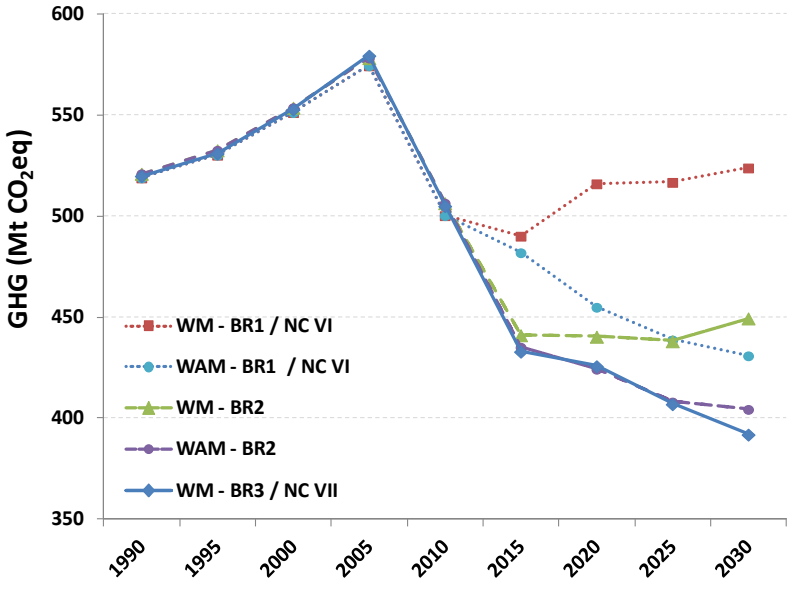
Figure 5.4 – Actual and projected emissions of CO_2 from non-energy sectors and other GHGs from energy and non-energy sectors.



Source: ISPRA

The resulting trend in total GHGs emissions is reported in figure 5.5. The current WM scenario is compared with the ones reported in previous NCs and Biennial Reports.

Figure 5.5 – Actual and projected GHG emissions (Mt CO_2 eq.)



Source: ISPRA

Table 5.7 reports emissions by gas expressed as CO_2 eq. CO_2 emissions represent about 84% of total emissions. It is worth to note the sharp reductions of methane, HFCs, and SF_6 emissions in the period 2015-2035, amounting to 20.6%, 51.4% and 25.1% respectively. As previously noted, the emissions contraction registered by methane is mainly due to the waste sector. The decreasing emissions of HFCs and SF_6 are mainly due to the implementation of the European Regulation n. 517/2014 on F-gases.

Table 5.7 – WM Scenario's GHG emissions from 1990 to 2030, disaggregated by gas ($MtCO_2$ eq.)

	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
CO_2	435.0	447.5	466.2	491.6	425.3	357.2	352.9	341.0	327.9	323.3
CH_4	54.2	52.2	53.1	51.0	48.7	43.2	40.5	38.2	36.6	34.3
N_2O	26.9	28.3	29.3	28.3	19.5	18.2	18.7	18.5	18.6	18.4
HFCs	0.4	0.8	2.1	6.1	9.6	12.3	11.8	7.3	6.9	6.0
PFCs	2.9	1.5	1.5	1.9	1.5	1.7	1.6	1.6	1.6	1.6
SF_6	0.4	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.3	0.3
NF_3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**519.9**	**531.0**	**552.8**	**579.4**	**505.0**	**433.0**	**425.8**	**407.0**	**392.0**	**383.9**
% wrt base year, 6 gases		2.1%	6.3%	11.4%	-2.9%	-16.7%	-18.1%	-21.7%	-24.6%	-26.2%

Source: ISPRA.

5.2.5 Energy industries sector

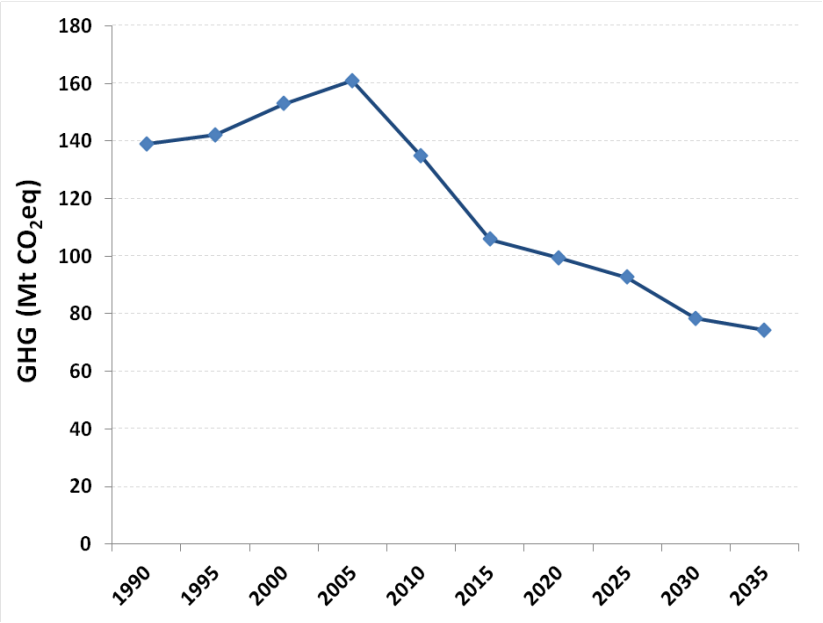
According to IPCC guidelines, the energy industries sector includes the electricity production from fossil fuels, refineries and the production of coke and of electricity from coal gases in integrated steel plants. Self-generated and self-consumed electricity are not included in the energy industries sector (see also chapter 3 and in particular CRF data in section 1.A.1 a-c) as they are included among industrial emissions (see also chapter 3 and in particular CRF data in section 1.A.2). The emissions from self-generated and self-consumed electricity were relevant in the past, but in recent years they only amount to about 10% of emissions from total electricity production, as reported in the NIR[78].

The emissions from refineries are relevant but the lower consumption of fossil fuels in the transport sector foreseen in the next years will reduce the refineries activity. Moreover the production of coke only accounts for small quantities of emissions, so the projected emissions from the energy industry sector are mainly linked to electricity production.

As shown in Figure 5.6, between 1990 and 2005 a noticeable increase in emissions of 16% has been registered by the energy industries sector, more than 1% yearly. From 2005 onwards, emissions sharply decreased at an average annual rate of -4.1%. The declining trend in the last years is mainly driven by a reduced activity in the years of economic crisis and an increasing share of renewable sources to produce electricity. A significant role is also played by increasing fossil fuels efficiency for electricity generation. A further decrease of emissions is expected in the period 2015-2030 with an annual average rate of around -2%. The reduction is due to increasing share of renewable sources for electricity generation, lesser contribute is expected by efficiency factor due to limited scope remaining for technologies to increase the energy generation efficiency and for fossil fuel switch to gas.

[78] See Annex 2 and table A2.3 of National Inventory Report 2017, ISBN 978-88-448-0822-8 - ISPRA, 2017 http://www.isprambiente.gov.it/it

Figure 5.6 – Energy industries, actual and projected GHG emissions (Mt CO_2 eq.)



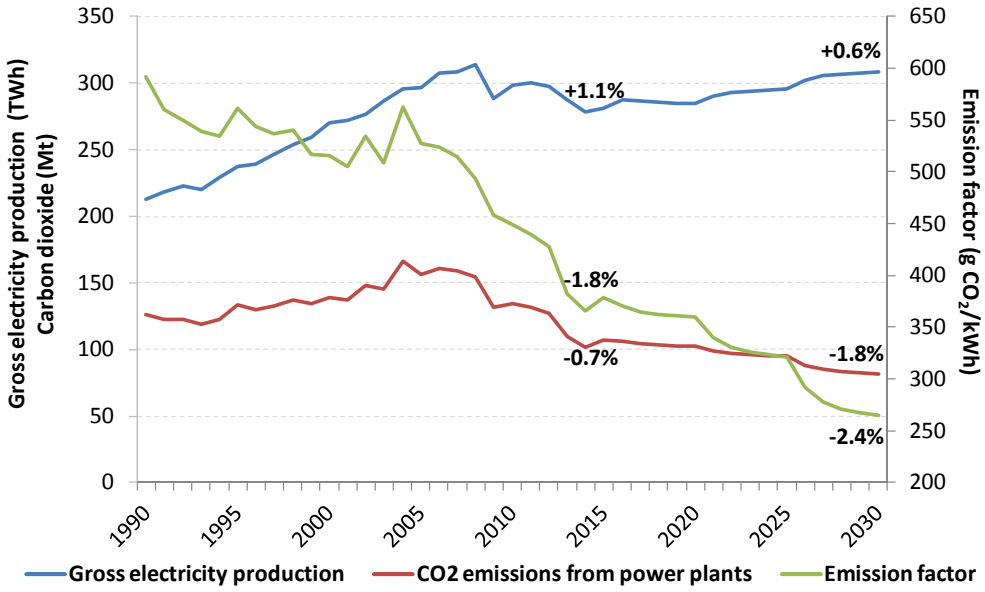
Source: ISPRA

5.2.5.1 Electricity production

Data considered in this paragraph concern all electricity generation plants, including those plants usually dedicated to the supply of electricity and heat to sectors different from 1.A.1.a (Public electricity and heat production).

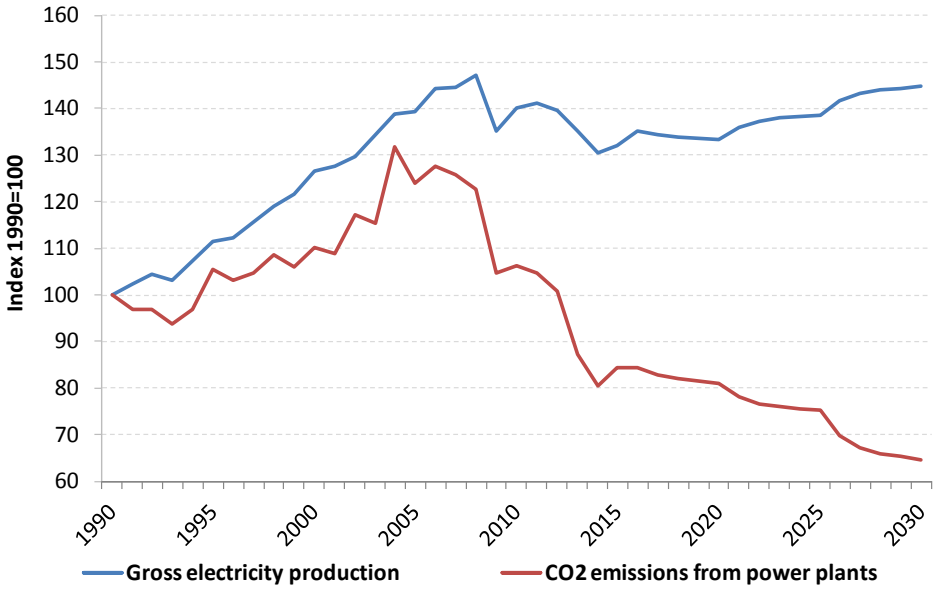
Historical data show a decoupling between CO_2 emissions from power plants and electricity production (Figure 5.7 and Figure 5.8). Since 1990, the electricity production increased constantly up to 2008 with an average annual rate higher than CO_2 emissions. The average growth rate of gross electricity production amounted to 2.2% per year from 1990 to 2008, doubling the growth rate of CO_2 emissions (1.1% per year) and thus showing a relative decoupling for the two parameters. From 2008 to 2014, the electricity production dropped down for the economic crisis (-2.0% per year for gross electricity production and -6.8% per year for CO_2 emissions). In the same period, it is evident how the decoupling between electricity production and CO_2 emissions becomes absolute as respective trends continue diverging. Such effect is mainly due to the sharp development of renewable sources in the period. Data for the last years (2015, 2016, and provisional data for 2017) show the increase of electricity production as result of economy recovery from the long financial and economic crisis that hit the national system.

Figure 5.7 – Electricity production and CO_2 emissions



Source: ISPRA

Figure 5.8 – Electricity production and CO_2 emissions relative trends on 1990



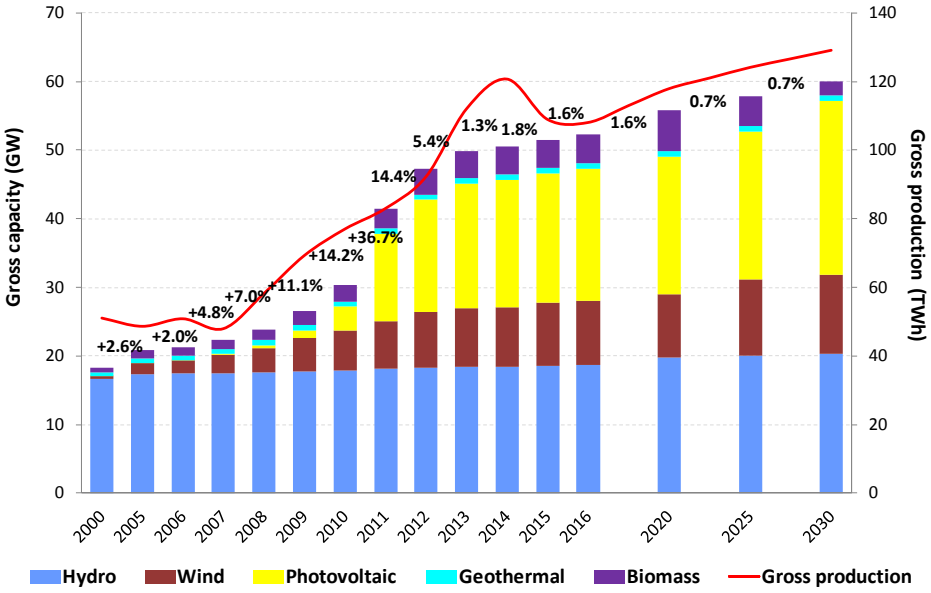
Source: ISPRA

The decoupling between electricity generation and atmospheric emissions, particularly evident since 2004, is due to fuel shift toward lower carbon content fuels, and to a relevant increase in electricity production efficiency. Since 2007, the increasing share of renewable sources was the most relevant factor contributing to the decoupling trend (Figure 5.8).

According to WM scenario, the expected increase in electricity demand will be covered by a strong increase in installed renewable sources power. The installed capacity in 2015 was 51.5 GW, with an average growth rate of 5.2% per year from 2000 to 2010 and of 11.2% per year in the following years up to 2015. From 1990 to 2008, hydropower was the most relevant renewable source; after 2008, other sources have become more and more relevant. Since 2013, the annual rate of new installed capacity has

shown a slowdown, while the electricity production has registered a downturn mainly due to the sharp reduction of hydropower share (Figure 5.9). The installed renewable capacity projected for 2030 is about 60 GW, mainly due to the increase of photovoltaic and wind.

Figure 5.9 – Renewable contribution to gross electricity production



Source: ISPRA

Total gross efficient power capacity, including renewables, increased from 102.3 GW in 2008 to 128.6 GW in 2013, with a renewable share of 23.3% and 36.8%, respectively. Since 2008, renewable power represents the main component of new installations (26.1 GW out of 26.3 GW). Starting from 2011, a growing decommissioning of thermal capacity has been registered (about 20 GW). In 2016, the efficient power capacity is 114.2 GW with 45.8% being from renewables.

The growth of renewable share has been mostly affected by photovoltaic and wind capacity. As concerns the electricity generation from renewable sources, the 2020 target assigned to Italy under European commitments is 26.4%, expressed as percentage of renewables on gross final consumption of electricity, including the import share of electricity. Such target is overachieved since 2011, and the 2015 share of renewables was 33.5% of gross final consumption of electricity[79].

In calculating the contribution of hydropower and wind, the effects of climatic variation are smoothed through the use of a normalization rule according to Directive 2009/28/EC. The increase of renewable electricity production is foreseen to continue in the next years. Projections show that renewable electricity production will amount to about 117.9 TWh in 2020 and 129.1 TWh in 2030, out of total generation figures of 284.5 and 308.5, respectively.

5.2.5.2 Refinery sector

The level of activity of this sector is strictly linked to the activity of the transport sector (82% of final energy consumption of total petroleum products in 2015) whose energy needs still rely mainly on oil

[79] GSE, 2017 – Energia da fonti rinnovabili in Italia – Anno 2015.

products.

During the past decade, under the economic crisis, the transport sector has been heavily affected, thus leading to a decrease of the activity of refineries too, which also led to a reduction of the number of operating installations.

An upward trend in emission levels was observed from 1990 to 2010 explained by the increasing quantities of crude oil processed and by the complexity of processes used to produce more environmental friendly transportation fuels and to reduce the production of residual fuel oil. The increase in complexity resulted in an increase of energy consumption with the installation of deep conversion units or integrated gasification units, that can use heavy residuals to produce electricity, heat and hydrogen.

Liquid fuel consumptions have reached a plateau in 2010 and are now in a downward trend that is expected to continue, due to the reduced quantities of crude oil processed and of electricity produced, and to the gradual substitution of oil products with natural gas in the civil and industrial sectors, and with gaseous fuels, biofuels and electricity in the transport sector.

In the period 2015-2035, the overall activity data is projected to continue its decreasing trend, with corresponding reductions in emissions. A partial recovery of production is foreseen up to 2020, to become stable in the following period.

Table 5.8 – Emissions from refineries for WM scenario (Mt CO_2)

	2005	2010	2015	2020	2025	2030	2035
Refineries	26.6	28.7	21.1	17.2	16.3	14.5	13.7

Source: ISPRA

5.2.6 Final uses of energy

The next table reports historical data and projections for final uses of energy according to Eurostat methodology.

Table 5.9 – Final energy consumption (Mtoe)

	2005	2010	2015	2020	2025	2030	2035
Total final uses	137.2	128.5	116.4	119.5	117.6	118.5	119.3

Source: ISPRA

The scenario shows a little increase of final energy consumption after 2015, following the recovery trend from the economic crisis.

Comments to data are provided in the sector-by-sector analysis.

5.2.6.1 Industry sector

According to the IPCC guidelines and to data reported in section 1.A.2 of CRF, the industrial sector considered herein excludes refineries and includes blast furnaces and emissions due to the electricity self-production. Reference is made only to emissions connected to energy use, excluding process emissions reported in section 2.A-C of CRF (see paragraph 5.6 “Projection of emissions from industrial processes”).

The next table reports the projections for final energy consumption in industry (Mtoe) for WM scenario, while the emission trend is reported in Figure 5.11.

Table 5.10 – Final energy consumption in industry sector (Mtoe)

	2005	2010	2015	2020	2025	2030	2035
Industry	39.9	31.3	26.0	27.2	27.5	27.2	28.1

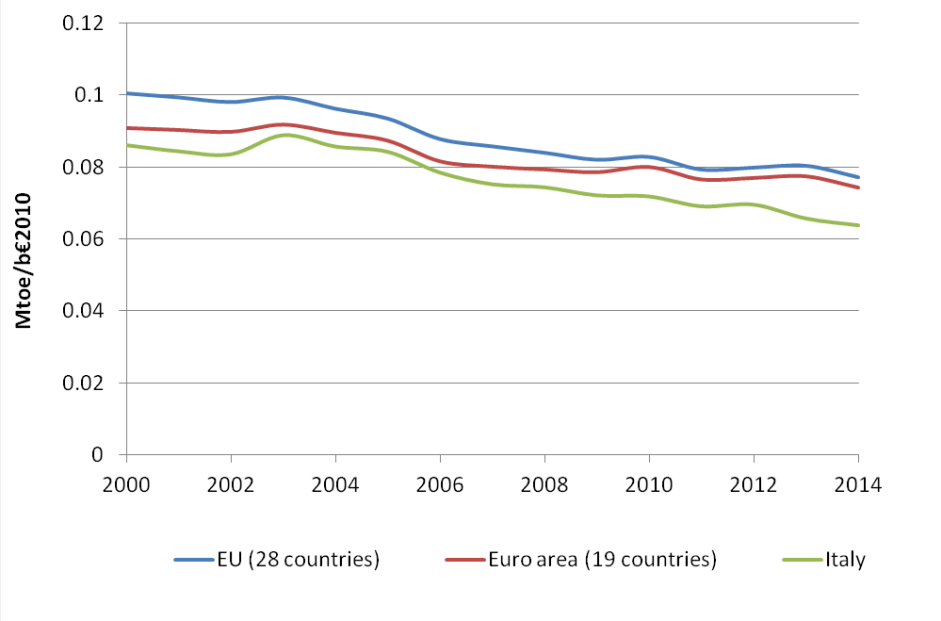
Source: ISPRA

A primary tool to reduce the emissions of greenhouse gases is by improving the level of energy efficiency of the industrial processes. According to the American Council for an Energy-Efficient Economy's (ACEEE), Italy is one of the world's most energy-efficient countries[80] and stands below the average energy intensity among EU and Euro area countries. Figure 5.10 shows the energy intensity of the industrial sector calculated as the ratio between the final energy consumption and the GVA estimated according to Eurostat methodology.

The industrial sector has gone through a period of consumption reduction, driven by the economic crisis but also by improvements of industrial activities, which has led to a reduction of emissions as well.

Indeed, it is essential to remark that, as shown in Figure 5.11, the carbon intensity of energy uses of industry has also decreased steeply since 1995. This shows that the observed reduction of emissions is not only due to lower consumption but also to structural changes in the sector (less energy intensive activities as mechanical, food, specialized chemicals manufacture and other light industries are playing a major role) and to the increase in efficiency.

Figure 5.10 – Energy intensity of industrial activities in Italy and EU



Source: ISPRA

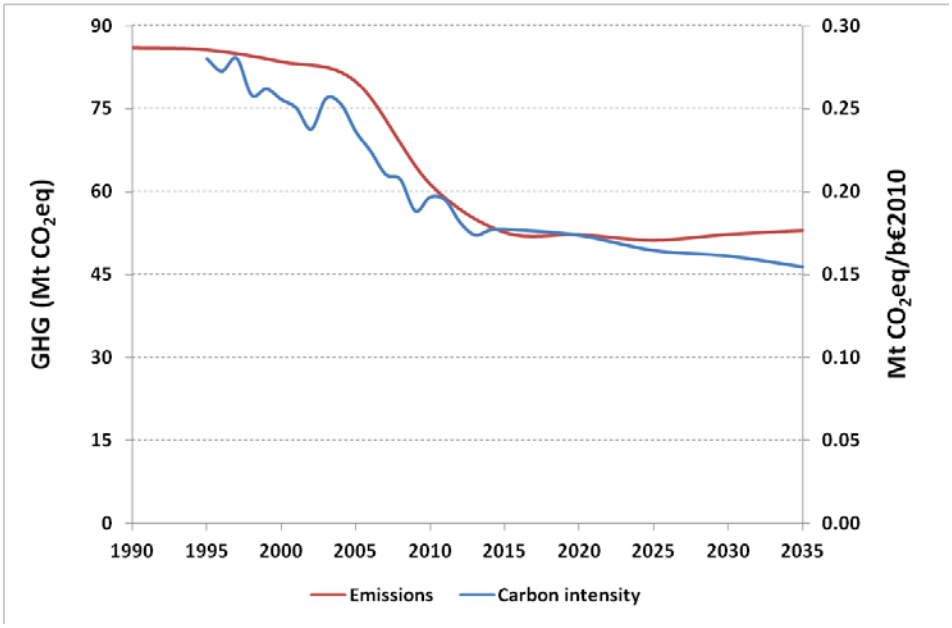
Further improvements remain technically feasible, although they represent a real challenge for those sectors which have already reached high levels of efficiency with respect to the biggest economies in the European Union, mainly for energy intensive subsectors as steel, cement, tiles, paper. Those subsectors are included in the EU–ETS and international competition concerns are addressed at the EU level, with the evaluation of the possibility of "carbon leakage" and the adjustment of emission allowances prices for sectors involved.

[80] ACEEE, 2016 - The 2016 International Energy Efficiency Scorecard.

Figure 5.11 shows GHG emissions from energy consumption in industry and the carbon intensity of the sector.

Compared to energy intensity, carbon intensity has decreased steeply due to the change in industrial structure and fuel mix, where natural gas, electricity and derived heat have increased their shares. For the projected years, further fuel switches from more carbon intensive fuels to natural gas are unlikely. Future improvements are mainly expected from moderate increases in efficiency and electrification of activities.

Figure 5.11 – Trends of GHG emissions and carbon intensity for industry sector



Source: ISPRA

5.2.6.2 Transport sector

In conformity with the IPCC Guidelines, the transport sector includes road and railway transportations, domestic air traffic, the national amount of international air flights (landing and take-off) and coastal navigation, as well as the consumptions in the harbour from ships travelling in international voyages.

The next table reports historical data and projections for final use of energy . Starting from 2015, energy consumption will decrease up to 2025 with average annual rate of 0.56% per year.

Table 5.11 –Final energy consumption in transport sector (Mtoe)

	2005	2010	2015	2020	2025	2030	2035
Transport	44.8	41.7	39.5	39.0	37.4	38.8	38.4

Source: ISPRA

GHGs emissions from this sector registered a strong historical growth from 1990 to 2007 (+25.8%). Following the economic downturn, the trend has changed direction registering a reduction of 18% in the period 2007-2015. Also, projected emissions are expected to slightly decline after 2015 up to 2025. Following 2025, emissions are expected to remain stable up to 2035.

Road transport accounts for almost the totality of sector emissions (93.8% in 2015). Passenger transport is responsible for 61.4% of emissions in 2015, while goods and other fuel-uses (Public administration, fisheries) account for the balance. Notwithstanding the increase of transport demand, both for

passengers and for freights, the projected emissions will be quite stable. This outcome is due to the effects of the following planned measures:

- efficiency gain and emissions targets, including the development of low consumption vehicles (preliminary estimation of the impact on gCO_2/km emissions of future regulation on new passenger cars, with target of 95 gCO_2/km for the years since 2020; average CO_2 emissions for new light duty vehicles, LDV, of 175 gCO_2/km since 2017 and 147 gCO_2/km since 2020);
- increase of electric vehicle fleet from near zero in 2015 to about 4-5 million in 2030;
- modal optimization: car sharing, car pooling and shared taxi initiatives for passenger transport;
- infrastructures: extension and modernization of the local railway network.

The modal split is foreseen to remain substantially unchanged up to 2020 for passengers, whereas a significant increase in railway / ship goods transport is expected. From 2020 to 2030, an increase of passenger-km in railway and public transport is foreseen.

Table 5.12 shows historical and projected emissions related to fuels sold to ships and aircrafts for international transport. For international aviation, emissions are expected to decrease after 2015 up to 2020; then, a slight increase has been projected up to 2035, although it should not be large enough to return to 2015 levels. In the period 2015-2035, a 12.2% reduction of aviation's emissions is foreseen. As for international maritime transport, projected emissions show a steady increase up to 2035 (+23.2% since 2015).

Table 5.12 – Emissions from international bunkers (Mt CO_2 eq.).

	1990	2005	2010	2015	2020	2025	2030	2035
Aviation	4.2	8.9	9.1	9.8	7.9	8.4	8.5	8.6
Marine	4.3	6.9	7.0	5.6	5.7	6.0	6.3	6.9

Source: ISPRA

5.2.6.3 Civil and agricultural sectors

The next table reports historical data and projections for energy final consumption in civil and agriculture sectors.

Table 5.13 – Final energy consumption in civil sector (Mtoe)

	2005	2010	2015	2020	2025	2030	2035
Services	15.1	17.0	15.4	16.2	16.3	16.5	17.3
Residential	33.9	35.4	32.5	34.4	33.7	33.4	32.7
Civil sector (total)	**49.0**	**52.4**	**47.9**	**50.6**	**50.0**	**49.9**	**50.0**
Agriculture	3.5	3.1	3.0	2.7	2.7	2.7	2.7

Source: ISPRA

The sectors are characterized by the following features:

- agriculture: moderate penetration of gas in the agricultural sector results in slight decrease of CO_2 emissions from energy uses (from 7.7 Mt in 2015 to 7.3 Mt in 2030);
- buildings (residential and tertiary): the main driver in the residential sector is the increase of families, while for services the main driver is the value added. It is expected a slight yearly increase of total square meters for buildings, both residential and services. The increase in heating demand

will be offset by the estimated natural gas expansion, by higher electricity penetration, and by the expected efficiency gains according to the National Plan for Energy Efficiency and minimal standards for buildings. As for building renovations, an annual average rate of 0.56% has been considered. Such effects will result in CO_2 emission reductions (from 74.1 Mt in 2015 to 70.2 Mt in 2030). The scenario takes into account the dynamic of degree days as in PRIMES 2016.

The residential sector shows a slight increase of energy consumption from 2015 to 2035 (+0.5%), while services consumption will increase over the same period (+12.5%). The share of energy consumption by services in the civil sector is expected to grow from 32.1% in 2015 to 34.6% in 2035, with a higher growth rate in the last five years of the projection period, according with higher GVA annual rate.

5.3 Emissions from other sectors

In Figure 5.4, GHG emissions from non-energy sectors are reported. As can be noted, a sharp emissions reduction is registered between 2005 and 2015. This reduction is due to the effect of the following factors (in order of importance):

- implementation on N_2O emission control in the adipic acid and nitric acid production;
- reduction of emissions from landfills due to increased recovery of methane;
- reduction of other process emissions due to a reduction of related industrial production;
- increase of recovery of animal wastes for biogas production.

According to the scenario, projected emissions are to remain quite stable in the period 2015-2020 and to show further slightly decreases from 2020 onward. The overall trend represents the combination of different evolutions of the underlining sectors and gases, in particular a stable trend in emissions from solvent, agriculture and industrial processes and a sizeable reduction of emissions from the waste sector.

5.3.1 Projections of emissions from industrial processes

Emission projections for most industrial processes have been calculated using the value added average annual rates shown in Table 5.14 to estimate expected activity production levels. Information directly communicated from industry has been used for aluminium production and for F-gases production and consumption. For SF_6 used in magnesium and aluminium foundries and for solvent and other product use, future trends have been estimated extrapolating most recent data and considering the implementation of the European Regulation n. 517/2014 on F-gases (F-gases Regulation), the European Directive 2010/75/EC regarding the reduction of VOC emissions due to the use of solvent (Industrial Emissions Directive) and the European Directive 2004/42/EC on the limitation of emissions of VOC due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products (Deco Paint Directive).

Table 5.14 – VA average annual rates for the industrial processes 2015-2035

	2016-2020	2021-2025	2026-2030	2031-2035
A. Mineral Products				
1. Cement Production	1.74%	1.35%	1.59%	1.76%
2. Lime Production	1.17%	0.65%	0.52%	0.59%
3. Limestone and Dolomite Use	1.17%	0.65%	0.52%	0.59%
4. Soda Ash Production and Use	0.41%	0.04%	0.03%	0.42%
Glass Production (decarbonising)	0.65%	0.61%	0.62%	0.64%
B. Chemical Industry				
1. Ammonia Production	0.14%	-1.24%	-1.34%	-1.02%
2. Nitric Acid Production	0.14%	-1.24%	-1.34%	-1.02%
3. Adipic Acid Production	0.14%	-1.24%	-1.34%	-1.02%
4. Carbide Production	0.14%	-1.24%	-1.34%	-1.02%
5. Other				
Carbon Black	0.14%	-1.24%	-1.34%	-1.02%
Ethylene	0.41%	0.04%	0.03%	0.42%
Styrene	0.41%	0.04%	0.03%	0.42%
Titanium dioxide	0.14%	-1.24%	-1.34%	-1.02%
Propylene	0.41%	0.04%	0.03%	0.42%
C. Metal Production				
1. Iron and Steel Production				
Steel	0.43%	0.04%	0.04%	0.23%
Pig Iron	0.43%	0.04%	0.04%	0.23%
Sinter	0.43%	0.04%	0.04%	0.23%
2. Ferroalloys Production	1.13%	0.59%	0.30%	0.32%

Source: ISPRA

The scenario includes the reduction of N_2O emissions from the nitric acid production obtained with the adoption of the most advanced technologies to be applied to the main existing nitric acid production plants by 2015 (installation of selective catalytic reduction systems for the treatment of process gases).
For the other categories, emission factors have been considered constant for the whole time series assuming that no further additional measures will be implemented. Emission estimates consider the six direct greenhouse gases under the Kyoto Protocol (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) plus nitrogen trifluoride (NF_3) which contribute directly to climate change owing to their positive radiative forcing effect. The resulting GHGs emission scenarios by sector and by gas up to 2035 are reported in Table 5.15 and in Table 5.16, respectively. The stability of industrial processes emissions is connected to the increase, following the economic crisis, of industrial production in mineral industry, compensated by the decreasing use of substitutes of ozone depleting substances, the other emissions being stable.

Table 5.15 – Emission scenario by sector from industrial processes and solvent use ($MtCO_2$ eq.)

	2005	2010	2015	2020	2025	2030	2035
Mineral products	23.3	17.4	11.1	14.7	15.6	16.5	17.8
Chemical industry	10.7	3.4	3.0	3.1	3.0	3.0	2.9
Metal production	2.8	2.0	1.6	1.5	1.5	1.5	1.5
Production of halocarbons and SF_6	1.5	1.1	1.1	1.1	1.1	1.1	1.1
Consumption of halocarbons and SF_6	6.0	9.6	12.2	11.7	7.3	7.0	6.0
Total Industrial Processes	**44.3**	**33. 5**	**29.0**	**32.2**	**28.5**	**29.0**	**29.3**
Solvent use	1.3	1.1	1.0	1.3	1.3	1.3	1.3
Total Industrial Processes and Solvent Use	**45.7**	**34.6**	**30.1**	**33.5**	**29.9**	**30.4**	**30.6**

Source: ISPRA

Table 5.16 – Emissions by gases from industrial processes and solvent use ($MtCO_2$ eq.)

	2005	2010	2015	2020	2025	2030	2035
CO_2	28.8	21.8	15.0	19.0	19.8	20.7	21.9
CH_4	0.1	0.1	0.0	0.1	0.1	0.1	0.1
N_2O	8.3	1.2	0.6	0.7	0.7	0.7	0.7
HFCs	6.1	9.6	12.3	11.8	7.3	6.9	6.0
PFCs	2.0	1.5	1.7	1.6	1.6	1.6	1.6
SF_6	0.6	0.4	0.4	0.3	0.3	0.3	0.3
NF_3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total GHGs	**45.7**	**34.6**	**30.1**	**33.5**	**29.9**	**30.4**	**30.6**

Source: ISPRA

5.3.2 Projections of emissions from the agriculture sector

GHG emissions figures from the agriculture sector are updated and improved thanks to different national research studies[81]. Methodologies for the preparation of national inventories under the Convention on Long-Range Transboundary Air Pollution and the United Nations Framework Convention on Climate Change are kept consistent[82].

Between 1990 and 2015, GHGs emissions from the agriculture sector have decreased by 16.0%. Emission trends are due to the reduction in activity data such as the number of animals, the variation of cultivated surface and crop production and use of nitrogen fertilizers, mainly linked to Common Agricultural Policy (CAP) measures[83]. Historical activity data trends are described in Chapter 2. Emission projections were estimated with the same model used for the preparation of the national emission inventory submitted in 2017[84]. Moreover, activity data for emission projections are consistent with those communicated to the UNECE for the implementation of the Protocol to The 1979 Convention on Long-Range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-Level Ozone (Gothenburg Protocol).

To estimate the number of different animal categories, a model has been developed by ENEA[85] and information is updated every year[86]. For the use of fertilizers, ENEA assumptions are based on the European Fertilizer Manufacturers Association (EFMA) forecast. For the surface and agricultural production, a trend has been estimated on the basis of the 1990-2015 time series.

In Table 5.17, the assumptions adopted for fertilizers consumption are shown. A decrease of 21.8% of total consumption of nitrogen synthetic fertilizers has been estimated in 2020 with respect to 2005. From 2020 onwards, data are assumed to be constant since no other information is available.

In Table 5.18, assumptions for the main animal categories (cattle, swine and poultry) are shown. The CAP

[81] NIR 2017, Chapter 5 - ISPRA, Report 261/2017 http://www.isprambiente.gov.it/it/pubblicazioni/rapporti/italian-greenhouse-gas-inventory-1990-2015.-national-inventory-report-2017

[82] ibidem

[83] Rural Development Plans (RDPs) from Italy are available at URL: https://ec.europa.eu/agriculture/rural-development-2014-2020/country-files/it_en

[84] NIR 2017, Chapter 5 - ISPRA, Report 261/2017 http://www.isprambiente.gov.it/it/pubblicazioni/rapporti/italian-greenhouse-gas-inventory-1990-2015.-national-inventory-report-2017

[85] ENEA, 2006. Valutazione del potenziale di riduzione delle emissioni di ammoniaca. Rapporto Finale. ENEA UTS-PROT, Unità Inquinamento Atmosferico. Settembre 2006.

[86] D'Elia et al., 2008. Nitrogen related research and policy activities in Italy: The Ammonia experience in Italy. Presentation Task-force on Reactive Nitrogen, Wageningen, 21 – 23 Maggio 2008. Updated scenarios are available at the link http://gains-it.bologna.enea.it/gains/IT/index.login.

2014-2020[87] agenda, such as the milk quota reform, will lead to revise these estimates in the next future.

Table 5.17 – Assumptions used for estimating GHG emission projections from fertilizers consumption

Fertilizers (kt nitrogen*)	2005	2010	2015	2020	2025	2030	2035
Consumption of urea	318	210	266	291	291	291	291
Consumption of other nitrogen fertilizers	462	287	252	319	319	319	319
Total consumption of nitrogen fertilizers	**780**	**497**	**518**	**610**	**610**	**610**	**610**

* Nitrogen content in synthetic fertilizers
Source: ISPRA

Table 5.18 – Assumptions used for GHG emissions projections with respect to the number of animals

Animal category (kheads)	2005	2010	2015	2020	2025	2030	2035
Dairy cattle	1,842	1,746	1,826	1,653	1,642	1,631	1,610
Non-dairy cattle	4,410	4,086	3,9556	4,090	4,057	3,970	3,782
Swine	9,200	9,321	8,683	9,526	9,596	9,693	9,700
Poultry	188,595	198,347	196,387	201,310	204,378	205,590	204,740

Source: ISPRA

In Table 5.19, GHG emissions projections by source category are shown. After an initial decrease in the period 2005-2010, emissions are estimated to remain constantly around 30.5 Mt. The main drivers for GHG emissions reductions are given by agricultural soils (-13.8% in 2030), whose emissions mainly decreased in the period 2005-2010. This source accounts for 32.3% of total agricultural emissions in 2005.

Table 5.19 – Emissions for the agriculture sector ($MtCO_2$ eq.)

	2005	2010	2015	2020	2025	2030	2035
Enteric Fermentation	13.8	13.6	13.8	13.8	13.9	13.9	13.8
Manure Management	6.1	5.9	5.1	5.2	5.3	5.3	5.2
Rice Cultivation	1.8	1.8	1.7	1.8	1.8	1.9	1.9
Agricultural Soils	10.6	8.8	9.0	9.2	9.1	9.1	9.0
Field Burning of agricultural residues	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Liming and urea application	0.5	0.4	0.4	0.5	0.5	0.5	0.5
TOTAL GHGs	**32.7**	**30.5**	**30.0**	**30.5**	**30.6**	**30.6**	**30.3**

Source: ISPRA

5.3.3 Projections of emissions from the LULUCF sector

The driving forces for projections are the activity data linked to the LULUCF sector; in particular, those related to *forest land* (and related activity *Forest Management*), *cropland* and *grassland* constitute the key variables to project emissions by sources and removals by sinks.

As reported in chapter 4, Italy has submitted information on Forest Management Reference Level (FMRL[88]), equal to -22,166Mt CO_2 eq. per year applying a first-order decay function for harvested wood products (HWP) and -21,182 Mt CO_2 eq. per year assuming instantaneous oxidation of HWP.

[87] On 26 June 2013 the Commission, the Council and the European Parliament reached a political agreement on the reform of the CAP 2014-2020.
[88] Submission of information on forest management reference levels by Italy: http://unfccc.int/files/meetings/ad_hoc_working_groups/kp/application/pdf/awgkp_italy_2011.pdf

According to Decision 2/CMP.7, methodological consistency between the FMRL and reporting for *forest management* during the second commitment period of the Kyoto Protocol has to be ensured, applying technical correction if necessary; the methodological elements triggering the need for a technical correction have been analyzed, providing a description on the detected inconsistencies and a timing for the addressing of the issue (Table 5.20).

Table 5.20 – Elements triggering a methodological inconsistency between the FMRL and FM reporting

Criteria	Description	Timing
The method used for GHG reporting (for Forest land remaining forest land or Forest Management) changed after the adoption of FMRL	The FMRL has been calculated with the EU models G4M (IIASA) and EFISCEN (EFI). Estimates of emissions and removals under FM activities have been carried out with the growth model Forest, used to estimate the net change of carbon in the five reporting pools.	2017-2018
Forest characteristics and related management[89]	Availability of new data resulting from the ongoing NFI and consequent recalculations of the reported data under FM and *Forest Land Remaining Forest Land used* to establish the reference level.	2017-2018
Harvested wood products	The estimates have been carried out on the basis of the 2013 KP Supplement (IPCC 2014) methodology.	2017

Therefore, to ensure methodological consistency between the FMRL and reporting for Forest Management during the second commitment period, Italy is going to apply a technical correction. Qualitative information on TC and methodological consistency as well as a quantitative assessment will be reported, consistently with the requirements of decision 2/CMP.7, annex, paragraph 14 and guidance of the 2013 KP Supplement (IPCC, 2014, par. 2.7.6.3). No further measures are planned for forestry.

In table 5.21, projections for LULUCF categories have been reported. These projections have been carried out on the basis of 1990-2015 trend, subcategory by subcategory and have been officially reported under Article 3(2) of the Monitoring Mechanism Decision (Commission Decision 280/2004/EC).

Table 5.21 – Projections for LULUCF categories (Gg CO_2 eq.)

	2005	2010	2015	2020	2025	2030	2035
Land Use, Land-Use Change and Forestry	**-28,385**	**-31,609**	**-36,218**	**-24,381**	**-39,699**	**-41,535**	**-43,375**
Forest land	-34,477	-36,541	-39,924	-27,564	-42,013	-43,091	-44,157
Cropland	1,459	1,335	2,160	1,777	1,392	1,008	623
Grassland	-2,648	-4,172	-6,658	-7,309	-7,981	-8,655	-9,327
Wetlands	8	-	-	-	-	-	-
Settlements	7,804	7,897	7,936	7,897	7,853	7,883	7,853
Other Land	-	-	-	-	-	-	-
Harvested wood products	-531	-128	267	819	1,050	1,321	1,633

Source: ISPRA

Communication of 11 May 2011 regarding harvested wood products value by Italy:
http://unfccc.int/files/meetings/ad_hoc_working_groups/kp/application/pdf/awgkp_italy_corr.pdf

[89] This includes, among others: age-class structure, increment, species composition, rotation lengths, management practices, etc.

Under the WM scenario, existing policies have been considered to remain in place until 2020: according to the "Whereas" 22 of Regulation (UE) No 1305/2013 on Rural Development, Member States should maintain the level of efforts made during the 2007-2013 programming period. Therefore, in this scenario the future mix of agronomic and financial measures remains constant on the same total of hectares provided to national and regional levels in the programming period 2007-2013. Regarding the use of land, in line with historical trends but also considering the proposed legislation at the national level on the containment of land consumption, a 2% reduction of cropland areas and a 2% increase of grassland areas have been assumed in a ten-year period.

Future developments of emission and removal projections for subsectors under LULUCF are expected, considering the new Regulations currently being discussed at the EU level. In this view and in the framework of the reporting and accounting under EU Decision 529/2013, further activity scenarios were developed for cropland and grassland for the 2014-2020 period, to assess the main changes while taking into account the different management practices[90].

The following policies are foreseen to have further impacts:

- enhancement of agricultural areas and containment of land consumption;
- implementation of CAP (first and second pillar) at national and regional levels.

The abovementioned policies are associated with three main hypotheses:

- the introduction of "Greening" in 2015 as stated in the Regulation (EU) No. 1307/2013 on direct payments;
- an increase of 20% in 2020 (compared to 2012) of the areas where conservative agricultural practices (organic, sustainable, set aside, etc.), in the context of RDP, are applied;
- the combined effect of the two previous measures (Greening and the enhancement of the area with conservative agricultural practices).

Detailed information on the assumptions and the quantitative assessment of scenarios considering different paths then those reported in the current WM scenario may be found in the Italian Progress report on LULUCF action under the art. 10.2 of Decision 529/201[91].

5.3.4 Projections of emissions from the waste sector

The following projections have been prepared in conformity with most recent inventories and evaluations on the implementation of mitigation measures. The driving forces for projections estimations are especially activity data linked to the whole waste sector and the reduction of biodegradable waste in landfills. In particular, the municipal waste cycle has been studied, analysing its evolution through the years on the basis of actions that have already been put into effect.

In the reference scenario, the total amount of annual waste production has been estimated on the basis of official population forecasts provided by the National Institute of Statistics (ISTAT). Starting from the

[90] The following management practices have been considered: *organic farming, sustainable agriculture, conservation practices, set-aside, ordinary agriculture, ordinary grazing land, managed grazing land, improved grazing land.*

[91] Italian Progress report on LULUCF action under the art. 10.2 of Decision 529/2013: http://cdr.eionet.europa.eu/it/eu/mmr/lulucf/envwm_kbq/ITALY_Progress_report_on_LULUCF_Article_10_2__of_dec_529_update_2016.pdf/manage_document

production, waste fluxes have been analysed on the basis of the following waste management options: recycling, landfilling, incineration, mechanical biological treatments and composting.

Focusing on recycling and other options, national circumstances turn out being very different from northern to southern regions. Many northern cities have already reached and exceeded their fixed target, whereas some southern regions are lagging behind in complying with national targets for separate collection, although significant improvements have been made over the last few years allowing to reach 47.5% for separate collection in 2015 (against 37.7% in 2011). Governmental efforts aimed to the improvement of waste management lead to an optimistic outlook for the fulfilment, by the deadlines, of the commitments for reuse and recycling set up by the current legislation (50% by weight within 2020 - Directive 2008/98/EC).

Table 5.22 – Emission for the waste sector (Gg)

	2005	2010	2015	2020	2025	2030	2035
CO_2							
Waste incineration without energy recovery	226.5	162.3	111.2	107.1	94.7	82.3	69.8
Total waste sector	**226.5**	**162.3**	**111.2**	**107.1**	**94.7**	**82.3**	**69.8**
CH_4							
Landfills	787.1	700.6	564.5	406.8	321.4	273.3	184.8
Biological treatment	3.7	4.6	4.9	6.8	6.9	7.0	7.1
Waste incineration	2.5	2.3	2.3	2.3	2.2	2.3	2.2
Wastewater treatment	110.7	105.8	99.7	100.7	102.6	104.8	105.1
Total waste sector	**903.9**	**813.4**	**671.4**	**516.6**	**433.1**	**387.4**	**299.2**
N_2O							
Biological treatment	1.3	1.7	1.7	2.4	2.5	2.5	2.6
Waste incineration	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Wastewater treatment	4.4	4.5	4.5	4.7	4.7	4.8	4.8
Total waste sector	**5.9**	**6.3**	**6.3**	**7.2**	**7.3**	**7.4**	**7.4**
CO_2 reported in the energy sector							
Waste incineration with energy recovery	2780.6	4253.8	4547.1	6018.9	7132.8	8246.9	9361.0

Source: ISPRA

Regarding landfills, the total amount of waste disposed into landfills will vary according to the actual trend, whereas the composition of waste has varied as a consequence of the compliance with the separate collection target. Notwithstanding, the amount of biodegradable waste disposed into landfills is not totally complying with the target of landfill directive (D.lgs. 36/2003) resulting in 121 kg_{waste}/inh.*year rather than 115 kg_{waste}/inh.*year. The share of landfill gas collected will reach 60% in 2028.

Furthermore, from 2010, each municipal waste incinerator is equipped with an energy recovery system and only industrial waste could still be treated without energy recovery. Emissions from incinerators with energy recovery are reported in the energy sector, while emissions from incinerators without energy recovery are reported in the waste sector. The total amount of waste incinerated will increase in line with the current trend. Finally, the amount of waste treated in Mechanical biological treatment plants will increase in line with the strategy to pre-treat waste in order to obtain a bio-stabilized product to dispose

to landfills and a dry-fraction to burn in waste-to-energy facilities. As a consequence of this waste cycle projection, biological waste treated in composting and anaerobic digestion plants will also increase following the trend up to 2035. According to these projections, a 48% reduction can be expected in 2035 with respect to 2015 in overall greenhouse gas emissions from the waste sector, expressed in terms of CO_2 equivalent, essentially as a result of a reduction in methane emissions from landfills.

5.4 Projection results and emissions targets

Table 5.23 summarizes the GHG emissions up to 2035, together with the EU targets, divided by ETS and non–ETS sectors.

Emissions target for non-ETS sectors in year 2020 is 291.0 $MtCO_2$ eq. (see par. 4.1.4 for detailed methodology). Considering emissions levels according to the WM scenario (line “Non-ETS sector” and “ESD/ESR targets” in the table) 2015 target has already been achieved and 2020 target is in line to be achieved, while there is a sizeable distance from the proposed 2030 target.

The mitigation options identified to "fill" the gap are reported in tables 4.15-4.17 and 4.19; the overall potential of the identified measures amounts to about 51.1 Mt CO_2 in 2020, although some of those effects are related to ETS sectors.

Table 5.23 – National GHGs emissions and European targets (Mt CO_2 eq.)

	1990	2005	2010	2015	2020	2025	2030	2035
National emissions	**519.9**	**579.4**	**505.0**	**433.0**	**425.8**	**407.0**	**392.0**	**383.9**
ETS sectors		247.5	199.5	156.2	161.0	152.7	140.1	132.2
Non-ETS sectors (ESD/ESR)		329.4	302.8	274.7	262.6	251.9	249.2	248.4
Civil Aviation		2.5	2.7	2.1	2.2	2.3	2.7	3.2
ESD/ESR targets*				304.2	291.0		220.7	-
Gap				-29.5	-28.4		+28.5	-

* Target has been set up to 2020 by the Effort Sharing Decisions (ESD) 406/2009/EC, while the 2030 target is still under negotiation among EU Member States. The reported emissions target is provisional and set to -33%wrt 2005 level. The target for 2025 is not reported because the starting point for 2021-2030 period is not yet defined. NF3 emissions are included into the ESD/ESR target for the post-2020 period.

Source: ISPRA

5.5 Sensitivity analysis

Sensitivity analysis has been performed with values for macroeconomic parameters different from those used to carry out the WM projections. The most recent national statistics of population, with a lower growth rate compared to PRIMES2016 reference scenario, have been considered (Tab 5.24). Also, starting from actual 2016 levels, a lower GDP growth rate up to 2020 has been used in accordance with population growth rate. From 2020 to 2030, the same GDP rate used in the WM scenario has been implemented. As for international carbon and fuels prices, lower costs have been applied to create worse conditions for the optimization process in term of fossil fuels preference against renewable sources.

Table 5.24 – Parameters value for sensitivity and WM scenarios

Scenario	Parameter	Unit	2015	2020	2025	2030
WM scenario	Population	Thousand	60,800	62,065	63,118	64,229
Sensitivity scenario			60,800	60,719	61,918	62,290
WM scenario	GDP	Billion €2010	1,547	1,675	1,776	1,885
Sensitivity scenario			1,547	1,644	1,743	1,850
WM scenario	Coal	€2010/GJ	1.91	2.39	2.85	3.42
Sensitivity scenario			1.91	1.87	2.33	2.78
WM scenario	Natural gas	€2010/GJ	6.47	8.05	8.71	9.47
Sensitivity scenario			6.47	6.52	7.39	8.27
WM scenario	Oil	€2010/GJ	8.04	12.51	14.20	15.65
Sensitivity scenario			8.04	8.62	10.2	11.77
WM scenario	Carbon	€2010/tCO_2	7.2	14.4	21.5	32.1
Sensitivity scenario			7.2	10.0	14.0	27.0

Source: ISPRA

In the following table the GHG emissions projections of Sensitivity scenario are compared to the results of WM scenario projections.

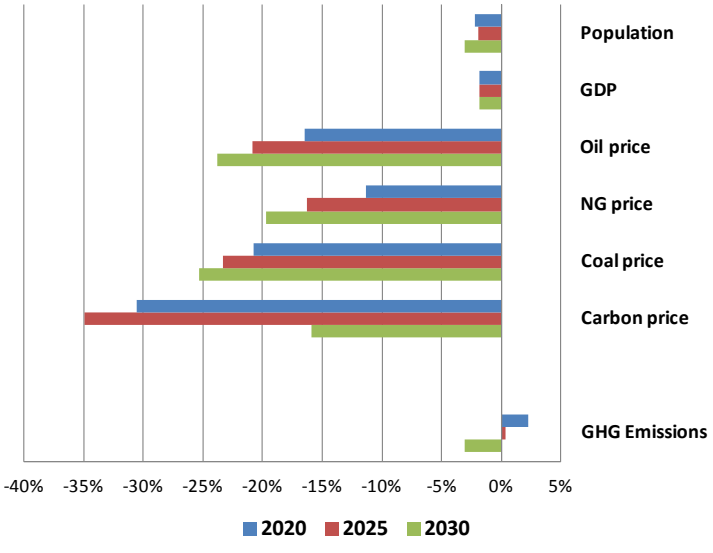
Table 5.25 – GHG emission (Mt CO_2 eq.)

	2015	2020	2025	2030
WM scenario	433.0	425.8	407.0	392.0
Sensitivity scenario	433.0	435.3	408.5	380.2

Source: ISPRA

Higher projections for 2020 in the sensitivity scenario are related to lower fossil fuels and carbon prices, while 2030 projections are driven by lower commodity demand due to lower GDP and population. In particular, transport and civil sectors show lower emissions as compared to WM projections since they are more sensitive to the demand reduction. Figure 5.12 shows the differences between WM and Sensitivity scenarios for the considered parameters and GHG projections.

Figure 5.12 – Relative difference between sensitivity scenario and WM scenario



Source: ISPRA

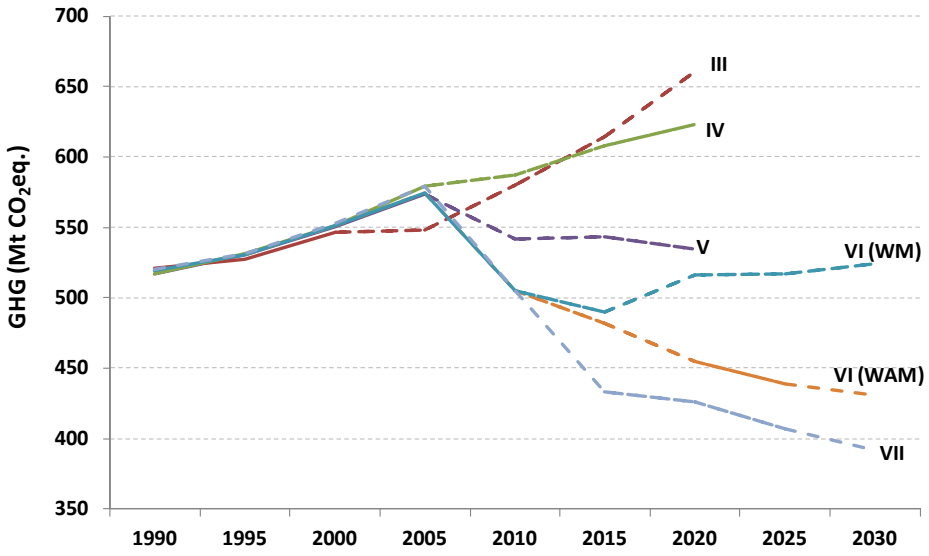
5.6 Comparisons with previous National Communications

An outline of the emission scenarios since the 3rd National Communication is reported (Table 5.26) in order to compare projected emissions with different sets of measures. Projections from WM scenarios have been considered. For the 6th National Communication, projections from WAM scenarios are also reported. Similar approaches were used to perform scenario and emission projections in the various National Communications, so the comparison between a projection trend and the previous ones gives information about without measure (WOM) scenarios patterns. Emission projections of WM scenarios reported in the 3rd National Communication could supply emissions esteems without the measures implemented after 2000.

Projected GHG emissions for 2010, with a range of ±2%, had remained quite stable between the 3rd and the 4th National Communications; instead, since the 5th National Communication the effects of the economic crisis, started in 2008, became evident with a sizeable reduction of projected levels with respect to the historical path. The registered reduction was also due to the effect of measures implemented up to mid-2009.

In the projections reported in the 6th National Communication, emissions were further reduced due to the depth of the economic crisis and to new measures implemented up to 2010 (WM scenario) or planned up to 2012 (WAM scenario). For other sectors and gases, it has to be underlined that the methodology for the emissions calculations (IPCC guidelines) has deeply changed between 1997 and 2004. Therefore, projections have been developed with different methodology and assumptions. The effect of changes can be seen in the changes in historical total GHGs emissions between the various NCs.

Figure 5.13 – GHG emissions of present and past NCs



Source: ISPRA

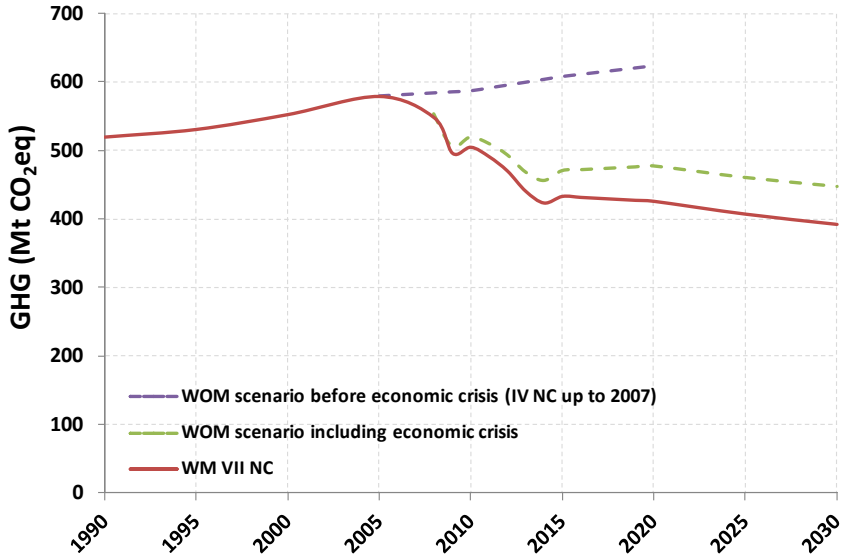
Table 5.26 – Emissions from previous and current NCs (Mt CO_2 eq.)

	1990	2005	2010	2015	2020	2025	2030
GHGs energy, Mt, II NC	424.3	478.8	491.8				
GHGs energy, Mt, III NC	424.9	456.0	484.1	513.1	553.9		
GHGs energy, Mt, IV NC	419.4	480.1	490.8	510.4	524.1		
GHGs energy, Mt, V NC	419.5	474.4	450.2	452.2	441.0		
GHGs energy, Mt, VI NC	417.7	471.9	414.6	404.3	427.1	427.5	433.0
GHGs energy, Mt, VI NC (WAM)	417.7	471.9	414.6	396.1	366.0	349.5	340.1
GHGs energy, Mt, VII NC	420.6	476.5	417.6	354.2	346.6	333.5	319.1
GHGs no energy, Mt, II NC	118.7	109.0	123.2				
GHGs no energy, Mt, III NC	96.1	92.4	95.6	101.2	106.3		
GHGs no energy, Mt, IV NC	97.4	99.4	96.1	97.4	99.3		
GHGs no energy, Mt, V NC	97.4	99.2	91.6	90.9	93.2		
GHGs no energy, Mt, VI NC	101.2	102.5	85.7	85.8	89.0	89.3	90.9
GHGs no energy, Mt, VI NC (WAM)	101.2	102.5	85.7	85.8	89.0	89.3	90.9
GHGs no energy, Mt, VII NC	99.3	102.9	87.4	78.8	79.2	73.5	72.9
TOTAL GHGs, II NC	543.0	587.8	615.0				
TOTAL GHGs, III NC	521.0	548.3	579.7	614.4	660.3		
TOTAL GHGs, IV NC	516.8	579.5	587.0	607.8	623.4		
TOTAL GHGs, V NC	516.9	573.6	541.8	543.1	534.2		
TOTAL GHGs, VI NC	519.0	574.4	505.0	490.2	516.1	516.8	523.9
TOTAL GHGs, VI NC (WAM)	519.0	574.4	505.0	482.0	455.0	438.8	431.0
TOTAL GHGs, VII NC	519.9	579.4	505.0	433.0	425.8	407.0	392.0

Source: ISPRA

Further insights about a WOM scenario can be carried out by estimating the effect of the implemented measures considered in the present NC. The impacts of implemented measures were estimated for 2015 (37.1 Mt CO_{2eq}), 2020 (51.1 Mt CO_{2eq}), and 2030 (55.1 Mt CO_{2eq}) and are assumed to be equal to 0 in 2007. The linear interpolation of data between each pair of years allows to estimate the impact for each year. The result is shown in Figure 5.14, where the WOM scenario, obtained by adding to WM scenario the interpolated effect of measures, takes into account the effects of economic crisis. The 4th NC projections can be considered as a WOM scenario before economic crisis with measures implemented up to 2007.

Figure 5.14 – WOM scenario estimate with and without taking into account the economic crisis effects



Source: ISPRA

6 VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

6.1 Climate modelling, projections and scenarios

Italy is located in an area identified as particularly vulnerable to climate change[92]: as a matter of fact, the Mediterranean region is considered to be a hotspot of climate change impacts[93].

Considerable impacts are expected because of climate change in many sectors, such as agriculture, tourism, water resources and geo-hydrological hazards. Climate observations already confirm an increase of the average temperature in Italy in the past, with a rate in the order of 1°C in the last 100 years and 2 °C in the last 50 years; extreme temperature indicators confirm this observed upward trend. The season featuring the highest trend are summer and spring, while mountain areas show a higher sensitivity with respect to lowland. As regards precipitation, trend tendency and related statistical significance are variable, depending on the period considered, the geographical area and the season. Nevertheless, a slight decrease of the cumulated annual precipitation (about 1%) is observed [94] [95]. Providing climate projection for this area is a challenging topic due to the complex orography, ranging from high mountain chains (Alps and Apennine) to a very diverse coastline. Italy is surrounded by the Mediterranean Sea and the climate is influenced by the arid climate of North Africa and by the temperate and rainy climate of central Europe. Following the Koppen-Geigen classification[96] , three main climate categories are found in Italy: warm temperature climate, snow climate and polar climate. The Italian peninsula is therefore a good example of the need of high-resolution climate analysis required to provide detailed climate change projection to support climate change analysis on impacts and vulnerability. Two different categories of tools are available for this goal: dynamical and statistical downscaling. The first class of methods, based on Regional Climate Models (RCMs) is the only currently available to provide climate scenarios over the whole country in a uniform way, with the advantage to provide a large number of atmospheric variables, not only in terms of average values but also of extremes. Nevertheless, RCMs are still affected by significant systematic bias, due to several reasons. In recent years in order to try to overcome these limitations, the WCRP Coordinated Regional Downscaling Experiment (CORDEX) project[97] has been established, to provide a global coordination of regional climate downscaling for improved climate change adaptation policy and impact assessment.

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[95] Nanni et al. (2009). La variabilità e le tendenze del clima in Italia nel corso degli ultimi secoli. In: I cambiamenti climatici in Italia: evidenze, vulnerabilità e impatti, a cura di Castellari S. e Artale V., Centro EuroMediterraneo per i Cambiamenti Climatici, Bononia University Press, ISBN: 978-88-7395-484-2, 11-45

[96] Kottek et al. (2006). World Map of the Köppen-Geiger climate classification updated. Meteorologische Zeitschrift 15(3):259-263

[97] Giorgi et al. (2004). Mean, interannual variability and trends in a regional climate change experiment over Europe. II: climate change scenarios (2071-2100), Clim. Dyn. 23, 839–858.

In particular, EURO-CORDEX is the European branch of the CORDEX initiative. An ensemble of historical simulations and climate projections was performed at 0.11° resolution in a combined effort among several research groups. Hindcast simulations driven by ERA-Interim Reanalysis were evaluated in terms of their ability to represent the basic patterns of the European climate for the period 1989–2008[98] against the E-OBS dataset[99]. EURO-CORDEX models over the Mediterranean area show non-negligible temperature biases and a generally high precipitation overestimation, up to 120% in summer. More specifically over Italy, most of the models underestimate winter temperature (especially at high altitudes) while summer temperature is overestimated by some models and underestimated by others; a wet bias characterizes both seasons over the whole Italian area with some exceptions. The ability of ensemble models to simulate heat waves was also evaluated[100]: even though local-scale feedbacks are better represented at high resolution, combinations of parameterizations have to be improved or adapted.

High-resolution simulations with COSMO-CLM over Italy (0.0715°) has been performed by Euro-Mediterranean center on Climate Change Foundation (a national research center funded in 2005 by IMELS, Italian Ministry of Education, University and Research, and of Economy and Finance) in order to assess the effects of increasing resolution on the quality of results[101] [102]. Given the complex orography of Italy, results have shown that high-resolution simulations, along with an optimized model configuration, could provide good earnings. The main features of the Italian climate were well represented, biases being general equal or lower than values that affect "state-of-the-art" regional climate simulations (i.e., EURO-CORDEX data at 0.11°) with a high detail level, not obtainable with coarser resolutions.

Climate projections were performed over the XXI century employing the IPCC RCP4.5 and RCP8.5 scenarios, driven by the GCM CMCC-CM. Analysis were performed in terms of average and extreme values[10]. Climate projections highlight a general warming expected in Italy at the end of XXI century, along with a general reduction in precipitation, especially according to the RCP8.5 scenario. In particular, climate changes in terms of precipitation generally project a reduction in the case of mean values and 'less extreme' indices (e.g. number of days with precipitation ≥ 10 mm) and an increase in the case of 'more extreme' indices (e.g. maximum of daily precipitation, number of days with precipitation ≥ 20 mm and percentiles). These findings are qualitatively in agreement with the increase in heavy precipitation over Italy found literature work[103]. With regard to temperature extremes, the climate change signal is much more evident than for precipitation, indicating an increase in temperature for several extreme indices, such as Summer Days (number of days when the daily maximum temperature is above

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[98] Kotlarski et al. (2005). Regional climate model simulations as input for hydrological applications: evaluation of uncertainties. Advances in Geosciences 5: 119–125. doi:10.5194/adgeo-5-119-2005

[99] Haylock et al. (2008). A European daily high-resolution gridded data set of surface temperature and precipitation for 1950–2006. J. Geophys. Res. 113: D20119, doi: 10.1029/2008JD010201.

[100] Vautard et al. (2013). The simulation of European heat waves from an ensemble of regional climate models within the EURO-CORDEX project. Climate Dynamics 41: 2555–2575. doi: 10.1007/s00382-013-1714-z

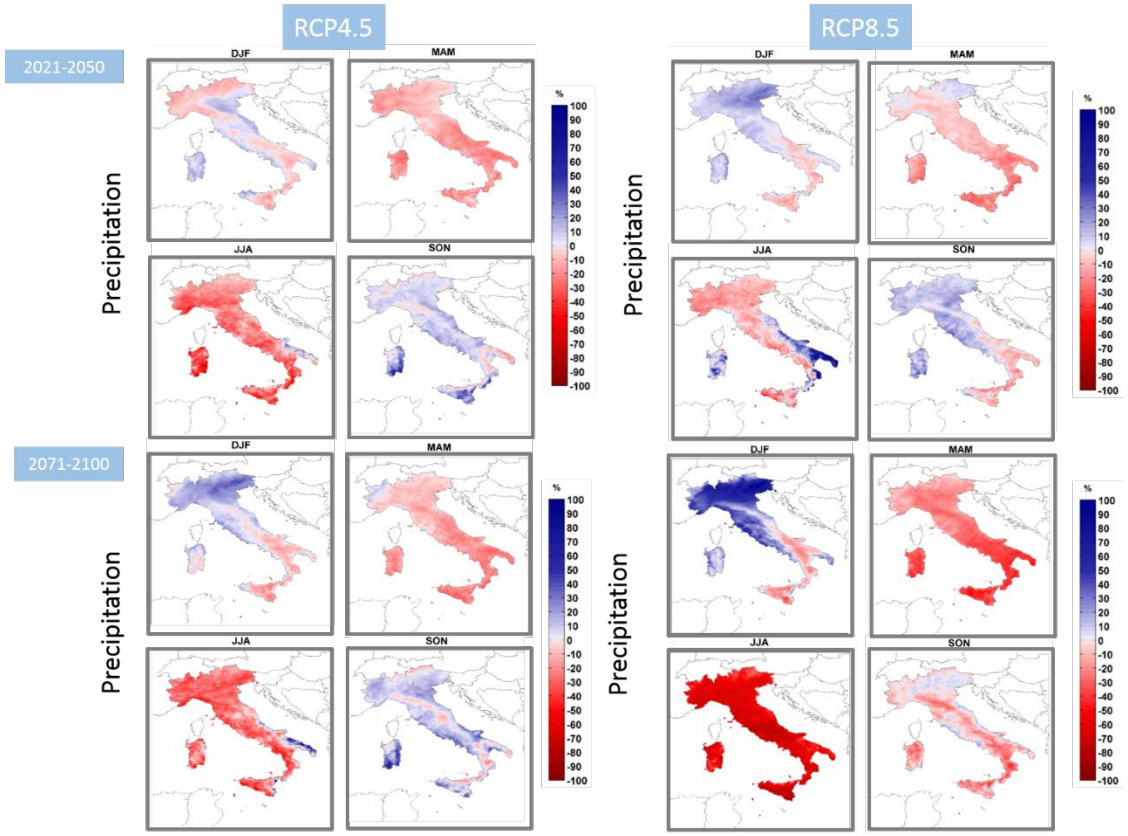
[101] Bucchignani et al. (2016). High-resolution climate simulations with COSMO-CLM over Italy: performance evaluation and climate projections for the 21st century. International Journal of Climatology, 36(2), 735-756. doi:10.1002/joc.4379

[102] Zollo et al. (2016). Extreme temperature and precipitation events over Italy: assessment of high resolution simulations with COSMO-CLM and future scenarios. International Journal of Climatology, 36(2), 987-1004. doi:10.1002/joc.4401

[103] Jacob et al. (2014). EURO-CORDEX: new high-resolution climate change projections for European impact research. Reg. Environ. Change 14: 563–578, doi: 10.1007/s10113-013-0499-2.

25°C),Tropical Nights (number of days when the daily minimum temperature is above 20°C) and percentiles. Specifically, this increase is more accentuated for scenario RCP8.5 and affects both minimum and maximum temperature. It is worth noting that temperature projections are statistically significant and consistent with others obtained with both global and regional models, for different emission scenarios, while projected precipitation changes are affected by larger uncertainties.

More specifically, considering the future period 2021-2050 (Figure 1), a general increase of temperature is recorded with respect to 1981-2010, up to 2° C under RCP8.5. Concerning precipitation, RCP4.5 scenario projects a general reduction in spring and a more accentuated reduction of summer, especially over south Italy and Sardinia (up to 60%). Winter is affected by a small precipitation reduction over Alps and south Italy and by a small increase in Sardinia and Po Valley. Finally, in autumn a general slight precipitation reduction is projected(the percentage positive values reported for Apulia are mainly due to the low absolute values observed in the control period). Under RCP8.5, instead, an increase of winter and autumn precipitation is recorded over north Italy and a small reduction over south Italy. Spring precipitation will diminish over south Italy, while in summer a general reduction is observed (with exception of Apulia where, however, autumn precipitation have low absolute values in the control period). Considering the future period 2071-2100 (Figure 1), a general temperature increase is projected in all the seasons, between 3 and 4°C under RCP4.5. Instead, under RCP8.5, a larger warming is projected, characterized by a marked seasonality, with peaks up to 8°C in summer. In terms of precipitation, RCP4.5 shows in winter a moderate increase over north Italy and a slight reduction over south Italy, while autumn is characterized by a general tendency toward precipitation increases. In spring, Italy will be affected by a general reduction, and in summer an even stronger reduction (up to -60%).



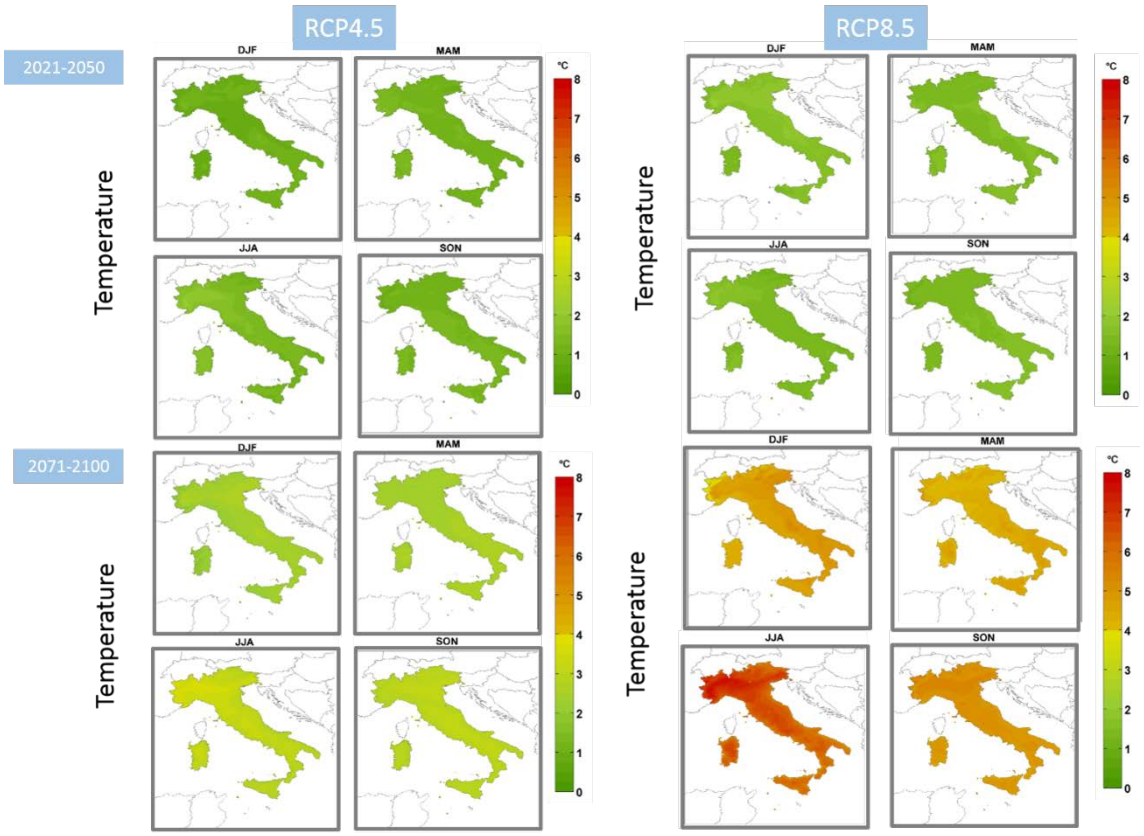


Figure 1: Climate projections for temperature and precipitation considering the future periods 2021-2050 and 2071-2100 with respect to 1981-2010, for the four seasons and two different scenarios RCP4.5 and RCP8.5.

6.2 Assessment of risks and vulnerability and climate change impacts

Italy is notoriously prone to natural hazards and climate change is expected to increase the Italian vulnerability to climate-related hazards over the next decades. This, combined with the economic, social and environmental pressures, makes Italy one of the most vulnerable country in Europe. The key risks for the European area are mainly related to:[104]

- increased water restrictions due to reduction in water availability combined with increased water demand (e.g. for irrigation, energy and industry, domestic use), and with increased evaporative demand, particularly in southern Europe;
- increased impacts related to extreme heat events on health and well-being, labor productivity, crop production, air quality, and wildfires risks in southern Europe;
- increased economic losses and people affected by flooding in river basins and coasts.

The Italian National Adaptation Strategy (NAS) to climate change, adopted in 2015, analyzed the state of scientific knowledge on impacts and vulnerability to climate change for the major socio-economic and environmental sectors. The approach used in the NAS was based on literature review and experts

[104] IPCC (2014b). Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32.

appraisal. The NAS does not include a quantitative risk analysis for these sectors, but discusses the main findings related to the vulnerabilities, risks and impacts posed by climate change, mainly in a qualitative way, with different levels of detail according to the state of knowledge available for each sector. Climate change is likely to magnify the regional differences in terms of quality and availability of natural resources and ecosystems in Europe and also in Italy.

Water resources (quality and quantity)

The situation of water resources in Italy is characterized by an unequal natural distribution combined with a high anthropic pressure, as well as a non-homogeneous quality of infrastructure and water management. Climate change is already affecting the hydrological cycle, with observed consequences on soil moisture, runoff, groundwater recharge[105].

Water resources (in terms of annual precipitation and river discharge) are projected to decrease over Southern Europe, and this regional pattern could intensify in the last decades of this century.

The existing conditions of high stress on water resources and hydro-geologic disturbance in some Italian regions could be exacerbated by projected climate change, with the following effects: reduced water availability and quality and increases in frequency and intensity of droughts especially in summer; increases in frequency and severity of river summer flows reductions and annual river flow decline and limited groundwater recharge; increased seasonal water deficit due to significant pressure of summer tourism peaks in small Italian islands[106] [107].

All these pressures will reduce the capability regenerate reservoirs, increasing, especially in summer and in southern regions, the competition among the different water uses (civil, industrial and agricultural). The systems that have the highest risks are those that use water resources from alluvial aquifers that are characterized by a large storage capacity coupled with long recharging times. Moreover, systems dependent on small-sized karst aquifers are particularly vulnerable to possible deficits[108] [109], requiring the use of alternative resources (usually alluvial aquifers), with the consequent risk of overexploitation in case of prolonged drought. Systems less exposed to the risk of deficit, due to a variation in the climatic regime, are the interconnected ones that use different types of resources with different charging times and storage capacities.

Desertification, land degradation and drought

Desertification is the combined result of anthropic pressure and climate change effects. Temperature and precipitation variations during the period 1961-2000 have been responsible of the increase in the

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[105] Castellari et al (2014a). Rapporto sullo stato delle conoscenze scientifiche su impatti, vulnerabilità ed adattamento ai cambiamenti climatici in Italia. Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma.

[106] Portoghese I. et al. (2009). "Impatti sul ciclo idrologico e risorse idriche". In Castellari S. and Artale V. (2009). Bononia University Press.

[107] Funari E. et al. (2007). "3.1 Water". In Menne B. and Wolf T., 2007. Rome, WHO-APAT.

[108] Romano et al (2012a). Generating synthetic time series of springs discharge in relation to Standardized Precipitation Indices. Case study in Central Italy. Journal of Hydrology, 507, 86–99. doi: 10.1016/j.jhydrol.2013.10.020. Elsevier B.V.

[109] Romano et al (2012b). Modeling karst spring discharge in relation to standardized precipitation indices: a new method for forecasting water scarcity conditions. Geophysical Research Abstracts, 14, EGU2012-9180. EGU General Assembly 2012.

extension of semi-arid and dry sub-humid areas in the southern regions and the islands, up to 20% of the national territory[110]. Sensitive areas to desertification already affect Italian regions, even if with different degrees and extensions. Regions with "higher sensitive areas" compared to the national average (30%) are: Basilicata, Marche, Molise, Sicilia, Sardegna, Puglia e Emilia-Romagna[111]. Coastal areas of Sardegna, Sicilia and Puglia, like almost all the Italian coastal regions, are already affected by saltwater intrusion which is mainly due to a groundwater overexploitation[112] and to the consequent decreasing ground levels. Water erosion already affect arable hilly areas of central Italy and the calanchian areas of Calabria and Basilicata that are likely to be also the most exposed to the climate change effects on soil erosion[113].

The gradual worsening of desertification trends, already observed in the whole country, can be accelerated from climate change by increasing the actions of erosion, salinization, loss of organic matter and drying up of soil[114]. Severe indirect socio-economic impacts of this desertification process may follow, including: decline in agriculture and tourism productivity, growing unemployment in rural areas with consequent migration, conflicts over water uses, harm to properties and people, due to increased frequency of fires, overall biodiversity loss[115] [116].

Hydrogreological risk

Hydrogeological phenomena, such as flooding, landslide, debris flow, erosion, subsidence are already occurring in Italy and show an increasing trend of the induced damages over the last 50 years up to more than two billions per year. The areas most exposed to the hydro-geological risk include: the river basin of the Po River, subject to increased flood risk, and the Alpine and Apennine areas, subject to increased flash flood risk[117].

An analysis of flood risk[118] showed that around 4.0%, 8.1% and 10.6% of the Italian territory was prone to high (return period 1: 20–50 years), medium (return period 1: 100–200 years) and low risk (return period 1: 300–500 years), respectively.

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[110] Perini et al. (2008). "La desertificazione in Italia. Processi, indicatori, vulnerabilità del territorio". Acireale – Roma: Bonanno Editore. ISBN 88-7796-422-7.

[111] Castellari et al (2014a). Rapporto sullo stato delle conoscenze scientifiche su impatti, vulnerabilità ed adattamento ai cambiamenti climatici in Italia. Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma.

[112] INEA (2011). Valutazione del rischio di salinizzazione dei suoli e di intrusione marina nelle aree costiere delle regioni meridionali in relazione agli usi irrigui.

[113] Di Leginio and Fumanti (2012). Il progetto SIAS, un approccio bottom-up per la costruzione di indicatori ambientali sul suolo (carbonio organico e erosione idrica) a scala nazionale. Atti del workshop: Sviluppo e conservazione dei servizi degli ecosistemi contro siccità e desertificazione, Roma, 14-15 giugno 2012.

[114] Carraro C. and Sgobbi A. (2008). "Climate change impacts and adaptation strategies in Italy: an economic assessment". FEEM Research Paper; CMCC Research Paper No. 14. Milan: FEEM; CMCC.

[115] Perini L. et al. (2008). "La desertificazione in Italia. Processi, indicatori, vulnerabilità del territorio". Acireale – Roma: Bonanno Editore. ISBN 88-7796-422-7.

[116] Sciortino M. et al. (2009). "La desertificazione e il degrado del territorio". In Castellari S. and Artale V. (2009). Bononia University Press.

[117] UNFCCC (2013). VI National Communication.

[118] Trigila et al. (2015). Dissesto idrogeologico in Italia: Pericolosità e indicatori di rischio, Report No 233/2015, ISPRA, Rome, Italy.

In Italy about 9,6% of the national territory (about 29.500 km^2) and 82% of the Italian municipalities (6631) is actually affected by a high hydrogeological risk. It is estimated that about 5,8 million people (10% of the national population) is potentially exposed to this risk and buildings potentially involved are about 1,3 million. This critical situation is likely to be exacerbated due to future climate trends[119]. Climate change impacts on the Italian hydro-geological system include: (i) variations in the hydrologic regime; (ii) higher risk of inland flooding, due to increased events of river flood heights in relation to heavy precipitation events[120]; (iii) increased winter run-off by 90% and decreased summer run-off by 45% in central Europe Alpine rivers[121] with consequent greater risk of flooding and drought respectively; (iv) significant changes in the hydrologic balance (and water quality) of some studied river basins (Rio Mulargia in Sardegna and Alento river in Campania)[122] with an estimated reduction in annual discharge as well as nutrients and sediments transport in the next decades; (v) increased risk of flash mud/debris flows, due to a potential increase of extreme weather events; (vi) increased risk of landslides in the Alps, due to temperature warming and ice melting; risk of rock falls in the Apennines, because of possible more frequent and sudden temperature changes, especially in winter; risk of flash floods in both areas, due to severe precipitation events.

Biodiversity and ecosystems (terrestrial, marine, inland water and transition ecosystems)

Italy is characterized by one of the most significant natural heritages of animal and plant species in Europe in terms of both the total number of specimens and the high rate of endemism. Furthermore, 50 Italian sites are recognized as internationally important wetlands in the Ramsar Convention's list. Climate change can threat Italian biodiversity at the level of species and habitats on terrestrial, marine and freshwater and inland ecosystems[123].

Terrestrial ecosystems

The effects of climate change on species and ecosystems can be summarized into the following main categories[124] [125]: (i) changes in life cycle (phenology), (ii) impacts on physiology and behavior, (iii) impacts on geographical distribution, and (iv) impacts on composition and interactions of species in ecological communities. A 20% loss of biodiversity for animal species is estimated by the end of the 21st

[119] Castellari et al (2014a). Rapporto sullo stato delle conoscenze scientifiche su impatti, vulnerabilità ed adattamento ai cambiamenti climatici in Italia. Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma.

[120] EEA (2012b). "Climate change, impacts and vulnerability in Europe, An indicator-based report". EEA Report No 12/2012. Copenhagen: EEA.

[121] Beniston M. (2006). "Climatic change in the Alps: Perspectives and impacts". Proceedings of the "Wengen 2006 Workshop – Adaptation to the Impacts of Climate Change in the European Alps". Organisation for Economic Co-operation and Development (OECD).

[122] Lo Porto A. et al. (2007). "Influenza dei cambiamenti climatici sul regime idrologico di due bacini idrografici in ambiente mediterraneo". In Carli B., Cavarretta G., Colacino M., Fuzzi S. (eds) "Clima e Cambiamenti Climatici: Le attività di ricerca del CNR", 577-580. CNR.

[123] UNFCCC (2013). VI National Communication; Castellari et al (2014a) Rapporto sullo stato delle conoscenze scientifiche su impatti, vulnerabilità ed adattamento ai cambiamenti climatici in Italia. Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma.

[124] Hughes, (2000). Biological consequences of global warming: Is the signal already apparent? Trends in Ecology and Evolution, 15, 56-61.

[125] Walther et al. (2002). Ecological response to recent climate change. Nature, 416, 389-395.

century in Mediterranean environment.

The Mediterranean region is identified as one of the 25 biodiversity hot-spot at global level and is undergoing relevant climate and anthropic changes. Terrestrial ecosystems are already affected by climate change also in Italy. The impacts of recent climate change have been so far more evident mainly in the Alpine region and in the Mediterranean area. Among the most significant impacts on species distribution in the alpine region are: the upward migration of alpine species[126], the upward migration of shrubs species[127], the rise of arboreal species[128], the variation of floristic composition, extension and pattern of spatial distribution of plant communities[129] and finally the acceleration of the impacts of climate change on dynamism and species colonization processes[130].

Mediterranean-type terrestrial ecosystems are likely to be especially affected by climate change[131] with the following future effects: (i) advancing trends in plant phenology; (ii) changes in spatial distribution of flora and fauna; (iii) increased risk of extinction for several terrestrial species, changes in the structure of the biological community and biodiversity loss; (iv) loss of wetlands ecosystems; (v) reduction in forests extension and biodiversity loss, especially in the South and in the mountains; (vi) shift of plant and animal species towards higher elevations (with changes in the composition and structure of alpine and nival communities)[132], with consequent changes in the structure of mountain communities and high risk of extinction for mountain flora and fauna.

Marine ecosystem

Biodiversity effects associated to the increasing sea surface temperature of the Mediterranean sea are already occurring and are documented by the high number of tropical alien species that are now settled in the basin. This phenomena, combined with the reduction of species with an affinity for cold-water conditions, are producing change in the structure of marine ecosystems and consequently in their functioning. In the Adriatic, over the last 20 years, significant changes have been observed in the

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[126] Cannone et al (2007). Unexpected impacts of climate change on alpine vegetation. Frontiers in Ecology, 5, 360-364.; Parolo and G., Rossi, G. (2008). Upward migration of vascular plants following a climate warming trend in the Alps. Basic and Applied Ecology, 9, 100-107.; Erschbamer et al (2006). Plant diversity along altitudinal gradients in the Southern and Central Alps of South Tyrol and Trentino (Italy). Gredleriana, 6, 47-68; Pauli et al (2012). Recent plant diversity changes on Europe's mountain summits. Science, 336, 353-355.

[127] Cannone et al., (2007). Unexpected impacts of climate change on alpine vegetation. Frontiers in Ecology, 5, 360-364.

[128] Motta and Nola (2001) . Growth trends and dynamics in sub-alpine forest stands in the Varaita Valley (Piedmont, Italy) and their relationships with human activities and global change. Journal of Vegetation Science, 12, 219-230; Gehrig-Fasel et al. (2007). Tree line shifts in the Swiss Alps: climate change or land abandonment?. Journal of Vegetation Science, 18, 571-582; Leonelli et al. (2011). Climate warming and the recent treeline shift in the European Alps: the role of geomorphological factors in high-altitude sites. Ambio, 40, 264-273.

[129] Cannone et al. (2007). Unexpected impacts of climate change on alpine vegetation. Frontiers in Ecology, 5, 360-364.; Erschbamer et al. (2011). Changes in plant species diversity revealed by longterm monitoring on mountain summits in the Dolomites (northern Italy). Preslia, 83, 387-401.

[130] Cannone et al. (2008). Accelerating climate change impacts on alpine glacier forefield ecosystems in the European Alps. Ecological Applications, 18, 637-648.

[131] IPCC (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK, 982pp.

[132] Cecchi L. et al. (2007). "3.3 Urban environments and socioeconomic sectors". In Menne B. and Wolf T., 2007. Rome, WHO-APAT.

composition of the fish fauna: the number of thermophilous species has increased significantly and several rare species are becoming abundant, while others have appeared for the first time in this sea[133]. In the last decades the increasing development of marine mucilage in Italian waters indicates altered environmental conditions for such aquatic system. This phenomenon might favor the spreading of pathogenic bacteria[134].

Mediterranean marine organisms, communities and ecosystems might be further altered by climate change, including with spreading of invasive species driven by water warming, which would cause a general threat and possible decline of marine biodiversity. Many biological processes are expected to be negatively affected by climate change especially in summer (possible mass mortality of invertebrates); simulations of these conditions indicate a biomass loss higher than 35%[135].

Freshwater and transition ecosystems

Among the most vulnerable inland and transition water ecosystems are marginal environments and groundwater dependent ecosystems, high altitude lakes, and the waterways of the Apennines and the major islands on which significant pressures are already insisting such as land and water resources exploitation[136].

High vulnerability is projected also for lakes of central and southern Italy, due to a reduction of precipitations and an increase in temperature that, combined with an increase in water consumption, could accentuate the risk of deterioration of water quality.

Future scenarios for these ecosystems depict loss of habitats, as well as biotic components and processes. Higher temperatures might increase the risk of excessive growth of algae and cyanobacteria in the lakes and eventually of eutrophication processes in lake ecosystems, especially in late summer[137]. The loss of wetlands would cause severe imbalances in the related biotic communities[138].

Health

In addition to the direct effects of climate change due to heat and frost waves, with a consequent excess of mortality and morbidity and further socio-economic impacts such as damages to infrastructure and settlements, deaths, psychological and physical pathologies, resulting from increasingly frequent weather events, indirect health risks are mediated by the impacts of meteoclimatic factors on ecosystems, biodiversity, drinking and bathing water, soil, and outdoor and indoor air[139]. Vector-borne diseases are already occurring in Italy, such as the Chikungunya virus, the West Nile Disease and the Dengue.

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[133] Castellari et al. (2014a). Rapporto sullo stato delle conoscenze scientifiche su impatti, vulnerabilità ed adattamento ai cambiamenti climatici in Italia. Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma.

[134] Danovaro R. et al. (2009). "Climate Change and the Potential Spreading of Marine Mucilage and Microbial Pathogens in the Mediterranean Sea". PLoS ONE 4(9): e7006. PLOS.

[135] Coma R. et al. (2009). "Global warming-enhanced stratification and mass mortality events in the Mediterranean". PNAS 2009 106 (15) 6176-6181. National Academy of Sciences.

[136] IMELS (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: IMELS.

[137] Menne B. et al. (2009). "6. Conclusions". In Menne B. and Wolf T., 2007. Rome, WHO-APAT.

[138] UNFCCC (2013). VI National Communication.

[139] IMELS (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: IMELS.

Furthermore, recent studies have also investigated the malariogenic potential in Italy[140]. Even tick-borne infectious diseases have increased over the past decades in Italy. Furthermore, several scientific sources estimates that the consequences of hydrogeological occurrences have caused between 2002 and 2012 direct damages to population (128 dead due to floodings and 165 due to landslide).

Expected impacts of climate change include[141] [142] [143] [144] [145]: (i) increased heat-related mortality and morbidity, related to summer heat waves; (ii) slight reduction of cold-related mortality, linked to expected milder winter temperatures; (iii) increased risk of injuries, morbidity (e.g. enteric infections, post-traumatic stress disorder and vector-borne diseases) and deaths, from floods, heavy precipitation and fires events; (iv) increased respiratory diseases and allergic disorders, as a result of the effects of changes in air pollution concentrations that may be aggravated by climate change; (v) adverse consequences of potentially more frequent and prolonged extreme ozone events and increasing toxicity of pollutants particularly in summertime; (vi) possible increase of the cases of West Nile fever and leishmania, of risks for malaria and dengue fever and of the spreading of vector borne diseases[146].

Forestry

The effects of climate change on forest ecosystems are already significant so as to endanger the Italian forestry heritage, thus compromising the functionality and the ecosystem services it offers and are intended to increase as a consequences to future climate scenarios.

In particular, the impact of climate change is causing changes in growth rates and productivity, in changes in the composition of existing species and altitudinal and latitudinal displacement of forest habitats resulting in local biodiversity loss and increased risk of fire and damages from insects and pathogens, as well as alteration of the water cycle and carbon[147].

The actual possibilities for the forest ecosystems to shift are scarce, because climate change rate far exceeds the rate of colonization of new areas and the potential corridors are often obstructed by territorial fragmentation. Hence, a progressive disruption of forest ecosystems could be expected[148].

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[140] Boccolini et al. (2009). Ulteriori indagini sulla presenza di specie del complesso Anopheles maculipennis nella maremma toscana. Atti XXII Congresso Nazionale di Entomologia, Ancona 15-18 giugno 2009: 239; Boccolini et al. (2012). Impact of environmental changes and human-related factors on the potential malaria vector, Anopheles labranchiae (Diptera: Culicidae), in Maremma, Central Italy. Journal of Medical. Entomology, 2012; 49 (3); Romi et al. (2012a). Assessment of the risk of malaria re-introduction in the Maremma Plain (Central Italy) using a multi-factorial approach. Malaria Journal 2012 (a), 11: (98); Romi et al. (2012b). Probable autochthonous introduced malaria cases in Italy in 2009-2011 and the risk of local vector-borne transmission. Eurosurveillance, Volume 17, Issue 48, 29 November 2012; Di Luca et al. (2009). Caratterizzazione della fauna culici dica (Diptera: Culicidae) della Maremma laziale. In: 22. Congresso nazionale italiano di entomologia. Atti; 15-18 giugno 2009; Ancona. 2009a. p.256.

[141] Michelozzi P. et al. (2007). "4.1 Heat and health". In Menne B. and Wolf T., 2007. Rome, WHO-APAT.

[142] Funari E. et al. (2007). "3.1 Water". In Menne B. and Wolf T., 2007. Rome, WHO-APAT.

[143] Forestiere F. (2007). "4.4 Air quality and health". In Menne B. and Wolf T., 2007. Rome, WHO-APAT.

[144] Menne B. et al. (2009). "6. Conclusions". In Menne B. and Wolf T., 2007. Rome, WHO-APAT.

[145] Majori G. (2007). "4.5 Vector-borne diseases". In Menne B. and Wolf T., 2007. Rome, WHO-APAT.

[146] UNFCCC (2013). VI National Communication.

[147] IMELS (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: IMELS.

[148] Valentini R. et al. (2009). "Foreste e cambiamenti climatici". In Castellari S. and Artale V. (2009). Bononia University Press.

Existing studies[149] [150] show that climate change could induce overall changes in the composition of species and habitats of Italian forests, resulting in local losses of biodiversity. Potential impacts of climate change include: (i) northwards and altitudinal shift of the range of climatic and environmental conditions typical of the Mediterranean area; (ii) reduction of growth and productivity rates in central-Southern Italy; (iii) changes in the distribution of main tree forest species in central Italy mostly located in the central Apennines, over 1500 m, in 2080; (iv) higher risk of forest fires and droughts, with possible extension of burned areas, more ignitions and longer fire seasons (in particular in the Alpine area and in Calabria, Campania, Sicilia and Sardegna regions). Some possible positive impacts, such as an increase in forest productivity in the Alps in relation to the expansion of the growing season could be expected[151].

Agriculture

The productive capacity of agricultural crops in the Mediterranean region is strongly conditioned by the amount of available water in the soil even more than by the temperatures.

In Italy water shortages during specific crop development stages may reduce the productivity of most crops (e.g. corn, soybeans and wheat). The decline in agricultural productivity could especially concern wheat yield and fruit and vegetables production, as a consequence of water scarcity, pathogens species increasing and soil degradation. Conversely olive, citrus, wine and durum wheat cultivation could become possible in the North of Italy. Wine production, an activity of particular economic relevance in Italy, could undergo major changes too. The suitability of cultivation areas for specific crops might modify, which could lead to displacements of agricultural productions[152] [153]. In addition, the future temperature increase (+ 2 e 5°C)[154] could reduce further the crop productivity[155].

Climate change is expected to affect the livestock by increasing the risk of heat stress.

Moreover, climate change is expected to reduce the quality of agricultural products, especially for the

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[149] Valentini R. et al. (2009). "Foreste e cambiamenti climatici". In Castellari S. and Artale V. (2009). Bononia University Press.

[150] Petriccione B. et al. (2009). "Gli effetti dei cambiamenti climatici sugli ecosistemi forestali". Atti del Terzo Congresso Nazionale di Selvicoltura. Taormina (ME), 16-19 ottobre 2008. Accademia Italiana di Scienze Forestali, Firenze, p. 570-574.

[151] UNFCCC (2013). VI National Communication.

[152] Cecchi L. et al. (2007). "3.3 Urban environments and socioeconomic sectors". In Menne B. and Wolf T., 2007. Rome, WHO-APAT.

[153] Miglietta F. et al. (2009). "Impatti dei cambiamenti climatici sull'agricoltura". In Castellari S. and Artale V. (2009). Bononia University Press.

[154] Giorgi et al. (2004). Mean, interannual variability and trends in a regional climate change experiment over Europe. II: climate change scenarios (2071-2100), Clim. Dyn. 23, 839–858; Kjellstrom (2004). Recent and future signatures of climate change in Europe, Ambio, 33:193–298; Raisanen et al. (2004). European climate in the late 21st century: regional simulations with two driving global models and two forcing scenarios, Clim. Dyn. 22, 13–31; Good et al. (2006). Nonlinear regional relationships between climate extremes and annual mean temperatures in model projections for 1961-2099 over Europe, Clim. Res., 13, 19-34; Christensen e Christensen (2007). A summary of the PRUDENCE model projections of changes in European climate during this century, Climatic Change, 81, S7-S30.

[155] Olesen and Bindi (2002). Consequences of climate change for European agricultural productivity, land use and policy, European Journal of Agronomy 16, 239-262; Maracchi et al. (2005). Impacts of present and future climate variability on agriculture and forestry in the temperate regions: Europe, Climatic Change 70, 117-135; Giannokopoulos et al. (2005). Climate Change Impacts in the Mediterranean Resulting from a 25). Climate Change Impacts in t report, Gland Switzerland; Audsley et al. (2006). What can scenario modelling tell us about future European scale agricultural land 462 use, and what not?, Environ Sci Policy 9(2):148–162; Olesen et al. (2007). Uncertainties in projected impacts of climate change on European agriculture and ecosystems based on scenarios from regional climate models, Clim. Change 81 (suppl. 1), 123-143.

most vulnerable regions, characterized by a widespread use of traditional cultivation methods for quality food production.

A particular attention should be paid to the risk posed by temperature and precipitation change to the different Protected Designation of Origin (PDO), the Protected Geographical Indication (PGI) and the Typical Geographical Indication (TGI), which are a significant element of the Italian agriculture[156].

Aquaculture

Changes in thermal regimes, rainfall and their effects on the concentration of dissolved oxygen and salinity can have direct effects on reproduction, growth and survival of the species. The vulnerability of aquaculture to climate change is influenced by the localization of infrastructures used for production that cannot be moved in the case of exceptional climatic conditions.

Climate change could affect the ecosystems that are supporting aquaculture farming activities, the production cycles, the infrastructures, the physiology of organisms produced in farms or harvested in nature. In Italy despite the lack of knowledge and evidences about the climate change effects on aquaculture, the increasing attention is focusing on the possible effects on the molluscs production[157].

Specific ecosystems, and in particular coastal environments, the lagoons and the river delta are considered to be the most vulnerable to the effects associated to the increase of surface temperatures, the sea level rise, the water acidification, the increase in the extreme weather events and the water stress. The most vulnerable areas in Italy are located in the North-East and along the Adriatic coast[158].

Fishery

In recent years, a moderate rise in the Mediterranean mean surface temperature has been observed together with changes in the geographical and bathymetric distribution of animal and plant species, including the fish fauna. The expansion of the distribution area of thermophilic marine species has been among the first significant signals of the Mediterranean warming[159].

Expanding species come from the warmest Mediterranean sub-basins or tropical and sub-tropical areas of the Red Sea or the Eastern Atlantic. For this reason, the whole community is going toward the so called "meridionalization" and "tropicalization"[160] depending on whether it is based on the native or not native species expansion.

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[156] IMELS (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: IMELS.

[157] Viaroli et al., (2007). Analysis of clam farming scenarios in Sacca di Goro lagoon, Transitional Water Monographs, 1, 71-92. doi: 10.1285/i18252273v1n1p71; Melaku Canu et al. (2010). Effect of global change on bivalve rearing activity and the need for adaptive management. Climate Research, 42, 13-26. doi: 10.3354/cr00859.

[158] IMELS (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: IMELS.

[159] Azzurro (2008). The advance of thermophilic fishes in the Mediterranean Sea: overview and methodological questions. In: CIESM Workshop Monographs, 35, 39-45; Lejeusne et al. (2009). Climate change effects on a miniature ocean: the highly diverse, highly impacted Mediterranean Sea, Trends Ecology Evolution, 25, 4, 250-260. doi:10.1016/j.tree.2009.10.009. Elsevier Ltd.

[160] Bianchi (2007). Biodiversity issues for the forthcoming tropical Mediterranean Sea, Hydrobiologia, 580, 7-21. Doi 10.1007/s10750-006-0469-5; Lejeusne et al. (2009). Climate change effects on a miniature ocean: the highly diverse, highly impacted Mediterranean Sea, Trends Ecology Evolution, 25, 4, 250-260. doi:10.1016/j.tree.2009.10.009. Elsevier Ltd.

The influx of non-Mediterranean species has become progressively more rapid in recent times[161].

The following adverse climate change effects can be expected: (i) fish stock movements, inducing changes in the composition of biological communities in a given area also affecting the economic activities related to fishery; (ii) reduction in the resilience of many water ecosystems due to anthropogenic stress (e.g. from overfishing, pollution, tourism, fragmentation and loss of habitat); (iii) possible general reduction in the productivity of the fished species[162]; (iv) increased risk for economic activities based on the collection of bivalve and gastropod mollusks or shellfish due to their potential problems linked to the reduction of sea water pH[163].

Energy

The energy sector is particularly vulnerable to climate change, as a result mainly of the high sensitivity of production and consumption to temperature and extreme weather events. In Italy, in the last three decades the mean Heating Degree Day rate has decreased by 19%, with significant interannual variations[164]. Furthermore, the hydropower production is already affected, and will be increasingly affected in the future, by meteo-climatic variations, which are responsible of a reduction of water availability and a more difficult water management[165].

In Italy, as in other European countries, the increase in energy demand for cooling in summertime could exceed the decreasing energy demand for heating in winter[166]. Summer cooling needs might increase up to 50% Italy by 2080[167].

Furthermore, the increase in the frequency and intensity of extreme weather phenomena will also affect the energy production and supply, both from fossil fuel power plants and form plants based on renewable sources[168].

Coastal zones

Coastal ecosystems in the Mediterranean already show a high vulnerability to climate change, with rapid coastal erosion phenomena.

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[161] Zenetos et al. (2012). Alien species in the Mediterranean Sea by 2012. A contribution to the application of European Union's Marine Strategy Framework Directive (MSFD). Part 2. Introduction trends and pathways. Mediterranean Marine Science, 13, (2), 328-352. doi: 10.12681/mms.327.

[162] Cheung W. W. L. et al. (2010). "Large-scale redistribution of maximum fisheries catch potential in the global ocean under climate change". Global Change Biology, 16:24–35. Blackwell Publishing Ltd.; Cheung W.W.L. et al. (2012). "Shrinking of fishes exacerbates impacts of global ocean changes on marine ecosystems". Nature Climate Change. Nature Publishing Group (NPG).

[163] UNFCCC (2013). VI National Communication.

[164] Eurostat: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_esdgr_a&lang=en

[165] Gaudioso D. and Masullo A. (2009). "Impatti dei cambiamenti climatici sul settore energetico". In Castellari S. and Artale V. (2009). Bononia University Press.

[166] Mima S. et al. (2011). "Technical Policy Briefing Note 4: Energy - The Impacts and Economic Costs of Climate Change and Energy in the European Union. Summary of Sector Results from the ClimateCost project". ClimateCost project. Funded by the European Community's Seventh Framework Programme.

[167] Cecchi L. et al. (2007). "3.3 Urban environments and socioeconomic sectors". In Menne B. and Wolf T., 2007. Rome, WHO-APAT.

[168] IMELS (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: IMELS.

This phenomenon is related to sea level rise, due to the melting of glaciers, the subsidence and the thermal expansion of the ocean masses because of climate change and the anthropogenic pressures that make them particularly vulnerable, with increased flood risk, instability and saline intrusions into coastal aquifers.

Over 7.500 km of Italian coasts, 47% is represented by high or rocky shores and 53% are beaches. About 42% of the beaches is currently undergoing erosion processes[169]. The rate of coastal erosion varies between 13% in Friuli Venezia Giulia and 91% in Molise[170].

Saltwater intrusion in the coastal groundwater is already occurring in many coastal areas and will be aggravated by the sea level rise and the precipitation reduction, causing new potential problems to water supply[171].

Future scenarios of climate change impacts on Italian coastal areas include[172]: (i) increase in coastal erosion and instability; (ii) loss of coastal land and related economic activities, infrastructures, urban settlements, recreational areas and natural heritage sites; (iii) reduction and loss of biodiversity and ecosystems (especially wetlands), and decrease of marine life caused by the combined effect of climate change and anthropogenic stress; (iv) damages to coastal rural economy, due to saltwater intrusion; (v) negative impacts on tourism and possible displacement of tourist flows; (vi) possible threat to human health posed by flood events.

Specifically, about 4500 km^2 of Italian coastal areas are at risk of sea flooding from sea level rise (SLR) by the next 100 years; most of them are located in the North Adriatic Sea, but some Tyrrhenian and Ionian coasts may be at risk too[173] . The Northern Adriatic coast, characterized by the Po river delta and the Venice lagoon, is at high risk, as this area lies below sea level and hosts many residential settlements, cultural heritage sites as well as industrial establishments[174].

Tourism

Without adaptation measures, according to the estimates of the Hamburg Tourism Model, Italy by the end of the century will lose significant market shares sliding from the current fifth to the thirteenth among the most popular international destinations. Climate change will particularly affect coastal summer, due to high temperatures and water scarcity, and winter mountain tourism, due to decreasing

[169] IMELS (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: IMELS.

[170] Castellari et al (2014a). Rapporto sullo stato delle conoscenze scientifiche su impatti, vulnerabilità ed adattamento ai cambiamenti climatici in Italia. Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma.

[171] Castellari et al (2014a). Rapporto sullo stato delle conoscenze scientifiche su impatti, vulnerabilità ed adattamento ai cambiamenti climatici in Italia. Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma.

[172] IPCC (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK, 982pp.

[173] Antonioli F. and Silenzi S. (2007). "Variazioni relative del livello del mare e vulnerabilità delle pianure costiere italiane". In "Quaderni della Società Geologica Italiana (SGI) 2". SGI.

[174] Policy Research Corporation (in association with MRAG) (2009). "The economics of climate change adaptation in EU coastal areas". ("Country overview and assessment". Chapter 11. "Italy"). European Commission, Directorate-General for Maritime Affairs and Fisheries.

natural snow cover, and, to a lesser extent, tourism in art cities. On the other hand improved conditions for spring and autumn tourism might occur[175].

The most likely vulnerable regions are, in descending order, Sicily, Lazio, Tuscany and Umbria[176].

The Tourism Climate Index approach shows a transformation by the end of the century from optimal summer climate conditions in the Italian coastal areas to almost unacceptable conditions even in the higher tourist vocation areas[177]. According to several studies, in the coming decades a snow cover decrease and a rise of the snowfall limit will be observed. Winter tourism will be then strongly affected, in particular in Friuli Venezia Giulia, Lombardia, Trentino Alto Adige and Piemonte. With an increase of 4°C and the snow limit at 2.100 m of altitude, ski resorts above this altitude would be reduced at just 18% of those currently used.

Urban settlements

The impacts that climate change may have on urban settlements are highly diverse and are mainly due to extreme events like floods, storms, heatwaves, droughts[178] [179]. These climate threats could affect for example the health of citizens, the functioning of infrastructure and technology networks, the sudden increase in energy demand, changes in the conditions of sociality, shortages in water supplies, decline in the quality of life, increased risk of flooding, soil instability and fires, flooding in coastal settlements. In large settlements, some impacts are exacerbated by the typically Urban Heat Island (UHI) phenomenon, causing higher average temperature in the cities than in peripheral and suburban areas (up to 5-10 degrees of difference)[180].

Critical infrastructures (cultural heritage, infrastructure and transport, industrial hazards)

Cultural heritage. The research on the effects of climate change on the cultural heritage has been limited until now[181]. Water plays a predominant role as a possible damage factor of cultural heritage: extreme events, floodings and stroms, could cause structural damages to the roofs and ornamental elements of buildings. Humidity changes are responsible for the growth of microorganisms, especially on stone and wood materials, and the formation of salts that degrade surfaces and accelerate corrosion phenomena.

The increase in atmospheric CO2 concentration, combined with rainfall, is expected to cause an increase up to 30% of the chemical dissolution of carbonate stone materials, respect to the present. Data show

[175] UNFCCC (2013). VI National Communication.

[176] Castellari et al (2014a). Rapporto sullo stato delle conoscenze scientifiche su impatti, vulnerabilità ed adattamento ai cambiamenti climatici in Italia. Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma.

[177] IMELS (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: IMELS.

[178] EEA (2012a). "Urban adaptation to climate change in Europe - Challenges and opportunities for cities". EEA Report No 2/2012. Copenhagen: EEA.

[179] EEA (2016). "Urban adaptation to climate change in Europe 2016. Transforming cities in a changing climate". EEA Report No 12/2016. Copenhagen: EEA.

180 IMELS (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: IMELS.

[181] Castellari et al (2014a). Rapporto sullo stato delle conoscenze scientifiche su impatti, vulnerabilità ed adattamento ai cambiamenti climatici in Italia. Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma.

that Mediterranean regions including Sicily, particularly rich in monuments and archaeological sites in stone, will continue to experience a high level of thermal stress risk, with values sometimes over 200 events per year at the end of the century[182] [183]. However, the research on the impacts of climate change on cultural heritage has been so far very limited, with studies mainly focused on construction materials, while studies on impact assessment for complex systems, such as historical centers and archaeological sites would be required.

Temperature rise is already transforming the landscape, with consequent upward shifts of vegetation and desertification processes in the Mediterranean area[184].

Infrastructure and transport.

Climate change will affect transport infrastructures through four main types of phenomena:

(i) the increase in temperatures, which increases the vulnerability of road and rail infrastructure due to the increasing frequency of hot days and, on the other hand, reduces their vulnerability as a consequence of the reduction in the frequency of days with low temperatures;

(ii) the variation in precipitation, which adversely affects soil stability and consequently road and railway infrastructures located in unstable environments and increases the risk of flooding of underground infrastructures;

(iii) sea level variation, which poses risks for road and rail infrastructures located on coastal areas and port infrastructures;

(iv) floods, which have impacts on transport infrastructures located near watercourses.

In Italy, there is no currently a unique, specific and complete framework for the assessment of climate change impacts on transports. However, extreme weather events already cause damages to infrastructure. Due to the future possible increase in extreme weather events, temperature rise, changing precipitation patterns, increased risk of floods, landslides and rock falls, possible deterioration, disruption or inaccessibility of the transport network will occur increasingly[185].

Industrial hazards.

Over the last 20 years at least 20 NaTech events (events in which a natural disaster triggers on or more technological disaster) have taken place, involving refineries, chemical and petrochemical industries and gas pipelines. Due to the future increasing frequency and intensity of extreme weather events, the impacts on infrastructure (i.e. gas pipelines, oil pipelines, pipelines carrying inflammable or toxic substances) and hazardous industrial activities (i.e. plants at risk of major accident and other productive activities using hazardous chemical substances) will be increasingly significant[186].

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[182] Sabbioni et al (2008). Global climate change and archaeological heritage: prevision, impact an mapping. In: ARCHAIA Case Studies on Research Planning, Characterisation, Conservation and Management of Archaeological Sites. (Eds. Marchetti, N., Thuesen, I., Archaeopress), Oxford, 295-300.

[183] Bonazza et al (2009). Climate change impact: mapping thermal stress on Carrara marble in Europe. Science of the Total Environment 407, 4506-4512.

[184] IMELS (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: IMELS.

[185] Caserini S. and Pignatelli R. (2009). “Cambiamenti climatici e trasporti: il contesto e gli impatti”. In Castellari, S. and Artale, V. (2009). Bononia University Press.

[186] IMELS (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: IMELS.

Mountain areas (Alps and Apennines)

The climate change impacts on mountain areas (Alps and Apennines) mainly concern glacial retreat and glacial mass loss, snow cover reduction at low altitude, a progressive warming of permafrost.

It is very likely that in the coming decades the impacts of climate change so far observed in the mountain systems will increase their magnitude. The decrease in summer rainfall and the increase in winter precipitation - increasingly in terms of rain - together with the acceleration of the cryosphere melting, will result in significant changes in the mountainous hydrological regime such as a decrease in summer run-off and above all a considerable increase in winter run-off. Consequently, hydrogeological risk and availability of water resources will be seriously affected.

An increase in glacial risk is also expected, as substantially stable areas will become more subject to collapses and landslides[187].

Po river basin

The river Po district is the most important in Italy in terms of geographical, economic, social and political conditions, despite the abundance of water resources is extremely vulnerable to changes induced by climate change.

Due to climate variations and to the reduction of the area and the volume of the alpine glaciers, large variations of water outflows will likely occur and will be only partially compensated by the existing artificial hydraulic works. Historical time series already in the basin confirms this tendency. Since 2003, the Po basin has been characterized by frequent water scarcity conditions compared to the demand, as a consequence of the more arid climate on one side and the variations in demand related to new factors on the other side. In particular, summer energy needs have increased in addition to water irrigation needs arising from agricultural drought.

Energy production, agriculture and water supply for civil use could be damaged by prolonged drought conditions. Alterations in the hydrological regime could lead to increased risks for urban and productive areas, as well as for essential transport and mobility infrastructure, electricity distribution, telecommunications and water infrastructure[188].

6.3 Domestic adaptation policies and strategies

In 2012 the Italian Ministry for the Environment, Land and Sea (IMELS), that is the institution in charge of climate policy, started a process aiming to build the basis for adaptation planning at national level.

A Scientific Panel was established to collect background information on current and future climate variability and on impacts and vulnerability in Italy. Also, an analysis of policy framework for adaptation at National and European level was carried out.

In 2013, a public consultation on the perception of the risks of climate change and on the general

[187] IMELS (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: IMELS.

[188] IMELS (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: IMELS.

concept about adaptation, and an "ad hoc" public consultation for the involvement of citizens and stakeholders, were launched by IMELS.

Some background documents were published in 2014:

- An impact and vulnerability assessment: Report on the state of scientific knowledge on impacts, vulnerability and adaptation to climate change in Italy[189].
- A strategic document: Elements for an Italian National Adaptation Strategy to climate change[190].
- A legal assessment: Analysis of Aquis Communitaire and National Legislation relevant for impacts, vulnerability and adaptation to climate change[191].

The main methods used to perform the assessment were the review of existing literature and experts appraisal. The climate change, impacts and vulnerability assessment and the related NAS were presented in many workshops and conferences at national and international level during the period between 2014 and 2016.

In order to lay the foundation of a multilevel governance on adaptation, an horizontal coordination took place through an Institutional Panel, set up to support the elaboration of the National Adaptation Strategy. Represented Ministries included the Ministry of Economic Development, the Ministry of Agricultural and Forestry Policies, the Ministry of Infrastructures and Transport, the Ministry of Health; the Ministry of Education, University and Research; the Ministry of Cultural and Environmental heritage; the Ministry of Regional affairs and Tourism and Sport, and other institutions such as the Department of Civil Protection, regional committees, the national association of Italian municipalities and the Union of Italian Provinces.

The IMELS also established an Interregional Panel with the national State-Regions Commission for climate change, with the aim to build the ground for adaptation, having in mind the needs and the perspective of all actors involved in the process of tackle climate change and its impacts.

According to the International and European provisions[192], and after approval by the "State-Regions Unified Conference" on the 30th of October 2014 (14/136/CU6/C5), the *National Adaptation Strategy to Climate Change* (NAS)[193] was finally adopted on June 2015 with a Directorial Decree[194] of the Climate and Energy General Director (DG-CLE).

The main objective of the NAS was to develop a national view on the common path to be undertaken for dealing with climate change and its impacts.

The NAS includes an analysis of current and future climate variability in Italy and describes the effects of climate change in terms of induced process (e.g. desertification and hydrogeological risk), alteration of natural resources (e.g. water resources and biodiversity), environmental compartments and socio-

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[189] Castellari et al (2014a). Rapporto sullo stato delle conoscenze scientifiche su impatti, vulnerabilità ed adattamento ai cambiamenti climatici in Italia. Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma.

[190] Castellari et al (2014b). Elementi per una Strategia Nazionale di Adattamento ai Cambiamenti climatici. Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma.

[191] Castellari et al (2014c). Analisi della normativa comunitaria e nazionale rilevante per gli impatti, la vulnerabilità e l'adattamento ai cambiamenti climatici. Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma.

[192] EC (2013). Communication from the Commission to the European Parliament, the Council, the European economic and social Committee and the Committee of the Regions. An EU Strategy on adaptation to climate change. COM(2013) 216 final. Brussels: EC.

[193] IMELS (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: IMELS.

[194] http://www.minambiente.it/sites/default/files/archivio/normativa/dd_16_06_2015_86_snac.pdf

economic sectors.

The sectors of the Strategy were chosen based on their environmental and socio-economic relevance and on their vulnerability to the impacts of climate change:

- water resources (quantity and quality);
- desertification, soil degradation and drought;
- hydrogeological instability;
- biodiversity and ecosystems;
- forestry;
- agriculture, aquaculture, marine fishery;
- coastal zones;
- tourism;
- health;
- urban settlements;
- critical infrastructures (cultural heritage, transport and infrastructures, industry);
- energy (production and consumption);
- and 2 special cases: the mountain areas of the Alps and Apennines, and the Po river basin.

For each sector, impacts and vulnerability were summarize in the form of “key messages” and took into account geographic specificities; also, the NAS proposed a portfolio of adaptation actions based on three approaches: 'soft' (i.e. managerial, legal and policy approaches), 'green' (i.e. ecosystem based approaches) and 'grey' (i.e. technological and engineering solutions) and two implementation terms: short and medium term. The NAS is planned to be updated within five years.

The Decree of adoption of the NAS states that the Ministry for the Environment defines: specific roles for the implementation of adaptation actions as well as coordination instruments between different level of governance; adaptation options that are preferable considering opportunities and synergies; evaluation of costs and human resources; specific indicators for monitoring and evaluation of adaptation actions.

Moreover, the above mentioned Decree provides for the institution of a “Permanent Forum” for the promotion of information, training and decision making-capacity of citizens and stakeholders and also the institution of a “National Observatory” composed of Regions and local authorities for identification of territorial and sectorial priorities and for monitoring of adaptation actions.

As far as adaptation strategies at subnational level, a survey on the ongoing processes towards climate change adaptation strategies and plans at regional level, carried out by the Institute for Environmental Protection and Research (ISPRA) describes the following state of the art[195]:

- Lombardia Region approved its Regional Adaptation Strategy
- Other regions (Valle D’Aosta, Piemonte, Friuli Venezia Giulia, Emilia Romagna, Toscana, Abruzzo, Sardegna, Calabria and the Province of Trento) have started procedures aiming to define planning documents on adaptation (Strategies or Plans).

It is important to highlight that some regions (e.g. Sardegna, Calabria, Puglia) recognized the cross-cutting nature of adaptation into their governance model; some other regions are reviewing their

[195] ISPRA - Istituto Superiore per la Protezione e la Ricerca Ambientale. (2016). “Annuario dei dati ambientali – edizione 2016”. ISPRA Report No 69/2016. Roma: ISPRA.

regulatory measures (e.g. EIA) and planning tools (e.g. EU Structural Funds) considering adaptation (e.g. Abruzzo, Molise); some other regions are promoting adaptation at local level by facilitating the implementation of the European Covenant of Mayors for Climate and Energy programs (e.g. Lazio, Abruzzo).

Under the European cooperation for regional development programs (ERDF), for the regions Calabria, Sicilia, Campania and Puglia, the IMELS coordinated a project to support the regional environmental authorities for the implementation of the principles of the NAS in the future regional adaptation plans. A report for each region on the state of the art of climate change consideration in planning activities was released in October 2016.

6.4 Monitoring and evaluation framework

The National Adaptation Strategy does not include approaches to the monitoring and evaluation of adaptation. However, the ongoing process toward a National Adaptation Plan, started in 2016, is currently taking into consideration the need for a Monitoring, Reporting and Evaluation of adaptation, which will be then defined within the NAP framework.

Furthermore, in 2016 the National System for Environmental Protection set up a national Working Group on "Impacts, vulnerability and adaptation to climate change" with the main objective to define a set of climate change impact indicators which is currently lacking in Italy. This activity will be coherently carried out in synergy with the ongoing process toward the National Adaptation Plan and will provide useful indicators to be included in the national Monitoring, Reporting and Evaluation system in order to monitor the effectiveness of the adaptation measures in reducing the impacts of climate change.

6.5 Progress and outcomes of adaptation action

The IMELS, with the support of the Euro-Mediterranean Center on Climate Change (CMCC), is currently working on the implementation of the NAS through the development of the *National Adaptation Plan to Climate Change* (NAP).

The work for the elaboration of the NAP started in 2016. The main activities of the working plan comprises:

- a context analysis to describe current and future climate variability and an evaluation of impacts and vulnerability of the main sectors identified;
- the planning of adaptation actions (taking into account roles for the implementation, vertical coordination, human and financial resources);
- tools for institutional and stakeholders participation and for monitoring and evaluation of adaptation actions.

The NAP will provide institutional guidance to national and local authorities, for the integration of adaptation measures within policy processes and spatial planning. Finalization is tentatively planned for the first half of 2018.

7 FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY, INCLUDING INFORMATION UNDER ART. 10-11 OF KYOTO PROTOCOL[196]

7.1 Provision of New and additional resources

Italy is undertaking continuous efforts to scale-up its international climate finance and will continue to do so. Our public climate finance in the period 2015-2016 increased substantially compared to the levels of previous years (2013-2014), while improving the quality and transparency of our reporting.

Total public climate specific support that is currently being reported amount, for the biennium **2015-2016,** to **729,75** million US dollars. This represents more than a **70%** increase compared to the public climate specific support reported for the biennium 2013-2014, amounting to 428,76 million US dollars. The total public climate specific support for the period 2013-2016 amounts to 1.158,51 million US dollars.

In the provision of public financial resources, Italy aims to strike a fair balance between mitigation and adaptation over time. Direct support for adaptation in the period 2015-2016 increased more than five times compared to previous years. The adaptation component in 2015-2016 represents 53% of the total public climate finance addressing mitigation and adaptation, without considering crosscutting activities.

Since 2015, Italian Development Cooperation has undergone an important legislative reform. The new system is gradually being implemented, against the backdrop of our European and International goals and partnerships. The reform of the Italian Development Cooperation has led to a new institutional framework designed to make it more effective as well as cooperation policies more consistent. Under the new system, the Ministry of Foreign Affairs and International Cooperation is seen to give guidance in the definition of cooperation policies, while the Italian Development Cooperation Agency, established following the reform, is in charge of implementing policies. The law also confirms the role of financial institution in development cooperation given to the "Cassa Depositi e Prestiti Spa" (CDP), with new innovative Public Private Partnership mechanisms. In addition, a permanent inter-ministerial “table” for coordinating support in the field of climate change (priorities, actions, countries etc.) has been set up.

In this context, the Italian development cooperation aims at effectively mainstreaming environmental and climate considerations into its activities. Starting from 2015, the Italian Government allocated additional financial resources to the international development cooperation. On top of these resources, the commitment of Italy to tackle climate change and related support to developing countries is strongly expressed in Decree nr.30 (DLGS n.30 13/03/2013). In fact, this latter defines the criteria for the allocation of the proceeds from auctioning of greenhouse gas emission allowances. In particular, it is

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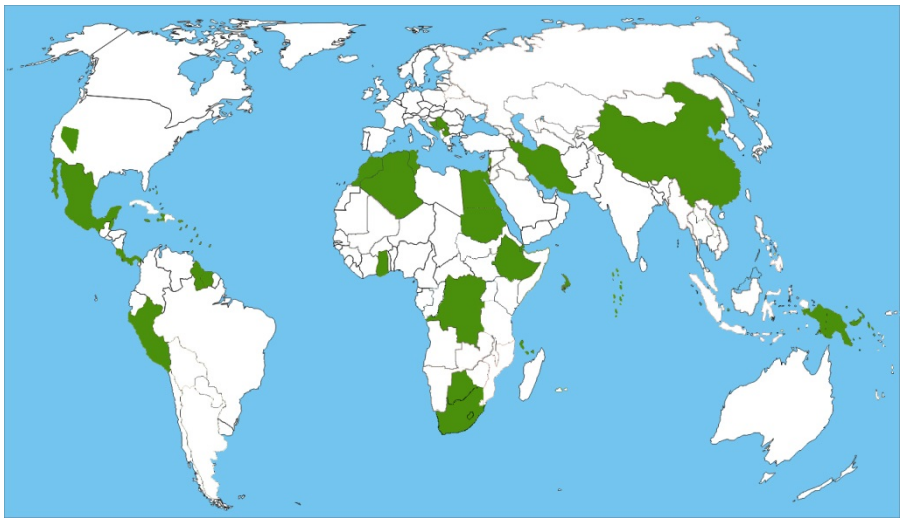
established that at least 50% of those proceeds should be used to reduce greenhouse gas emissions; to adapt to the impacts of climate change; to fund research and development for reducing emissions and promote adaptation; to develop renewable energies and increase energy efficiency; to contribute to the Global Energy Efficiency and Renewable Energy Fund and to the Adaptation Fund; to provide for measures to avoid deforestation and facilitate adaptation in developing countries. The proceeds from auctioning of greenhouse gas emission allowances has been allocated by the Italian Ministry for the Environment starting from 2015 and these resources represent additional public climate financial resources to developing country Parties.

An integrative approach to environment and development has been adopted in development actions run by the **Ministry of Foreign Affairs and International Cooperation (MFA)**, housing the traditional development cooperation originally focused on social and economic challenges. In this light, efforts have been aimed at environmental compliance, integration, and mainstreaming in all sorts of programmes and financing, resulting in adding a climate change component in more than 300 initiatives. The specific approach by MFA cooperation is therefore characterized by the integration of climate change in the 2030 Development Agenda.

Taking into account also recent evidence of migratory implications, Italian MFA approach to targeted concrete territories is growingly shaped – where appropriate – as integrated landscape management, i.e. aiming at maximizing co-benefits in the framework of coupled and resonant environmental and societal consolidation cycles. Target integration sectors are mainly: agriculture, food security, smart cities, biodiversity conservation, water, energy, off grid power, reforestation and biodiversity in general, land recovery and combating desertification, seas and fishing, disaster risk management, sustainable marketing supply chains, wetlands, waste. Geographical distribution reflects not only mitigation and adaptation, but also the need to address destabilization patterns in areas where environmental fragility overlaps socio-economic and/or governance weakness.

Since 2015, the bilateral cooperation activities promoted by IMELS have been enlarged to new areas of the world. The strategy underlying the priority countries is defined in agreement with the Ministry of Foreign Affairs and International Cooperation. In particular, the objective is to support the countries that are most vulnerable to the effects of climate change: the Small Island Developing States and the African countries. The **Italian Ministry for the Environment** signed 31 new bilateral agreements with developing countries including regional groups to support mitigation and adaptation actions, to facilitate access to climate finance, to provide capacity building and technology transfer. Priority actions have been focused on 8 areas: management of extreme events, promotion of renewable energy and energy efficiency, water resources management, waste management, air quality, address forest degradation, land rehabilitation and soil improvement, sustainable mobility. In this framework, the Ministry for the Environment works closely with the Ministry of Foreign Affairs and International Cooperation, the Italian Agency for Cooperation and Cassa Depositi and Prestiti.

IMELS Bilateral cooperation



In order to ensure the efficient and effective implementation of the activities foreseen by the bilateral cooperation and to address the needs of developing countries and enhance country ownership, each Memorandum of Understanding establishes a Joint Committee (JC). The JC, that is composed by representatives of both Governments involved, provides general direction to the established collaboration, approves work programs and budget, supervises and supports the cooperation activities by taking stock and assessing the implementation and progress of approved projects and takes financial decisions over such activities. To complement this approach and ensure that activities implemented are in line with the expected results, periodical site visits of national experts to monitor and assess activities on the ground are carried out.

All projects and programs financed in this context are proposed by developing countries and reflect priorities and objectives included in the Nationally Determined Contributions (NDCs) and other relevant climate change and development strategies.

The **methodological approach** for tracking and reporting on the provision of financial, technological and capacity-building support to non-Annex I Parties considers:

- a combination of all the Rio Markers and the Aid to Environment marker for bilateral and multi-bilateral figures, and imputes a climate relevant share to multilateral contributions;
- committed funds for bilateral flows and disbursed funds for multilateral flows, so that they do not overlap with past year's figures, avoiding double counting across the years;
- climate specific and core/general amounts as mutually exclusive: the figure reported as core/general is the result of the whole contribution to the multilateral institutions minus the climate specific share, computed according to the imputed multilateral shares provided by the DFIs themselves (or through the OECD calculations or the share of activities reported by DFIs);
- most part of the Italian public development cooperation is in form of public grants through official agencies. Thus, almost all contributions are classified as Official Development Assistance;
- The sector assigned in the DAC CRS table is reported in the relevant column. As requested, the notation “Not applicable” is reported in case of purely multilateral contributions.

The methodology has been developed and agreed among the Ministry for the Environment, Land and Sea and the Ministry of Foreign Affairs and Development Cooperation - which coordinates development cooperation activities at all levels, from the central public administration to local government and universities.

Public financial support provided through **multilateral channels** includes both purely multilateral and multi-bilateral flows. The first includes grants provided to multilateral development banks, contributions towards climate related conventions and funds, contributions to UN specialized agencies. The second includes finance that flows through multilateral organizations but earmarked towards specific country or multi-country projects.

For multi-bilateral flows, the adaptation/mitigation/crosscutting categories are imputed according to either the Rio Markers, or the sector indicated in the DAC CRS database. For purely multilateral flows, the nature and the purpose of the fund is considered, even though they mostly fall into the crosscutting category. For those multilateral flows whose figures fall into the core/general column only, and the project description do not report a clear mitigation or adaptation purpose, or the nature of the fund is not clearly relevant for both (crosscutting), the category is left blank.
Finally, contributions are reported as either disbursed or committed only if they are reflected in official documents that proof the commitment or the financial transaction (decreto di impegno e/o di pagamento).

Bilateral flows include contributions to development cooperation programmes from all the central public administrations (Ministries) and the Italian Development Cooperation Agency (AICS), the Italian Development Bank (Artigiancassa / Cassa Depositi e Prestiti), Local administrations (regions and municipalities), considering all kind of implementing agencies (f.i. Universities, NGOs and religious organizations).

For bilateral contributions, Rio Markers assess the climate specific share of the projects. In particular, where the "significant" marker is reported, 40% of the total value of the project is reported as climate specific; 100% when the "principal" marker is reported. Priority is given to climate markers for mitigation and adaptation, but a combination of all the Rio Markers and Aid to Environment marker is considered. In particular, where the project description and the sector are relevant, either 100% or 40% of the value of the project is reported. This qualitative consideration has been jointly led by the two Ministries, also referring to the OECD DAC Rio Markers for Climate Handbook.

Italy is not yet reporting at this stage **private finance mobilized** through public interventions. We are implementing measures to increase the mobilization of private resources. Leveraging private finance is a component of all our bilateral agreements and activities. Italy is in the process of undertaking a pilot study for tracking mobilized private finance through public interventions, with the view of progressively integrate these figures in the reporting and refine our capacity to gather data and apply more complex methodologies. The study will be conducted in the context of the OECD Research Collaborative on Tracking Private Climate Finance and its work. The Research Collaborative is an open network composed

by governments, research institutions and international finance institutions and coordinated and hosted by the OECD. The goal is to share best available data, expertise and information to advance policy-relevant research in a comprehensive and timely manner. The project is designed to serve as a coordinating platform for identifying research priorities and gaps, sharing information, weaving a coherent narrative across what would otherwise be disparate research outputs, as well as communicating results to raise awareness in this area.

To sum up, Italy's public financial resources to assist developing countries to develop and implement actions in the field of climate change in the period 2013 - 2016 came from:

- the Italian Ministry for the Environment, Land and Sea funds according to law June 1, 2002, n°120;
- the Italian Foreign Affairs Ministry funds for development cooperation;
- the Italian Ministry of Economy of Finance funds provided to multilateral institutions for environmental activities targeted for climate change;
- the proceeds from auctioning of greenhouse gas emission allowances allocated starting from 2015. According to DIRECTIVE 2003/87/EC, the revenues generated from the auctioning of allowances should be used to tackle climate change in the EU and third countries;
- the financial contribution to the Green Climate Fund (GCF).

Provided that there is no common understanding on what is to be considered **"new and additional"**, only newly and additional committed or disbursed climate finance during the **period 2013 - 2016** originating from these above channels are considered as such, in particular: budget increase for development cooperation dedicated to climate change, revenues from auctioning of greenhouse gas emission allowances, financial contribution to the Green Climate Fund.

7.2 Assistance to developing country Parties that are particularly vulnerable to climate change

Multilateral Cooperation on climate change

Between 2013 and 2016, the Italian multilateral environmental activities were carried out in several organizations or programmes, such as: the World Bank (WB), the Green Climate Fund (GCF), the Global Environment Facility (GEF), the Least Developed Countries Fund (LDCF), the Adaptation Fund (AF), the Food and Agriculture Organisation (FAO), the Capacity Building Initiative for Transparency (CBIT) and the African Development Bank (ADB).

A substantial share of climate finance requirements are expected to be met by International Financial Institutions (IFIs) and other multilateral initiatives. At COP21 in Paris, multilateral development banks (African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, European Investment Bank, Inter-American Development Bank and World Bank Group), committed to substantially increase support for climate change mitigation and adaptation through providing policy, advisory, financial, and technical support to countries where a transition towards a lower carbon, more climate resilient future is taking place.

These six multilateral development banks (MDBs) have set specific and differentiated targets for increasing climate finance and for leveraging finance from other sources. These pledges contribute to the US$100 billion a year commitment by 2020 for climate action in developing countries.

In this respect, the Ministry of Economy and Finance (MEF) of Italy is the shareholder of the MDBs of which Italy is a member. In this capacity, the MEF oversees progress towards these targets in the governing bodies of the institutions.

Furthermore, the Italian Ministry for the Environment, Land and Sea (IMELS) has been participating in various trust funds at the **World Bank** with the aim of promoting sustainable development in developing countries, increasing renewable energy and improving awareness, globally, on environmental issues and the fight against climate change.

In the years 2013 to 2016, as energy access continues to be a priority for our government, IMELS continued its longstanding support to Global Lighting and Energy Access partnership (Global LEAP), the voluntary forum bringing together Governments, Development Partners and private entities in order to share knowledge and best practices and support the development of systems of access to energy, with particular attention to the quality and prices of off-grid lighting systems.

With regard to the 2013-2014 workplan, IMELS decided to finance activities in Nigeria, Ethiopia, Tanzania, Senegal, Democratic Republic of Congo, Bangladesh, Pakistan, Afghanistan, as well as to support the launch of a pilot in Papua New Guinea. Resources were also devoted to the development of end-of life product disposal systems and to extend the network of product verification laboratories and their certification.

Building on the success that has been able to achieve through the Global Lighting and Energy Access Partnership (Global LEAP), which has resulted in over 100 million people having benefitted from modern energy services through affordable solar systems providing basic lighting and phone charging services, and a new solar off-grid energy industry launched, in 2015 IMELS provided additional financial resources with the aim of promoting opportunities for expanded energy services delivery. As a result, region-wide market development has been promoted with a view to expand the sector's development, piloting new market opportunities for emerging solar-based energy technologies and acknowledging the importance to enlarge country-specific market development programs, especially in Africa.

The Ministry for the Environment also continued its support to the Communication for Climate Change Multi-Donor Trust Fund (MDTF), with the aim of promoting communication and awareness-raising activities in favor of sustainable development.

Thanks to this support, the **Connect4Climate network** was launched in 2013 and a global platform was created to promote climate change awareness raising activities involving more than 200 partners worldwide (civil society groups, international organizations, Enterprises, media, universities, etc.).

The **Green Climate Fund (GCF)** is a new global fund created to support the efforts of developing countries to respond to the challenge of climate change. It seeks to promote a paradigm shift to low-emission and climate-resilient development, taking into account the needs of nations that are particularly vulnerable to climate change impacts. By the end of 2017 the Fund's portfolio consisted of 54 projects and programmes amounting to USD 2.65 billion in GCF funding. The GCF approvals demonstrate how the Fund aims to balance projects approvals between mitigation and adaptation as well as between different regions at the same time taking into account the most vulnerable developing countries, including LDCs,

SIDS and African States. The GCF is dedicating significant resources to support country partners in developing high quality country-owned programmes. In particular, the GCF Readiness Programme aims to support five outcomes connected to the Programme objectives: strengthening country capacity, engaging stakeholders in consultative processes, realizing direct access, providing access to finance, and mobilizing the private sector. In addition, the GCF's Project Preparation Facility will support accredited entities, especially direct access entities, to develop high quality GCF funding proposals. The PPF will provide support to help cover the costs of early design work, including feasibility studies and risk assessments.

Italy is a strong supporter of the Green Climate Fund (GCF), as the key multilateral vehicle for helping developing countries adapt to climate change and follow low-carbon development paths. In 2014, at the GCF donor conference, Italy pledged to contribute to the first capitalization of the Fund with 250 million euro. The Italian Ministry for the Environment provided 150 million euro for the period 2015-2017. IMELS, in the context of its bilateral programmes, is supporting developing countries partners in accessing the resources of the Green Climate Fund and developing projects through existing accredited entities.

The Ministry of Economy and Finance (MEF) of Italy is the member of, and the financial contributor to, the **Global Environment Facility (GEF)**. The GEF was established in 1991 and provides funding to developing countries and countries with economies in transition. The funding comes in the form of grants and concessional funding and covers the incremental or additional costs associated with transforming a project with national benefits into one with global environmental benefits (GEBs).

The GEF administers four trust funds : the GEF Trust Fund, the Least Developed Countries Fund (LDCF), the Special Climate Change Fund (SCCF) and the Nagoya Protocol Implementation Fund.

Financial contributions to GEF are replenished every four years by donor countries (GEF Replenishment). Italy, via the Ministry of Economy and Finance (MEF) is a donor of the GEF Trust Fund since its establishment.

MEF contributed to the Fifth and Sixth Replenishment with the same amount of 92 million euros, representing a share of around 3.3% of total pledges . GEF-5 covers the period July 2010 – June 2014, GEF-6 covers the period July 2014 – June 2018. Negotiations for the Seventh Replenishment are underway and will be completed by June 2018.

In 2015, IMELS has also strengthened its support to the **Least Developed Countries Fund** (LDCF), managed by the GEF, to help the world's most vulnerable countries in their efforts to adapt to the effects of climate change. The Fund aims at supporting countries in preparing and implementing their National Adaptation Programs of Action. Projects financed by the LDCF are addressed to several sectors including water, agriculture, disaster risk management and prevention and health. LDCF projects support practical community level adaptation actions to improve resilience.

Since 2015, Italy is a contributor to the **Adaptation Fund (AF)** through IMELS. The AF provides finance to projects that help vulnerable communities in developing countries to adapt and build resilience to the

effects of climate change while providing an innovative direct access modality that allows accredited national institutions in developing countries to access financing and manage projects directly. Since 2015, Italy provided 7 million euro to the AF and announced, during COP23 (2017), additional 7 million euro. These contributions helped the Fund to assist vulnerable communities' efforts in developing countries to adapt to climate change and surpassing its fundraising target of USD 80 million per year both in 2016 and 2017. Furthermore, IMELS is working in synergy with the Adaptation Fund Secretariat and National Implementing Agencies in order to scale up AF's projects through its bilateral cooperation programmes and activities.

Italy joined the **Climate & Clean Air Coalition (CCAC)** in 2012 with the intention to support actions and initiatives to reduce Short-Lived Climate Pollutants and to contribute to combat climate change, improve air quality and protect human health in the short-medium term.

Areas of interest of Italy in the framework of the CCAC are international actions on production and consumption of HFC under the Montreal Protocol and UNFCCC, biogas recovery and production from agriculture, gas capture in landfill, reduction of black carbon emissions from the transport sector.

In December 2015 and December 2016, the Italian Ministry for the Environment contributed to the CCAC Trust Fund to provide support the CCAC Initiatives and the Secretariat, indicating as main areas of interest and specific Initiatives: HFC, Urban Health, addressing SLCPs from agriculture, Oil and Gas.

As member of the CCAC, the Italian Ministry for the Environment supported the work of the CCAC participating to Working Groups and to the definition and adoption of the political Communiques at the CCAC High Level Assembly meetings.

The Project IACSA (International Alliance on Climate-Smart Agriculture) was started in March 2014 by the Italian Ministry for the Environment and the **FAO** with the general objective to support the establishment and functioning of the Global Alliance on Climate Smart Agriculture (GACSA).

The GACSA was launched on September 23rd 2014 at the UN Climate Summit in New York. It is a voluntary and inclusive platform facilitating dialogue, knowledge exchange and learning, partnerships across and within diverse interest groups, including Governments, International Organizations, NGOs, farmers associations, practitioners and other stakeholders to accelerate up-take and practicing of the Climate Smart Agriculture (CSA). The Climate Smart Agriculture is an approach developed by FAO to developing the technical, policy and investment conditions to achieve sustainable agricultural development for food security under climate change. CSA integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenge in 3 main pillars: a) sustainably increasing agricultural productivity, incomes and livelihoods; b) adapting and building resilience to climate change; c) reducing and/or removing greenhouse gas emissions, where possible.

GACSA brings together more than 160 members, including 23 Governments. The Alliance is aimed to generate knowledge and mobilize technical support and financing to allow countries to adopt and implement CSA.

The IACSA Project contributes to the GACSA by supporting the governance of the GACSA and the relevant Action Groups in providing policy support, fostering investment, mobilizing funds and developing

knowledge, tools and methodologies to support the identification of the appropriate farming systems, practices, technologies that address food security and climate change, at the national and local level.

Project milestones also included the preparation of Prefeasibility Studies on CSA in 3 developing countries (Ethiopia, Ecuador, Botswana) and the contribution to strengthen the focus on agriculture sectors in COP22 (Morocco).

Since November 2015, Italy is party and donor of the **Initiative Climate Action Transparency (ICAT)**. This voluntary partnership, supported by four donors and four implementing partners, aims at enhancing the ability of recipient countries for accountability and transparency in the implementation of their commitments to mitigation and adaptation set at national level and for reporting of financial resources utilization made available for this purpose.

The Initiative is designed as a fast start to complement the work under the UNFCCC-Paris Agreement, single framework for greater transparency which requires countries to report on their progress in implementing the commitments and achieving their mitigation plans, the adaptation and mobilization efforts or use of financial resources and other means of implementation to mitigate and adapt. So its added value lies in doing front running work before and during the first years of activities by the CBIT, since it is designed by donors as a vehicle to bring in a short time a substantial contribution to enhancing the transparency of beneficiaries' countries efforts while keeping a close look at developments on transparency and accountability under the Paris Agreement.

IMELS has contributed 5 million Euro to the ICAT trust fund to assist 10-15 beneficiary countries selected on the basis of balanced geographical distribution and willingness and readiness to participate. ISPRA, the technical branch of the Italian Ministry for the Environment, is involved as ICAT implementing partner both in the definition of the methodological toolbox and in the in-country capacity building activities.

In the same spirit, Italy is actively engaged in supporting the **Capacity Building Initiative for Transparency (CBIT),** established by the Paris Agreement, and is one of the donor countries which contributed to the founding and launch of a voluntary GEF trust fund in order to operationalize CBIT and allow the first set of projects to be selected and funded before GEF – 7 replenishment .

The Italian Ministry for the Environment, Land and Sea is also committed to ensure synergies between CBIT and the Initiative for Climate Action on Transparency (ICAT) and welcomed with appreciation the global coordination platform which will be established by UNEP, UNDP, UNEP DTU Partnership as implementing agencies, to enhance the interactions among existing similar Initiatives to leverage each other resources and impact and avoid duplication.

An enhanced transparency system for action and support with common modalities and procedures for all parties is crucial to achieve the long-term goals of the Paris agreement .In this respect, CBIT, which Italy sustained with a voluntary contribution of 4 Million Euro, is a key outcome stemming from the Paris Agreement and will be fundamental to improve transparency and building capacity overtime by strengthening national institutions in line with national priorities.

CBIT aims to assist developing countries in meeting the enhanced requirements for transparency of action and support under the Paris Agreement and it supports national institutions to plan, coordinate, implement and monitor policies, strategies and programs to enhance transparency and report on progress made in implementing Nationally Determined Contributions (NDCs). Moreover, CBIT provides access to tools and applications to facilitate the use of improved methodologies and guidelines, as well as

country-specific training. In addition, it facilitates activities such as peer exchange programs to help share experiences and expertise between countries.

The Global Bioenergy Partnership(GBEP) was established to implement the commitments taken by the G8 Gleneagles Plan of Action in 2005. Following a consultation process among developing and developed countries, international agencies and the private sector, the Global Bioenergy Partnership (GBEP)[197] was launched at the 14th session of the Commission on Sustainable Development (CSD-14) in New York on 11 May 2006, and in response to the 2005 G8 mandate (renewed in 2007, 2008 and 2009), GBEP initiated an international discussion on the issues related to bioenergy. From 2006 to 2012, GBEP received a renewed mandate by the G8, then, in 2013, a recognition and support by the G20. The Partnership is a forum where voluntary cooperation works towards consensus in the areas of the sustainability of bioenergy and its contribution to climate change mitigation. It brings together public, private and civil society stakeholders and focuses its activities in three strategic areas: Sustainable Development, Climate Change, Food and Energy Security.

Italy supports the functioning and activities of the GBEP since 2006 through a Memorandum of Understanding with the FAO which was extended until the end of 2019. Furthermore, Italy was entrusted by the GBEP Steering Committee at its 19th meeting in 2016 to continue its co-chairing function of the GBEP together with Brazil. The GBEP Secretariat, hosted at FAO Headquarters in Rome with the support of Italy, is the principal coordinator of the Partnership communications and activities. Since 2014, several activities have been developed by the GBEP partnership also through its specific Working Groups and Task Forces.

For instance, the Working Group on Capacity Building for Sustainable Bioenergy organized several workshop and activities aimed at raising awareness and data on the implementation of the 24 voluntary sustainability indicators for bioenergy developed by the GBEP since 2011, which represent a unique tool to inform the development of national bioenergy policies and programmes, monitor the impact of these policies and programmes, as well as interpret and respond to the environmental, social and economic impacts of their bioenergy production and use. Until now, GBEP sustainability indicators for bioenergy have been tested in 10 Countries, including Vietnam, Paraguay, Germany, Italy, Ukraine, India and

[197] GBEP and its Partners comprise 23 countries and 14 international organizations and institutions: Argentina, Brazil, Canada, China, Colombia, Fiji Islands, France, Germany, Ghana, Italy, Japan, Mauritania, Mexico, Netherlands, Paraguay, Russian Federation, Spain, Sudan, Sweden, Switzerland, Tanzania, United Kingdom, United States of America, Economic Community of West African States (ECOWAS), European Commission, Food and Agriculture Organization of the United Nations (FAO), Inter-American Development Bank (IDB), International Energy Agency (IEA), International Renewable Energy Agency (IRENA), United Nations Conference on Trade and Development (UNCTAD), United Nations Department of Economic and Social Affairs (UN/DESA), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), United Nations Industrial Development Organization (UNIDO), United Nations Foundation, World Council for Renewable Energy (WCRE) and European Biomass Industry Association (EUBIA). A further 28 countries and 12 International Organizations and institutions are participating as Observers: Angola, Australia, Austria, Cambodia, Chile, Denmark, Egypt, El Salvador, Ethiopia, Gambia, India, Indonesia, Kenya, Jamaica, Lao PDR, Madagascar, Malaysia, Morocco, Mozambique, Norway, Philippines, Peru, Rwanda, South Africa, Thailand, Tunisia, Viet Nam, Zimbabwe, African Development Bank (AfDB), Asian Development Bank (ADB), Economic Commission for Latin America and the Caribbean (ECLAC), European Environment Agency (EEA), Global Environment Facility (GEF), International Civil Aviation Organization (ICAO), International Fund for Agricultural Development (IFAD), Organization of American States (OAS), Union Economique et Monétaire Ouest Africaine (UEMOA), World Agroforestry Centre (ICRAF), World Bank and the World Business Council on Sustainable Development (WBCSD).

Nepal. Furthermore, with a view to promote mutual cooperation and continue dialogue between public and private sectors' stakeholders, "Bioenergy Weeks" were organized yearly in specific regions worldwide to focus on the respective priorities and challenges:

- 2nd Bioenergy Week, Maputo, Mozambique, May 2014;
- 3rd Bioenergy Week, Medan City, Indonesia, May 2015;
- 4th Bioenergy Week, Budapest, Hungary, June 2016.

Furthermore, sustainable modern wood energy development was discussed in the framework of Working Group on Capacity Building for Sustainable Bioenergy, to discuss sustainable production and use of wood energy for household and productive local uses, mainly in developing countries. This was realized through the development of an ad hoc report and the realization of specific workshop in Benin to share best practices in the field of wood energy management in Africa.

Capacity building activities were also undertaken on bioenergy mapping, discussing its role to collect relevant indicators for the measurement of the GBEP indicators and contributed to populate the IRENA Global Bioenergy Atlas.

Finally, further work was done within the GBEP since 2014 to integrate bioenergy systems into agriculture and forestry systems to improve sustainable management of water resources, and further discussions are ongoing on the potential establishment of two new activity groups, respectively on biogas and advanced biofuels.

In November 2016, IMELS signed a new agreement with **UNIDO-ITPO Italy** to finance a project to support the Iranian Government in upgrading and strengthening the competitiveness of the industrial SMEs in Iran by identifying and promoting sustainable investment and technology transfer opportunities in selected environment and renewable energy sectors with the aim of supporting sustainable development, local job creation and fostering international partnership.

To pursue this goal, it is foreseen the establishment and operability of a focal point in Iran that assists in field UNIDO-ITPO Italy in scouting an "ad hoc" portfolio of sustainable investments opportunities in the country and open up new international partnerships, working also in close cooperation with other local institutions in supporting private sector.

Regional cooperation

African Development Bank (AFDB)

The outcomes of the 21nd Conference of the Parties to the United Nations Climate Change Convention (COP21) exemplify the increasing global awareness on climate change and the need to accelerate the transition to clean energy.

Following the signature of the Paris Agreement, the Government of Italy is working to fight climate change by supporting the **Sustainable Energy Fund for Africa (SEFA)** and the **African Climate Change Fund (ACCF)**, hosted and managed by the African Development Bank.

In late December 2015, the Italian Ministry of Environment, Land and Sea joined the SEFA with a total contribution of 7.4 million Euro to support small and medium-scale private sector projects in the renewable energy and energy efficiency sectors in Africa. The Fund helps projects develop bankable

investment opportunities and thus enables sponsors to attract equity and debt financing for successful implementation through the Africa Renewable Energy Fund (AREF). The Fund also provides enabling environment grants to improve the regulatory and policy framework for investments in sustainable energy.

During COP21 in Paris, the Italian Ministry for the Environment, Land and Sea made a commitment of 4.7 million Euro to support the Africa Climate Change Fund (ACCF). The Italian commitment has triggered the conversion of the ACCF to a multi-donor trust fund.

The Fund provides small grants to support the African countries in their transition to climate resilient and low carbon development, and to enable the Bank to scale up its climate change activities.

On 30th November 2015, IMELS signed with the **International Finance Corporation (IFC)** an agreement in order to support the implementation of the "Middle East and North Africa-MENA Inclusive Green Growth Program". IMELS provided 7 Million USD to the trust fund to support activities in Egypt, Lebanon, Morocco, Tunisia and Palestine. Main objectives of the trust fund are: i. support governments in reforming energy efficiency and renewable energy regulatory frameworks, ii. Promote energy efficiency best practices and private sector participation in the design and implementation of resource efficiency infrastructure projects, iii. Assist financial institutions to extend access to finance SME's for sustainable energy investments, IV. Help industry groups individual firms to mitigate their resource constrains.

In Central Eastern Europe, multilateral activities continued to be implemented also through the cooperation with the **Regional Environmental Center for Central and Eastern Europe (REC)**, located in Budapest, Hungary. From 2001 to 2014 the Italian Trust Fund (ITF), was established to finance and co-finance cooperation projects.

The funded projects have raised awareness of far-reaching challenges related to the environment, climate change and health, and have provided fundamental help in identifying solutions. Cooperation with the REC has also promoted strong networks among the beneficiary countries for regional and global solutions and has opened up new opportunities and channels for the involvement of Italian and other key stakeholders.

With particular reference to climate change and energy issues, several programs were carried out on training and capacity building, energy efficiency innovation, trans-boundary cooperation, promotion and awareness-raising regarding climate change mitigation and adaptation policies, promotion of low-carbon solutions.

From 2013 to 2016 the following specific projects have been developed within this framework:

• Sustainable Development Academy (SDA) (2010 – 2015) - The "Courses for Sustainability" run by the Sustainable Development Academy of the REC (SDA) are the fruit of a hugely successful Italian initiative spearheaded by the Italian Ministry for the Environment, Land and Sea. The changes in the program reflects the adaptation to the needs of different constituents and to the shifts in priorities of environmental policy. Under SDA, the following initiatives were developed:

- *Course for Sustainability 2014* has been designed to respond to the ongoing challenge of integrating sustainable development into policy making, planning and implementation in Albania, Bosnia and Herzegovina, Kosovo, the former Yugoslav Republic of Macedonia, Montenegro and Serbia by providing a theoretical framework for specific aspects of sustainable development and

water management. The Course was focused on information/dissemination activities of two projects co-financed by IMELS: CRESSIDA Project and *CEO Platform*.

The CRESSIDA Project (*Building Local Community RESilience for Sustainable Development in International Watersheds such as the Drini DrinA River Watershed*) is focused to assist Countries on water management at local level. Examples of best practices and successfully implemented policies at European and country level have been shared, equipping participants with appropriate tools to tackle national and local challenges.

CEO Platform for Green Growth in MENA Region is an initiative to facilitate the creation business leadership forum that brings together business leaders and champions of green growth to engage with regional and global policy makers to support the introduction of policies to promote green, sustainable growth in the region, while facilitating processes and stimulating the environment that business operate in and creating future markets in the region to turn risks into new business opportunities.

- *"Local resources and energy management in Ukraine"* (2015): initiative focused on capacity building of local communities in Ukraine to improve environmental planning, enhance environmental investments and combat climate change.

• Europe-China Clean Energy Center (EC2) project (2010 – 2015) - The Europe-China Clean Energy Centre is a cooperation project initiated in 2010 by the European Commission, the National Energy Administration of China and the Ministry of Commerce of China, with the support of IMELS, which is supporting the Chinese Government's efforts to shape a more sustainable, environment-friendly and efficient energy sector while tackling climate change challenges.

• SEARCH III project (School Environment and Respiratory Health of Children) (2014-2016)

The overall goal of "SEARCH III" is to increase visibility of results and recommendations of the first and the second phases of the SEARCH project and to produce a toolkit for environmental education. The overall objective of the SEARCH project is the indoor air quality and children respiratory health at school. On the basis of the results of SEARCH I and II, a dedicated user-friendly product was developed, ("AirPack"), an innovative educational online toolkit on indoor air quality in schools , climate change and energy efficiency designed for teachers and students.

• Strategic Activities of IMELS at UNFCCC COP 22 (2016)

At COP 22 a side event on "Air Pack: A Tool for Environmental Education", was organized by the IMELS in partnership with the REC and the Italian National Institute for Environmental Protection and Research (ISPRA). The side event was focused on 2 main issues: a) present the Air Pack as a best practice to raise awareness among decision-makers, policy-makers, agencies and other stakeholders, as well as students, on the impact of climate change on the vulnerability of children's health, especially the enhancement of climate related risks to hazards in outdoor and indoor air; b) create a launching pad for international activities (regional/sub-regional workshop) on environmental education on climate change for a specific region of interest, based on the commitments of the UNFCCC and Paris Agreement and the mandate of the REC as regional focal point for Article 6 of the UNFCCC and art. 12 of the Paris Agreement.

• Project "Building bridges between regions - Interregional cooperation on the implementation of Principle 10 of Rio Declaration and Article 6 of UN Framework Convention on Climate Change in the Caribbean Region" (2016-ongoing)

The project aims at supporting the regional efforts to implement Principle 10 of the Rio Declaration in the Latin America and Caribbean. It also aims at facilitating the inter-regional cooperation between UN ECE and UN ECLAC regions and more specifically the Caribbean sub-region on Principle 10, the transfer of lessons learned, sharing practical experience and approaches in ensuring access to information, public participation in decision-making and access to justice in environmental matters.

The project focuses on the 7 countries from the Caribbean region, signatories of the Declaration on Principle 10: Antigua and Barbuda, Jamaica, Dominican Republic, Saint Vincent and the Grenadines, Trinidad and Tobago and Grenada. It will aim at further promotion of the P10 regional instrument and will strive to involve other countries in the process. This Countries face unique challenges due to their environmental fragility and vulnerability to the effects of climate change and natural disasters. Access rights are instrumental for inclusive sustainable development and should set the baseline approach in addressing the complex challenges of our times. The main activities are related to national consultation and promotional activities and contribution to the preparation of the Negotiating Committee Meetings (NCM) on Principle 10.

Bilateral cooperation with developing countries

Inspired by the objectives of the Paris Agreement and its long-term goals as well as the Sustainable Development Goals, Italy is strongly engaged to continue the activities mentioned in the Sixth National Communication. Taking into account the initiatives undertaken in the previous years and the new commitments under the UNFCCC, the bilateral cooperation stretches across all continents and regions: Africa, Mediterranean region, Small Islands Developing States, Asia, Central and Eastern European and Central and Latin America. Since 2015, particular focus has been given to the countries that are most vulnerable to the effects of climate change: the Small Islands Developing States and the African countries.

The following sub-paragraphs provide the description of the most relevant initiatives.

Cooperation on climate change in the Asian region

IMELS started the Sino-Italian Cooperation Program for Environmental Protection (SICP) with the **People's Republic of China**, more than sixteen years ago. In this way, it was possible to develop over 200 project lines, for the environmental monitoring and management, mostly contributing at strengthening Chinese national and local institutions, protecting and conserving natural resources, water management, waste-to-energy, developing renewable energy sources, energy efficiency, sustainable urban planning and eco-building, environmental protection in the poorest regions, developing low-emission transport systems and technologies, sustainable agriculture, biodiversity protection and forest management. About 66 projects were strictly related to climate change activities and objectives of the Paris Agreement and the United Nations Convention on Climate Change, while the rest were useful to create an enabling environment for mitigation and adaptation measures.

Project formulation has been entrusted to a permanent Sino-Italian task force made up of experts from IMELS, Chinese Ministries and Agencies, Scientific Institutions, Italian and Chinese Universities. This task force constitutes the Program Management Offices (PMO) based in Beijing and Shanghai. In the timeframe between 2013 and 2016, the following projects were undertaken in the field of climate

change:

- Actions to Improve the Energy Efficiency Performance of the Yunchou Building: in the framework of an agreement among IMELS, Ministry of Science and Technology (MOST) and Tongji University, the project consisted in a series of actions to improve the Energy Efficiency Performance of the Yunchou Building in Tongji University, that will host the Sino-Italian campus for environmental sustainability (SICES) and is an example of eco-efficient building.
- Under the agreement on Beijing Clean Air Action Cooperation between IMELS and the People's Government of Beijing Municipality, signed in 2013, three projects were developed between 2014 and 2015, allocated on Sino-Italian Environmental Cooperation for Sustainable Beijing (SIEC-SUB) fund:
    - Vehicle emission control policy, including low emission zone study and planning, aimed at developing a policy study for vehicle emissions control, and planning an air emission inventory for Beijing.
    - Capacity Building for Management and Control of Air Pollution Sources: the objective of this project was to continue strengthening the capabilities of Beijing Environmental Protection Bureau (EPB) in the management and control of air pollution sources by sharing experience in emissions assessment and authorization procedures, pilot research activities on emission sources, calculation of emissions and pilot case assessment; regulatory and authorization procedures for polluting industries on the basis of European experience.
    - Beijing's clean air action plan international communication program.

In 2010, in cooperation with the National Development and Reform Commission (NDRC), IMELS launched the Sino-Italian Climate Change Cooperation Program (SICP), a specific cooperation program aiming at implementing joint initiatives in the field of mitigation and adaptation to climate change, transfer and promotion of low-carbon technologies, studies and researches as scientific support to decision-making. In 2014, under the Framework Agreement on Climate Change Cooperation between NDRC and IMELS, the project "Contribution to the development of China's Low Carbon Product Certification System" was developed. This is a pilot project in cooperation with the climate change department of the Chinese National Commission for the development of reforms (NDRC), where the Italian knowledge and experience about carbon footprint is shared with the aim to: study a carbon evaluation methodology of a specific product and develop technical standards for low carbon products, assist a pilot province for the definition of provincial technical standards for low carbon products, select a local businesses to be subjected to low carbon certification procedures to evaluate and improve the certification process.

Since 2003, IMELS has been promoting an Advanced Training Program on the various issues of environmental management and sustainable development, targeted at technicians, academics, young professionals and decision-makers in Chinese administrations, universities and enterprises; an important aim of the training program was the capacity building about potential climate change mitigation and adaption actions. Since 2003 more than 150 Italian companies were visited during about 600 study visits. Over 350 public and private institutions were involved, with a total of about 1000 speakers.

Between 2013 and 2016, over 2,000 participants from all the provinces of China took part in the training program, with a total of 45 courses (in Italy and China).

In the table below are summarized the recipient institutions of the trainings, the contents, the number of trainees and the amount of resources allocated on each training.

Recipient Institution	Content of the training	Number of trainees	Cost of the training	Period
Department of Climate Change of the National Development and Reform Commission of P.R.C. (NDRC)	Climate change and sustainable development (including capacity building, Policy, Conventions and Statistical Systems)	106 members of central and provincial DRC and other organizations selected by NDRC	241 k€	2013, 2015
Institute of Industrial Economics and the Chinese Academy of Social Science (CASS)	Eco-management strategies and policies (including a module on Clean Energy and Climate Change)	492 officials, experts and senior business leaders	950 k€	2013-2015
Beijing and Shanghai Municipal Environmental Protection Bureau	Environmental management and sustainable development (including low-carbon technologies, policies and mobility)	324 high level staff or technicians responsible for environmental management	243 k€	2013-2014
Ministry of Science and Technology (MOST)	Environmental management and sustainable development (focus on industrial energy efficiency)	159 officials from central and local governments, experts from R&D institutions, managers from organizations and enterprises.	138 k€	2013-2014

IMELS started its bilateral cooperation with the **Islamic Republic of Iran** in November 2015, signing with the Iranian Department of the Environment (DoE) the Memorandum of Understanding on “Cooperation for Environmental Protection and Sustainable Development” including a specific Annex aimed to “Cooperation in the area of energy and climate change and implementation of nationally appropriate mitigation actions”.

In 2016 the Joint Committee established under the abovementioned MoU adopted a Financial Agreement that established a total allocation of 3 million euros for implementation of the MoU and co-financing of joint projects.

In November 2016 a two-days technical workshop on “Environmental governance and climate change” was organized in Tehran and attended by several Italian and Iranian companies and officials from Iranian Institutions. Following this activity, a number of project proposals were submitted to the DoE in order to receive – through approval by JC – financing under the MoU.

South Pacific Small Islands Developing States

The Partnership with the Small Island Developing States has been launched ten years ago to implement a cooperation programme for addressing the key global challenges related to mitigation and adaptation to climate change, protection from vulnerability to extreme climate variability and mitigation of harmful emissions generated by energy utilization.

The Memorandum of Understanding between the Italian Ministry for the Environment, Land and Sea (IMELS) and the Governments of the Pacific Small Island Developing States participating to the project "Co-operation on climate change and on the clean development mechanism under article 12 of the Kyoto protocol", was signed in New York on 11 May 2007 and subsequently signed by all Parties and currently includes among donors: the Italian Ministry for the Environment, Land and Sea (IMELS), the Ministry of

Foreign Affairs and International Cooperation of the Italian Republic, the Grand Duchy of Luxembourg, the Ministry of Foreign Affairs and Cooperation of Spain, the Federal Ministry for Europe, Integration and International Affairs of the Republic of Austria.

Pacific Small Island Developing States participating to the programme are: the Republic of the Fiji Islands, the Republic of Kiribati, the Republic of the Marshall Islands, the Federated States of Micronesia, the Republic of Nauru, the Republic of Palau, the Independent State of Papua New Guinea, the Independent State of Samoa, the Solomon Islands, the Kingdom of Tonga, Tuvalu, and the Republic of Vanuatu.

Activities

The main component of the mitigation activities of the programme, includes the development and dissemination of the use of rural renewable energies sources and biofuels to meet the energy security of the Pacific Small Island countries, reduction of greenhouse gases emission and promotion of sustainable transport. Moreover, the programme intends to strengthen national capacities also through capacity-building and technology transfer activities for the establishment of national energy policies and strategies, as well as markets, develop specialized human resources and work closely with communities, so as to ensure sustainability.

Further, the adaptation activities aimed to support the Disaster Risk Reduction efforts of the Pacific SIDS as a means to decrease their vulnerability to the impact of severe weather occurrences and increase their capacity to adapt to increasingly extreme situations caused by climate change, inter alia supporting the protection and conservation of marine and terrestrial ecosystems and biodiversity as a means to increase the resilience of the Pacific.

Project implementation 2013-2016

The projects agreed by the Joint Committee (JC) established under the MoU, both ongoing or concluded, for the period January 2013 – December 2016 are the following:

<u>FIJI</u>

- Project: "*Extension of the Fiji Fellow on Ocean and Seas*" approved in 2016 at JC10.

The main objective is to build on the successful implementation of the implemented project Tonga' project "*Capacity building for the follow-up to and implementation of major international agreements. Fellowship on the Ocean and Seas - PSIDS FOS*", previously funded by IMELS, by ensuring that the skill-set gained is maintained and disseminated in the Fiji team in New York and in capital including PSIDS Missions in New York. It was the intention of the PSIDS FOS to enable the Fellows to take the acquired knowledge and skills back to their home countries and further strengthen their respective political, legal, and/or technical capacities attuned to the regional and international interests of the PSIDS.

<u>KIRIBATI</u>

- Project: "*Outer Island Fish Center Solar Panel System*" approved in 2016 at JC9.

The main objective is to install Solar off-grid System in ten fish centers of outer islands, to generate and supply 24/7hrs electricity to the ice making machine, freezers to store fresh fish, also for maximizing the benefits of small fisheries community, the local and sustainable use of marine resources and the largely resilience.

MARSHALL ISLANDS

- Project: "*Building Infrastructure Resilience*" approved in 2016 at JC9

The main objective is improve the national Planning and Zoning Act of Marshall Islands trough the revision of building code and standards with the inclusion of climate change adaptation and disaster risks management and the establishment of a resource center for information on DRM/CCA/GIS. The long-term goal is to enhance the overall capacity of the Marshall Islands to reduce risk and vulnerability, especially in the infrastructure sector.

NAURU

- Project: "*Household Water Storage Project – Phase II and III* " approved in 2015

The main objective is to meet the ever increasing demand for potable water in Nauru, due to its changing climatic variability and continuous population growth, within a larger local strategic approach to securing Nauru's National water supply. Following the National census of 2011, 260 of the 1652 household dwellings on the island represented the most vulnerable of the requiring assistance.

SOLOMON

- Project: "*Sustainable Program of a widespread rural electrification for water and energy security*" approved in 2016

The main objective is to reach out to rural communities in terms of provision of sustainable and reliable electricity supply. It will combine electrification initiatives with technology transfer activities. The installation of small off-grid plants for rural electrification and the creation of two Youth Micro-Enterprises (YME) to provide a maintenance service for solar plants. The project installed 16 plants in two provinces of the Solomon Islands involving almost 3.000 people who lived in absence of essential energy services. In addition, 30 people, among teachers and students, were trained on selection and maintenance of a PV system. For each village, a well pump was installed with a dispenser of drinking water, lighting computer and projector, sterilizer and refrigerator for surgery and a satellite phone. All equipment were monitored with a remote control both to detect malfunctions and to collect operating data.

- Project: *"Planning for electricity network in Solomon Islands"* approved in 2016 at JC10

The main objective were to enable finding, through a simulation model, the more efficient way to connect, on the field, different nodes inside electricity grid or networks. In particular the simulation software provided with: (i) electricity network constraint study to identify quickly areas of reinforcements; (ii) reliability and network optimization with maintenance of key assets; (iii) load flow analysis for network extensions, protection study and network loss study. Furthermore the project produced a case study for 2 sites, including a business and feasibility study, that supported SP boards to proceed with its plan to install additional 37 mini solar hybrid systems in Guadalcanal Province and in the other Outer Islands.

PALAU

- Project: "*Increasing Palau's resilience to extreme drought events: taking action for long-term adaptation to the impacts of climate change*" approved in 2016

The main objective was to build Palau's resilience to extreme drought events in particular to prolonged period due to the exacerbated effects of the ENSO Oscillation as for example the recent severe drought that led Palau to declare a State of Emergency in March 2016. The objectives of the work are: 1) To identify and develop new ground water sources for rural areas of Palau; and 2) To prepare and launch an educational program that promotes proper water conservation and management in communities, business and schools throughout Palau.

- *Project: "Establishment and operationalization of the first nationwide Marine National Sanctuary in Palau"* approved in 2014

The main objective was to increase socio-ecological resilience in Palau Challenge through an innovative and first of its kind adaptation response strengthening fish stocks for traditional fishing and reforming and modernizing Palau's domestic fishing industry for the development of Palau's Eco-tourism. The marine sanctuary is motivated by the need to: (i) adapt to climate change; (ii) promote sustainable livelihoods; (iii) foster regional integration; and (iv) produce globally significant benefits.

TONGA

- Project: "*Tonga at the United Nations: A Capacity-Strengthening Project Aimed at the "De-Silo-ing" the Whole-of-Government Approach to Sustainable Development and Connecting Ocean Health with Climate Change Policies*" approved in 2016

The main objective is to train fellows that will integrate with the Kingdom's diplomatic mission at the UN as Advisors and representing the interests of the country as directed from time to time by the Permanent Representative as the proponent of this project. The project provides a means to not only support the immediate needs of the Tongan Mission, but it will also help strengthen the civil servants' negotiating capacity so as to improve their engagement in international and regional fora. Providing these professionals with useful skills will contribute to promoting and safeguarding Tonga's national interests through foreign policy pursuits

- Project: "Capacity *building for the follow-up to and implementation of major international agreements*" approved in 2015

The main objective is to assist Small Island Developing States of the Pacific by building both individual and institutional capacities. It provided a fellowship with training on relevant issues of ocean and law of the sea, ocean policy, and marine science to build fundamental knowledge and understanding of the various processes (biological, physical, and legal) related to oceans; negotiations and media training to learn the skills necessary to carry information beyond policy-making circles to a broader international audience

TUVALU

- Project: "*Solar Home Standalone (SHS) Systems and PV Cooling Storage Facility Niulakita/Funafala*" approved in 2014

The main objective was to install a Solar Home System (SHS) to provide the user with a convenient

means of supplying power for small electrical loads like TV and radio, the v-sat to provide a more reliable communication, for the electrification of church building and the community hall, the school and the clinic.

VANUATU

- Project: "*Irrigation for a Resilient and Sustainable Agriculture*" approved in 2016

The main objective is to realize a high efficiency drip irrigation system, powered by solar energy, in order to promote local agriculture resilience to the impacts of climate change in particular during the dry seasons prolonged by the extreme cycles (El Nino and La Nina) of the El Nino Southern Oscillation (ENSO). Each system will consist of a well and pipes for irrigation, a submersible pump, a storage tank for water supply and a PV modules with inverters for the electrification of the pump. System has been planned to full cover the daily water demand during dry season (almost 10 m3/day/ha).
The six sites chosen for the installation of the irrigation systems are located on the islands of Tanna, Efate and Santo, for a total area covered by the project of 10 hectares.

Maldives

In 2015, IMELS signed a Memorandum of Understanding on climate change, vulnerability, risk assessment adaptation and mitigation, with the Ministry of the Environment and Energy of the Republic of Maldives.

According to this programme, in the first year of activities three projects have been adopted, namely:

- Project: *"Installation of a water desalination plant on the island of Magoodhoo - Faafu Atoll"*

It consists of a desalinating sea water plant through the reverse osmosis plant and a photovoltaic cell to electrically power this latter. The water is forced through polymer membranes that allow water molecules to pass, blocking, however, the salts and other inorganic impurities. The project will contribute to reduce the dependence on the imported fossil fuels in terms of fuel storage capacity and vulnerability to price fluctuations; indeed, it will contribute to promote awareness of the relationship between water resources and environmental vulnerability. The project takes place in the Magoodhoo – Faafu Atoll – Maldives.

- Project: *"Enhancing weather and climate monitoring and data management capacity of Maldives Meteorological Service for reducing vulnerabilities of climate change in the Maldives"*

The project aims to strengthen the meteorological monitoring network, early warning and disaster prevention systems. It consists of in the installation of 25 Automatic Weather Stations (AWSs), that will measure the following parameters: air temperature, relative humidity, air pressure, wind direction and speed, cumulative rain and rain intensity. The AWSs are powered by a solar panel system with battery backup. The project will also improve the Strengthening Early Warning Communication by establishing a Common Alerting Protocol at the Maldives Meteorological Service. Finally, the project contributes to increase the capacity building of the Maldives Meteorological Service, in the following key areas: climate modelling; short range weather forecasting; equipment maintenance including calibration.

- Project: *"Ocean Energy Resources Assessment for Maldives"*

The main objective of the Project is to perform a detailed assessment of the energy potential residing in

the marine currents in the Maldivian archipelago, and to individuate technological solutions to exploit it. Based on the analysis of the previous section, these main objectives can be achieved through the following actions: development (for the first time) of high-resolution three-dimensional models of the marine circulation in the Maldivian Archipelago and in some of the atolls to be selected; use of the numerical models to characterize in detail the variability of the circulation in the area, and to individuate the sites that are most interesting for energy extraction; deployment of instruments for measuring the currents in the selected sites. The use of these instruments will also provide validation of the numerical simulations; evaluation of the energy potential of the most interesting sites, and of the best devices to be used for energy extraction.

Cooperation in the Mediterranean region

Egypt

IMELS signed on 8 December 2015 a MoU with the Egyptian Ministry of the Environment with the aim to promote sustainable development and protecting the environment. The total amount committed by IMELS for the development of joint projects is 4 Million Euro. The Work Plan approved in April 2016, identifies the following sectors of intervention: management of protected areas, increase of energy production from renewable energies, sustainable waste management, promotion of sustainable public transport. Until now no project initiative has been approved due to political instability and some constraints in bilateral cooperation.

Meanwhile, IMELS financed through UNEP the initiative named “Creating a Strategy and Paving the way for the Deployment of Distributed Renewable Energy Technologies in Egypt” for a total amount of 2,18 Million euro. The initiative, which involves experts from Politecnico di Milano and technicians from New and Renewable Energy Authority (NREA), aims to increase energy efficiency, guarantee the decrease of fossil fuel and the diffusion of renewable energies, also through the implementation of financial mechanisms (with the involvement of local banks) in order to mobilize 22 Million euros.

Lebanon

On 7 July 2016, IMELS signed a MoU with the Lebanese Center for Energy Conservation (LCEC) with the aim to promote sustainable development. During the first Joint Committee established under the MoU a Work Plan has been approved which identifies as main sectors of intervention the following: innovation on energy policies, promotion of sustainable and low carbon emissions technologies, promotion of financial policies to increase interventions in the field of renewable energies and energy saving.

Also a MoU has been signed between IMELS and the Central Bank of Lebanon for a value of 5 million euros in order to promote a financial mechanism to facilitate, through the Lebanese trading banking system, an easy financing line for projects in the field of renewable energies and energy saving which could also attract Italian SME’s with competencies in such field, fostering the involvement of the private sector in general.

Morocco

Through an agreement signed in 2012 with “Agence Marocaine pour l'Efficacité Energétique (AMEE)” IMELS is supporting a project which aims to widespread energy efficiency initiatives within the Casablanca University Hospital. The project will provide some buildings of the hospital with the

installation and disposal of solar heating plants guarantying easy access to hot water.

The 21st of April 2016 a MoU has been signed between IMELS and the Ministry delegate in charge of Environment of the Kingdom of Morocco, with the aim to promote sustainable development initiatives with an Italian contribution of 2 Million Euros. In June 2016, a first Joint Committee has been held approving the Work Plan which identifies the following main sectors of intervention: enhancing the process of implementation of Mitigation and Adaptation measures linked to the NDC's, build capacity and share experience and knowledge at the national and regional level on mitigation and adaptation to climate change including through South-South and triangular cooperation, strengthen the national policy on the Integrated Coastal zone Management at the local level, strengthen education on Environment and Sustainable Development.

Palestine

The 23rd of February 2016, a MoU has been signed between IMELS and the Palestinian Quality Authority (EQA) with the aim to encourage and develop cooperation in the field of environmental protection and sustainable development.

During 2016 two Joint Committee have been held approving a Work Plan identifying sectors of intervention in the field of: public awareness and environmental education, strengthen the legal and institutional framework in accordance with the multilateral environmental agreements, enhance local capacity in environmental monitoring and planning, and capacity in pollution prevention.

In this framework a project on "Land use" has been approved that aims at increasing local capacity in assessing the status of the environment based on satellite image. In particular the project will strengthen EQA capacity in dealing with territorial development and increase local know-how in monitoring the status and the impact of climate change in Palestine. This activity will increase EQA capacity to comply with Multilateral Environmental Agreements such as the CBD, UNFCCC and others.

Tunisia

IMELS supports a reform of the Mediterranean Renewable Energy Centre (MEDREC), established in 2004, in Tunis, in collaboration with the Ministry for Industry of Tunisia and the Tunisian National Agency for Energy Conservation. With this aim in December 2015 a new Statute of MEDREC has been approved also by IMELS and relevant partners. In December 2016 a first Assembly of the MEDREC has been held in order to boost the activities in tackling climate change in the country.

Qatar

The 28th of January 2016 IMELS and the Ministry of Municipality and Environment of Qatar singed an MoU with the aim to promote cooperation in the field of sustainable development, climate change vulnerability, risk assessment, adaptation and mitigation. Main areas of cooperation are linked to the challenge of addressing drivers of land degradation, the promotion of economic diversification and technological transformation towards low GHG development, particularly the deployment of renewable energies. To date no concrete progress in terms of implementing activities have been made.

Cooperation on climate change in the Sub-Saharan African region

Africa has become a priority continent in the Italian development cooperation activities.

In this context, IMELS is committed to supporting national strategies that aim at:

- facing the high climate change vulnerability that often prevents African countries from consolidating their economic growth, and to address its environmental consequences;
- promoting an effective and sustainable growth of the energy sector taking into account the availability of renewable energy sources (sun, wind, rivers) in many Sub-Saharan African countries.

On this line, IMELS is developing several bilateral agreements with many African developing countries in order to strengthen and coordinate the efforts to combat global climate change, to support mechanisms to reduce climate change vulnerability and enhance risk assessment, to promote secure, clean and efficient energy, to stimulate the transition towards a sustainable low-carbon economy and to implement adaptation actions and opportunities to protect the environment and natural resources.

On December 2015, The Italian Ministry of Environment, Land and Sea signed with the Ministry of Environment, Natural Resources Conservation and Tourism of the Republic of Botswana the first African Memorandum of Understanding (MoU) on cooperation in the field of climate change vulnerability, risk assessment, adaptation and mitigation.

Subsequently, during 2016, environmental cooperation agreements have involved several countries in the region. In particular, agreements with the Ministries of the Federal Democratic Republic of Ethiopia, the Republic of the Djibouti, the Union of Comoros, the Kingdom of Lesotho, the Democratic Republic of the Congo, the Republic of Rwanda, the Republic of South Africa, the Republic of Sudan, the Kingdom of Swaziland have been signed, with a total budget of €18,5 Millions.

Furthermore several MoU with the United Republic of Tanzania, the Republic of Seychelles, the Republic of Kenya, the Democratic Republic of Sao Tomé e Principe, the Republic of Namibia, the Republic of Zambia, the Republic of Mozambique, the Republic of Mali and the Republic of Mauritius are still being negotiated.

The cooperation activities planned under the MoU range:

- realization of joint projects;
- programs for capacity building, technology transfer and technical assistance;
- exchange of information and documents related to environment, including programs, publications, expertise and study results;
- exchange of experts and trainers, organization of workshops, seminars and other meetings;
- promotion of private sector participation and activities to implement Public Private Partnerships;
- enhancement of cooperation with non-governmental organizations with regard to programs and initiatives in the field of environment and sustainable development;
- enhancement of public education and awareness campaigns on measures for adaptation to climate change.

Generally the main topics of the cooperation activities concern areas of common interest, such as:

- collection, analysis and dissemination of meteorological data relevant to the observation of climate change and the measurement of its impact on the potentially vulnerable economic sectors;
- implementation, monitoring, reporting and communication of the Nationally Determined Contributions (NDCs);

- enhancement of capacities for the implementation of Mechanisms under the UNFCCC and its related instruments;
- stimulation and dissemination of economic and technological transformation towards low emission development in ensuring energy security and creating adaptation actions and opportunities;
- capacity building for monitoring, reporting on climate issues, such as mitigation and adaptation;
- reduction of deforestation and forest degradation, enhancement of forest carbon stocks and sustainable management of forests;
- promotion of sustainable crop and livestock production practices for greater food security and greenhouse gas emissions reduction, also through the application of the climate-smart agriculture approach (CSA);
- access to electric power generation from renewable energy sources and promotion of renewable energies in order to achieve the target established by the country;
- implementation of regulatory reforms enabling private investments in energy efficiency and small scale renewable energies;
- access to drinking water and sustainable integrated water management;
- sustainable waste management;
- promotion of measures to enhance vulnerable coast ecosystems preservation;
- promotion of measure to preserve biodiversity;
- mitigation of environmental impacts due to migratory flows of person, including the promotion of the environmental sustainability of refugee camps.

Projects 2013-2016

During the period January 2013 – December 2016, the following project has been agreed by the Joint Committee (JC) established under the MoU:

Botswana

Project: *"Technical assistance in supporting Botswana private sector and relevant institutions in renewable energy through investment promotion and technology transfer"* of UNIDO ITPO approved in 24 October 2016 at JC2.

The objective of the project is to support the Botswana Government in identifying and promoting new investment and technology transfer opportunities, providing ad hoc capacity building activities in selected renewable energy with the aim of supporting sustainable development, local job creation and fostering international partnerships.

Cooperation on climate change in Central and Latin America

In **Mexico**, the activity proceeded under the Memorandum of Understanding on "Cooperation in the Field of Climate Change ", signed with the Secretariat of the Environment of Federal District of Mexico City in 2009.

Three projects have been concluded:

- "TRAINING PROGRAM ON SUSTAINABILITY AND CLIMATE CHANGE", with the aim to foster sustainable development and environmental protection through capacity building activities focusing on sustainable energy and climate change, addressed to policy makers, officers, local technicians and operators selected from the Federal District of Mexico City in order to promote a sustainable approach in the management of environmental, economic and social concerns.

- "WATER SUSTAINABLE MANAGEMENT AND GREEN TECHNOLOGY APPLICATION IN THE MUSEUM OF NATURAL HISTORY AND ENVIRONMENTAL CULTURE OF MEXICO CITY", aimed to identify and design an integrated water recycle system through the adoption of "green" technologies creating a water self-sustainable Museum while generating environmental benefits to the nearby Lago Menor de Chapultepec. In parallel a pilot project of integration of green technologies for water capture and depuration, thermal insulation and CO2 fixation has been implemented on small scale to be utilized for demonstration and education purposes.
- "Reuse of the Organic Waste Fraction": the project was devoted to develop, test and demonstrate a comprehensive integrated organic waste management, implemented with innovative measures and technologies, which aim is to improve the environmental performance of the compost recycling process and its final end-products and to foster a larger use of compost by agriculture and in public and private urban gardening and nursery.

On September, 2015 IMELS participated to "Green Expo 2015" - Mexico City, promoting the dialogue with the Italian companies involved in the energy sector. It gave also the opportunity to explore the possibility of launching new cooperation activities with the Ministry of the Environment and Natural Resources of the United Mexican States (SEMARNAT).

On July 20th, 2016, IMELS signed with SEMARNAT a new Memorandum of Understanding in the field of "Climate change vulnerability, adaptation and mitigation". The main areas of cooperation includes: early warning system, sustainable agriculture, natural capital and protection of coastal marine areas. Activities will be promoted through capacity building and training, sharing of resources and technology transfer.

Two main projects are currently on going: The organization of two Seminars based on "Environmental Economics and Natural Capital" and the elaboration of the Proposal "Sustainable energy use of the agro-forestry waste in Mexico".

CARICOM

In 2015, the Ministry for the Environment, Land and Sea of Italy and the Governments of Antigua and Barbuda, the Bahamas, Belize, Dominica, Grenada, Guyana, Haiti, Saint Kitts and Nevis, Saint Lucia, and Saint Vincent and the Grenadines signed a Memorandum of Understanding on Climate Change Vulnerability, Adaptation and Mitigation.

The main sectors of cooperation identified are:

- Adaptation to climate change, and protection from the vulnerability to sea level rise and climate variability, in the region.
- Implementation, reporting and assessment of the Nationally Determined Contributions.
- Development and dissemination of the use of renewable energies.
- Transfer of scientific and technical knowledge and experience.
- Transfer of technology.
- Exchange of experts, scientists and researchers.
- Enhancing capacities for the implementation of Mechanisms under the UNFCCC and its related instruments.
- Promotion of joint ventures between the private sectors of the Parties.

Indeed, two programmes of activities have been developed regrading:

Sustainable Energy Programme:

- Assessment of energy requirements and strengthening of energy policies and action plans, which refers to several actions, such as: technology assessment of energy requirements and infrastructure in the mid-and long-term and of the most appropriate renewable energy mix capable of meeting those needs; advice and technical assistance for the development of sustainable transport technologies, including non-motorized solutions, in order to reduce pollutants and GHG emissions; development of human resources specialized in the planning, implementation and management of energy policies, strategies and plans; strengthening the participation of all actors in the design and implementation of renewable energy policies and practices, in particular of rural women; strengthening national capacities for the development of national and regional energy markets, as well as of the appropriate financial instruments; improving the policy measures and a sound regulatory framework; energy data collection and analysis .
- Rural Electrification, which refers to several actions, such as: installations and rehabilitation of existing facilities with photovoltaic technology, or other renewable energy technologies – like: as mini hydro and wind.
- Development of renewable energy sources, which consists of investigating the renewable potential, photovoltaic stand-alone electrification in urban areas, photovoltaic integration into the national grid, wind energy data collection and resource assessment, biogas from household waste and waste management, assessment of the geothermal, tidal and wave power generation potential, small hydropower resource assessment.

Climate Change Adaptation:

- Sub-Programme for Disaster Risk Reduction, which consists in development of measures to adapt to sea level rise; in strengthening early warning systems through collection, analysis, management and use of relevant data, including preparation of risk maps, on the evolution of weather phenomena and their impact on ecosystems at the social and spatial scale; Strengthening disaster risk governance and national capacities for disasters prevention, mitigation, preparedness, response, recovery, and rehabilitation, and fostering collaboration and partnership across mechanisms and institutions for the implementation of instruments relevant to disaster risk reduction and sustainable development; in enhancing the resilience of national health systems, including by integrating disaster risk management into health care systems, especially at the local level; in development of contingency plans for risk management due to natural disasters; development of adaptation measures for critical facilities, such as schools and hospitals; development of new building codes, rehabilitation and reconstruction practices and standardized building materials; increasing resilience of new and existing critical infrastructure, including water and sanitation, transportation and telecommunications infrastructure.
- Sub-Programme for the Protection and conservation of marine and terrestrial ecosystems and biodiversity, which consists of development of conservation measures for coastal and marine areas affected by the negative impacts of climate change, especially those that are particularly significant for their biodiversity and for providing ecosystem services; strengthening the national managerial and organizational capacity as well as governance in the areas of protection and

conservation of marine biodiversity; development of protected areas; development of programmes and projects that enhance ecosystem resilience and increase the contribution of biodiversity to carbon stocks through conservation and restoration measures; development of measures to minimize and address the impacts of ocean acidification and invasive species.

In particular, in 2016, 7 projects have been approved, mainly related to the energy sector. These projects are mostly significant as they contribute to achieve the Intended Nationally Determined Contributions (INDCs) of the countries. They are:

- For Antigua & Barbuda, we adopted a pilot project to achieve emission reductions in the transportation sector, by providing the islands with electricity school buses.
- For Bahamas, the project consists of retrofitting the Anatol Rodgers High School.
- For Dominica, the project consists of creating a Solar Photo Voltaic system at the DOWASCO Sewage Treatment Plant. The project seeks to reduce the energy cost associated with sewerage treatment by replacement of approximately 59% percentage of the power obtained from the grid with renewable energy via the installation of a solar PV system. The project will serve to reduce DOWASCO's carbon footprint and serve as a pilot for powering the remainder of DOWASCO's facilities island wide with renewable energy, particularly potable water and wastewater pumping stations.
- For Grenada, the project aims to create a reverse osmosis desalinization system with a photovoltaic system, in the island of Carriacou.
- For Guyana, the project is on developing pregame able to ensure Energy Security, in the community of Bartica.
- For St Lucia, the project points to identify several parking areas on island with potential for development into solar car ports.
- For St Vincent and the Grenadines, like for Grenada, the project consists of creating a reverse osmosis desalinization system with a photovoltaic system.

Country	**Project**	**Cost**
Antigua and Barbuda	*Electric School Bus Pilot*	$ 625.000
Bahamas	*Retrofitting of the Anatol Rodgers High School*	$ 667.652
Dominica	*Solar Photo Voltaic system at the DOWASCO Sewage Treatment Plant*	$ 491.050
Grenada	*Carriacou Photo Voltaic powered Salt Water Reverse Osmosis desalinization system*	$ 500.000
Guyana	*Transitioning to National Energy Security: Bartica as a Model Green Town*	$ 650.000
St. Lucia	*Solar Carport and Electric Vehicle Charging Station*	$ 486.675
St Vincent and the Grenadines	*Salt Water Reverse Osmosis Desalinization powered by a Photo Voltaic Renewable Energy System*	$ 1.250.000

		Total $4.670.377

REDD+ in Ghana, Panama, Papua New Guinea

In 2015, a Memorandum of Understanding on cooperation to scale up private sector involvement in support of mitigation and adaptation to climate change, including addressing drivers of deforestation and forest degradation, and enhancement of low carbon sustainable development has been signed with Ministry of Environment, Science, Technology and Innovation of the Republic of Ghana, Ministry of Environment of Panama, and Ministry of Environment, Conservation and Climate Change of Papua New Guinea.

According to this programme, IMELS has supported activities to enable the three countries to present their National Forest Reference Level to the UNFCCC; as well as to evaluate the legal and policy frameworks, including national legislation around carbon ownership and rights, necessary to scale up private sector involvement in REDD+ activities.

Cooperation with Central and Eastern European countries on climate change

In **Central and Eastern Europe**, IMELS has been active since the beginning of the years 2002. Since then, the cooperation program has expanded with several projects implemented in Albania, Bosnia, Croatia, Bulgaria, Serbia, Montenegro, Macedonia, Poland, Romania, Turkey, Hungary, Kyrgyzstan and Tajikistan, mainly dedicated to:

- strengthen local and national capacities on environmental governance;
- transfer know-how and technologies to prevent and control environmental pollution and water management;
- promote renewable energy and energy efficiency.

In the Republic of **Albania** IMELS signed a Memorandum of Understanding, on 31 May 2005, on "Cooperation in the field of the Clean Development Mechanism under article 12 of the Kyoto Protocol". The agreement aimed at facilitating the implementation of the Kyoto Protocol, through legal support to the national competent authority (DNA), and technical support for potential CDM project assessment, in the field of renewable energy sources, energy efficiency, waste and forest management. One project (Power plant from HydroEnergy) has been admitted as a CDM by UNFCCC.

In **Montenegro,** IMELS co-financed, in the framework of the Cooperation Agreement for Environmental Protection signed in November 2012 in Podgorica, the construction of an "ecological building" that will host the headquarters of the Montenegro Ministry of Sustainable Development and Tourism, for an initial estimated value of 8.000.000 Euros.

In 2016 a renewed Cooperation Agreement foresees the provision by IMELS of additional 4.000.0000 Euros of technical assistance for the Ministry of Sustainable Development and Tourism.

Scientific cooperation

IMELS is also strongly committed to support programme on scientific research and technology transfer in strategic areas, like China, in collaboration with noteworthy research centre. These projects are dedicated to improve these regions capacity to tackle climate change by fostering research.

In the framework of the Sino-Italian Cooperation Program for Environmental Protection (SICP) several scientific and technological research projects have been implemented, in collaboration with the National Development and Reform Commission, the Chinese Ministry of Science and Technology, the main Chinese scientific institutions, Chinese Municipalities, companies and prestigious universities, such as Tsinghua University in Beijing, Tongji University in Shanghai and Jiaotong University in Shanghai.

Within the framework of Agreement on Scientific and Technological Cooperation between the Government of the Italian Republic and the Government of the People's Republic of China, IMELS co-funded in 2016 the project “Remediation of Old Landfills for Environmental sustainability and final Sink (ROLES)”, which is on-going at Tsinghua University and University of Padova.

The project is to advance scientific research and technology related to old landfill remediation by using modern concepts such as environmental sustainability by keeping diffused, long-term, and greenhouse gas emissions under control, stabilization and immobilization of long impacting hazardous substances, final sink for elements, recovery of resources.

The cooperation with the **Euro-Mediterranean Centre for Climate Change (CMCC)** allows IMELS to develop other projects as part of an integrated, multi-disciplinary and frontier research for understanding, controlling and adapting to Climate Change.

CMCC is a national research centre, founded in 2005 by IMELS, the Italian Ministry of Education, University and Research, and the Italian Ministry of Economy and Finance, represents the most ambitious initiative undertaken in Italy, within the framework of the National Research Plan, and specifically the National Research Plan on Climate. CMCC benefits from the extensive applied research experience of its members and institutional partners: Istituto Nazionale di Geofisica e Vulcanologia (INGV); Università del Salento; Centro Italiano di Ricerche Aerospaziali (CIRA S.c.p.a.); Università Ca’ Foscari Venezia; Università di Sassari, Università della Tuscia, Politecnico di Milano.

CMCC research activities are distributed among eight research divisions that share different knowledge and skills in the field of climate science: Advanced Scientific Computing (ASC) Division; Climate Simulation and Prediction (CSP) Division; Economic analysis of Climate Impacts and Policy (ECIP) Division; Impacts on Agriculture, Forests and Ecosystem Services (IAFES) Division; Ocean modeling and Data Assimilation (ODA) Division; Ocean Predictions and Applications (OPA) Division; Risk Assessment and Adaptation Strategies (RAAS) Division; Regional Models and geo-Hydrological Impacts (REHMI) Division.

Among the activities carried out by CMCC, the main projects, programmes, and international multilateral agreements directly financed by IMELS and coordinated by CMCC in the period 2013-2016 are:

GEMINA (2010-2015): the project aims to strengthen and further develop the research activities of CMCC. The project has been cofounded by IMELS and MIUR, more specifically IMELS provided funding for

the consolidation and further development of the international scientific network of CMCC, being crucial to ensure Italian research at the forefront within the international research community.

SNAC: as part of the strong cooperation with CMCC, the IMELS financed the project Elements for the elaboration of the National Strategy of Adaptation to Climate Change (SNAC).

The specific SNAC objectives were:

- Identification of specific sectors for sectoral and inter-sectoral analysis
- Evaluation of the status of scientific knowledge on climate change impacts, availability of data and information at different scales and sectors in the country
- Identification of sectoral vulnerabilities to those impacts and evaluation of related risks
- Support in identifying and analysing current adaptation measures carried out at different scales (national, regional and local) and in various sectors
- Estimation of costs and benefits of possible adaptation measures/actions for various sectors for short (2020-2030) and medium term (2040-2050).
- Support in identifying main national stakeholders and managing dialogue between institutions.
- Support in elaborating guidelines for sectoral adaptation action at different scales.

NAP: following the official adoption of the Strategy (decreto direttoriale 86/2015), in 2016 the IMELS financed the Development of the **National Adaptation Plan (NAP)**, currently available for public consultation at http://www.minambiente.it/pagina/consultazione-su-piano-nazionale-adattamento-cambiamenti-climatici.

Following the SNAC, the NAP offer robust, rigorous and updated national climate scenarios, with territorial analysis and expected impacts and risks in each of the key sector already identified in the National Adaptation Strategy. A focus on possible adaptive actions in response to these impact is at the core of the document. Preferable actions for adaptation are selected according to specific criteria, proposed in the international mainstream literature and will constitute a structured database.

Both documents have been developed under the coordination of CMCC, with the involvement of Italian experts of several national universities, research institutions and national stakeholders.

The NAP will detail for each action the entitled authorities, the timeframe for implementation and the indicators to monitor the progress and the effectiveness. Each action will be associated with a specific sector and with the relevant climatic areas. The NAP will offer an informative nation-wide framework, but the final selection of adaptive actions will require further strategical and political evaluation and also in-depth analysis at local level, consistently with the local development goals. This process should be conducted with the involvement of all local actors and stakeholders (authorities, businesses, civil society).

The adaptation plan should be regarded as dynamic instrument that will go through a continuous and timely update process.

IPCC Focal Point: since 2006, the Euro-Mediterranean Center on Climate Change hosts the IPCC Focal Point for Italy. The National IPCC Focal Point participates in the plenary sessions and meetings of IPCC, represents the IPCC in Italy, and carries out communication and education activities concerning IPCC activities.

Land sector: CMCC is also providing scientific support to IMELS on matters related to land sector and adaptation in international activities and negotiations.

7.3 Provision of financial resources

The tables below report information on financial support to developing countries provided through multilateral and bilateral channels in the period 2013-2016. For additional specific information, please refer to tables included in BR 2 (2013-2014) and BR3 (2015-2016).

Table 6. Provision of public financial support: summary information in 2013-16. [a]

Allocation channels	Domestic currency					USD [b]				
		Climate-specific [d, 2]					Climate-specific [d, 2]			
	Core/general [c, 1]	Mitigation	Adaptation	Cross-cutting [e]	Other [f]	Core/general [c, 1]	Mitigation	Adaptation	Cross-cutting [e]	Other [f]
2013										
Total contributions through multilateral channels	302.763.804,00	2.800.000,00	600.000,00	112.978.472,00		401.970.000,00	3.717.472,12	796.601,17	149.997.971,32	
Multilateral climate change funds [g]	7.004.760,00			8.586.480,00		9.300.000,00			11.400.000,00	
Other multilateral climate change funds [h]										
Multilateral financial institutions, including regional development banks	295.759.044,00			93.441.992,00		392.670.000,00			124.060.000,00	
Specialized United Nations bodies		2.800.000,00	600.000,00	10.950.000,00			3.717.472,12	796.601,17	14.537.971,32	
Total contributions through bilateral, regional and other channels		6.870.000,00	13.400.000,00	26.080.000,00			9.120.000,00	17.790.000,00	34.630.000,00	
Total		9.670.000,00	14.000.000,00	139.058.472,00			12.837.472,12	18.586.601,17	184.627.971,32	
2014										
Total contributions through multilateral channels	312.820.000,00	200.000,00		134.570.000,00		415.050.000,00	265.357,57		178.554.980,76	
Multilateral climate change funds [g]	24.120.000,00			13.640.000,00		32.000.000,00			18.100.000,00	
Other multilateral climate change funds [h]										
Multilateral financial institutions, including regional development banks	288.700.000,00			88.070.000,00		383.050.000,00			116.870.000,00	
Specialized United Nations bodies		200.000,00		32.850.000,00			265.357,57		43.584.980,76	
Total contributions through bilateral, regional and other channels		12.550.000,00	1.910.000,00	11.080.000,00			16.651.187,48	2.534.164,79	14.700.809,34	
Total		12.750.000,00	1.910.000,00	145.640.000,00			16.916.545,04	2.534.164,79	193.255.790,10	
2015										

Total contributions through multilateral channels	323,287,917.06	32,944,533.30	19,807,968.41	165,108,750.86		358,611,111.54	36,544,130.14	21,972,233.41	183,148,919.42	
Multilateral climate change funds [g]	6,588,000.00	11,259,157.00	2,000,000.00	67,076,385.18		7,307,820.30	12,489,358.85	2,218,524.68	74,405,308.03	
Other multilateral climate change funds [h]		11,259,157.00		1,704,385.18			12,489,358.85		1,890,610.30	
Multilateral financial institutions, including regional development banks	273,819,724.77	16,183,906.53	2,013,044.00	77,694,636.58		303,737,908.77	17,952,198.06	2,232,993.90	86,183,734.40	
Specialized United Nations bodies	42,880,192.29	5,501,469.77	15,794,924.41	20,337,729.10		47,565,382.47	6,102,573.23	17,520,714.83	22,559,876.99	
Total contributions through bilateral, regional and other channels		30,048,884.50	25,631,040.34	122,154,489.84			33,332,095.99	28,431,547.77	135,501,375.41	
Total	323,287,917.06	62,993,417.80	45,439,008.75	287,263,240.70		358,611,111.54	69,876,226.13	50,403,781.18	318,650,294.83	
2016										
Total contributions through multilateral channels	461,851,541.55	15,565,927.89	17,612,347.36	106,449,529.62		510,728,233.48	17,213,234.43	19,476,221.78	117,714,839.77	
Multilateral climate change funds [g]	14,848,000.00	4,700,000.00	1,793,078.72	25,011,657.40		16,419,329.87	5,197,390.25	1,982,836.14	27,658,583.88	
Other multilateral climate change funds [h]		4,700,000.00		2,739,657.40			5,197,390.25		3,029,589.08	
Multilateral financial institutions, including regional development banks	426,362,468.24	4,040,730.05	2,713,781.41	70,325,758.26		471,483,432.74	4,468,351.27	3,000,974.69	77,768,172.34	
Specialized United Nations bodies	20,641,073.31	6,825,197.84	13,105,487.23	11,112,113.96		22,825,470.87	7,547,492.91	14,492,410.95	12,288,083.55	
Total contributions through bilateral, regional and other channels		11,190,790.61	41,394,463.90	70,777,604.42			12,375,086.35	45,775,145.29	78,267,836.35	
Total	461,851,541.55	26,756,718.50	59,006,811.26	177,227,134.04		510,728,233.48	29,588,320.78	65,251,367.07	195,982,676.12	

Note: Explanation of numerical footnotes is provided in the documentation box after tables 7, 7(a) and 7(b).

Abbreviation: USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2015 and 2016, where 2018 is the reporting year.

[b] Parties should provide an explanation of the methodology used for currency exchange for the information provided in tables 7, 7(a) and 7(b) in the documentation box.

[c] This refers to support to multilateral institutions that Parties cannot specify as being climate-specific.

[d] Parties should explain in their biennial reports how they define funds as being climate-specific.

[e] This refers to funding for activities that are cross-cutting across mitigation and adaptation.

[f] Please specify.

[g] Multilateral climate change funds listed in paragraph 17(a) of the "UNFCCC biennial reporting guidelines for developed country Parties" in decision 2/CP.17.

[h] Other multilateral climate change funds as referred to in paragraph 17(b) of the "UNFCCC biennial reporting guidelines for developed country Parties" in decision 2/CP.17.

Table 7: Provision of public financial support: contribution through multilateral channels in 2013-16 [a]

Donor funding	Total amount				Status	Funding source [f,4]	Financial instrument [f,5]	Type of support [f,g,6]	Sector [c,f,7]
	Core/general [d,1]		Climate-specific [e,2]						
	Domestic currency	USD	Domestic currency	USD					
2013									
Total contributions through multilateral channels	302.763.804,00	401.970.000,00	116.378.472,00	154.512.044,61					
Multilateral climate change funds [g]									
1. Global Environment Facility	7.004.760,00	9.300.000,00	8.586.480,00	11.400.000,00	Disbursed	ODA	Grant	Cross-cutting	Not applicable
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 Fund	70.062.664,00	93.020.000,00	34.496.560,00	45.800.000,00	Disbursed	ODA	Grant	Cross-cutting	Not applicable
4. Asian Development Bank	29.977.360,00	39.800.000,00	10.017.560,00	13.300.000,00	Disbursed	ODA	Grant	Cross-cutting	Not applicable
5. European Bank for Reconstruction and Development									
6. Inter-American Development Bank									
7. Other									
International Development Association	195.719.020,00	259.850.000,00	48.927.872,00	64.960.000,00	Disbursed	ODA	Grant	Cross-cutting	Not applicable
Specialized United Nations bodies									
1. United Nations Development Programme									
UNDP			280.000,00	371.747,21	Disbursed	ODA	Grant	Cross-cutting	Agriculture
2. United Nations Environment Programme									
UNEP			6.650.000,00	8.828.996,28	Disbursed	ODA	Grant	Cross-cutting	Not applicable

3. Other									
UNDESA			2.000.000,00	2.655.337,23	Disbursed	ODA	Grant	Mitigation	
UNCCD			800.000,00	1.062.134,89	Disbursed	ODA	Grant	Mitigation	Not applicable
UNIDO			600.000,00	796.601,17	Disbursed	ODA	Grant	Adaptation	Not applicable
FAO			3.900.000,00	5.177.907,59	Disbursed	ODA	Grant	Cross-cutting	Not applicable
UNECE			120.000,00	159.320,23	Disbursed	ODA	Grant	Cross-cutting	Not applicable
2014									
Total contributions through multilateral channels	312.823.185,00	415.050.000,00	134.768.969,50	178.809.830,83					
Multilateral climate change funds g									
1. Global Environment Facility	24.118.400,00	32.000.000,00	13.265.120,00	17.600.000,00	Disbursed	ODA	Grant	Cross-cutting	Not applicable
2. Least Developed Countries Fund									
3. Special Climate Change Fund									
4. Adaptation Fund									
5. Green Climate Fund			376.850,00	500.000,00	Disbursed	ODA	Grant	Cross-cutting	Not applicable
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	39.388.362,00	52.260.000,00	19.400.238,00	25.740.000,00	Disbursed	ODA	Grant	Cross-cutting	Not applicable
4. Asian Development Bank	25.497.671,00	33.830.000,00	8.497.967,50	11.275.000,00	Disbursed	ODA	Grant	Cross-cutting	Not applicable
5. European Bank for Reconstruction and Development									
6. Inter-American Development Bank			565.275,00	750.000,00	Disbursed	ODA	Grant	Cross-cutting	Not applicable
7. Other									
International Bank for Reconstruction and Development			3.655.445,00	4.850.000,00	Disbursed	ODA	Grant	Cross-cutting	Not applicable
International Development Association	223.818.752,00	296.960.000,00	55.954.688,00	74.240.000,00	Disbursed	ODA	Grant	Cross-cutting	Not applicable
Specialized United Nations bodies									
1. United Nations Development Programme									
UNDP			260.000,00	344.964,84	Disbursed	ODA	Grant	Cross-cutting	Not applicable
2. United Nations Environment Programme									

UNEP			18.000.000,00	23.882.181,24	Disbursed	ODA	Grant	Cross-cutting	Not applicable
3. Other									
International Fund for Agricultural Development			11.893.386,00	15.780.000,00	Disbursed	ODA	Grant	Cross-cutting	Not applicable
UNIDO			550.000,00	729.733,32	Disbursed	ODA	Grant	Cross-cutting	Not applicable
WFP			200.000,00	265.357,57	Disbursed	ODA	Grant	Mitigation	Energy
FAO			2.150.000,00	2.852.593,87	Disbursed	ODA	Grant	Cross-cutting	Not applicable
2015									
Total contributions through multilateral channels	323,287,917.06	358,611,111.54	217,861,252.57	241,665,282.97					
Multilateral climate change funds	6,588,000.00	7,307,820.30	80,335,542.18	89,113,191.56					
1. Global Environment Facility	6,588,000.00	7,307,820.30	15,372,000.00	17,051,580.70	Disbursed	ODA	Grant	Cross-cutting	Not applicable
2. Least Developed Countries Fund									
3. Special Climate Change Fund									
4. Adaptation Fund			2,000,000.00	2,218,524.68	Disbursed	ODA	Grant	Adaptation	Other (Biosphere Protection)
5. Green Climate Fund			50,000,000.00	55,463,117.03	Disbursed	ODA	Grant	Cross-cutting	Not applicable
6. UNFCCC Trust Fund for Supplementary Activities									
7. Other multilateral climate change funds			12,963,542.18	14,379,969.15					
African Climate Change Fund			4,700,000.00	5,213,533.00	Disbursed	ODA	Grant	Mitigation	Energy
UNFCCC Secretariat			1,205,264.18	1,336,954.17	Disbursed	ODA	Grant	Cross-cutting	Not applicable
UNFCCC ITL			249,121.00	276,340.54	Disbursed	ODA	Grant	Cross-cutting	Other (Biosphere Protection)
UNFCCC Executive Secretary			250,000.00	277,315.59	Disbursed	ODA	Grant	Cross-cutting	Not applicable
Multilateral Fund for the Montreal Protocol			6,559,157.00	7,275,825.85	Disbursed	ODA	Grant	Mitigation	Other (Biosphere Protection)
Multilateral financial institutions, including regional development banks	273,819,724.77	303,737,908.77	95,891,587.11	106,368,926.36					
1. World Bank	187,048,465.05	207,485,818.13	44,720,318.96	49,606,565.68	Disbursed	ODA	Grant	Cross-cutting	Not applicable
2. International Finance Corporation			7,511,031.83	8,331,704.75	Disbursed	ODA	Grant	Mitigation	Energy
3. African Development Bank	46,989,478.22	52,123,658.59	19,655,354.87	21,802,944.94	Disbursed	ODA	Grant	Cross-cutting	Not applicable
4. Asian Development Bank	33,356,828.14	37,001,473.25	6,167,976.56	6,841,904.12	Disbursed	ODA	Grant	Cross-cutting	Not applicable
5. European Bank for Reconstruction and									

Development									
6. Inter-American Development Bank	5,047,917.76	5,599,465.07	1,033,910.87	1,146,878.39	Disbursed	ODA	Grant	Cross-cutting	Not applicable
7. Other	1,377,035.60	1,527,493.73	16,802,994.02	18,638,928.48					
Caribbean Development Bank	1,323,300.80	1,467,887.74	846,044.77	938,485.60	Disbursed	ODA	Grant	Cross-cutting	Not applicable
IRENA			468,697.02	519,907.95	Disbursed	ODA	Grant	Mitigation	Not applicable
International Energy Agency	6,000.00	6,655.57	60,413.00	67,013.87	Disbursed	ODA	Grant	Mitigation	Energy
International Energy Forum	44,734.80	49,622.63	29,823.20	33,081.75	Disbursed	ODA	Grant	Cross-cutting	Energy
OECD - Growth Prospects of African Economies	3,000.00	3,327.79	2,000.00	2,218.52	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
African Union Commission			80,000.00	88,740.99	Disbursed	ODA	Grant	Mitigation	Energy
Bioversity International			800,000.00	887,409.87	Disbursed	ODA	Grant	Adaptation	Agriculture
Caribbean Community Climate Change Centre			69,477.04	77,068.26	Disbursed	ODA	Grant	Cross-cutting	Energy
CIHEAM Libya - Istituto Agronomico Mediterraneo			213,044.00	236,321.69	Disbursed	ODA	Grant	Adaptation	Other (Fishing)
CIHEAM Myanmar - Istituto Agronomico Mediterraneo			136,000.00	150,859.68	Disbursed	ODA	Grant	Mitigation	Agriculture
CIHEAM Tunisia			400,000.00	443,704.94	Disbursed	ODA	Grant	Cross-cutting	Agriculture
EBRD - CEI Fund			51,822.00	57,484.19	Disbursed	ODA	Grant	Mitigation	Energy
EBRD - CEI Fund Belarus			19,312.00	21,422.07	Disbursed	ODA	Grant	Cross-cutting	Energy
EBRD - CEI Fund Serbia			2,952.00	3,274.54	Disbursed	ODA	Grant	Cross-cutting	Other (Education unspecified)
EBRD - CEI Fund Serbia			2,314.40	2,567.28	Disbursed	ODA	Grant	Mitigation	Other (Banking and Financial Services)
FAO Central African Rep.			500,000.00	554,631.17	Disbursed	ODA	Grant	Adaptation	Other (Developmental food aid/Food security assistance)
FAO Lebanon			148,000.00	164,170.83	Disbursed	ODA	Grant	Mitigation	Agriculture
FAO Sudan			200,000.00	221,852.47	Disbursed	ODA	Grant	Cross-cutting	Agriculture
FAO Sudan			240,000.00	266,222.96	Disbursed	ODA	Grant	Mitigation	Agriculture
FAO Syria			200,000.00	221,852.47	Disbursed	ODA	Grant	Cross-cutting	Other (Emergency Response)
IBRD - WORLD BANK GLOBAL FACILITY FOR DISASTER REDUCTION AND RECOVERY (GFDRR)			800,000.00	887,409.87	Disbursed	ODA	Grant	Cross-cutting	Other (Disaster prevention and preparedness)

IBRD Myanmar			292,000.00	323,904.60	Disbursed	ODA	Grant	Cross-cutting	Other (Rural Development)
IFC MENA Inclusive Green Growth			6,617,257.08	7,340,274.08	Disbursed	ODA	Grant	Mitigation	Forestry
IILA Istituto Italo latino Americano - Colombia			40,000.00	44,370.49	Disbursed	ODA	Grant	Mitigation	Other (Conflict prevention and resolution, peace and security)
IILA Istituto Italo latino Americano - Ecuador			100,000.00	110,926.23	Disbursed	ODA	Grant	Adaptation	Other (Health General)
IMF Somalia			360,000.00	399,334.44	Disbursed	ODA	Grant	Cross-cutting	Other (Government and Civil Society, general)
International Institute for Sustainable Development			20,000.00	22,185.25	Disbursed	ODA	Grant	Mitigation	Other (Environmental Policy and Administrative Management)
UNDP Albania			106,000.00	117,581.81	Disbursed	ODA	Grant	Cross-cutting	Other (Government and Civil Society, general)
UNDP Egypt			960,000.00	1,064,891.85	Disbursed	ODA	Grant	Cross-cutting	Other (Environmental Policy and Administrative Management)
UNDP Gaza			400,000.00	443,704.94	Disbursed	ODA	Grant	Cross-cutting	Other (Other infrastructure and services)
UNDP LAC			379,371.20	420,822.19	Disbursed	ODA	Grant	Mitigation	Other (Tourism)
UNDP Tunisia			414,733.91	460,048.71	Disbursed	ODA	Grant	Cross-cutting	Other (Government and Civil Society, general)
UNECE Western Balkans			48,000.00	53,244.59	Disbursed	ODA	Grant	Cross-cutting	Water and sanitation
UNEP Serbia			229,000.00	254,021.08	Disbursed	ODA	Grant	Mitigation	Other (Biosphere Protection)
UNESCO Iraq			120,000.00	133,111.48	Disbursed	ODA	Grant	Cross-cutting	Other (Site preservation)
UNESCO Jordan			200,000.00	221,852.47	Disbursed	ODA	Grant	Mitigation	Other (Environmental education/training)
UNICEF Ethiopia			180,000.00	199,667.22	Disbursed	ODA	Grant	Cross-cutting	Other (Emergency Response)
UNIDO Myanmar			320,000.00	354,963.95	Disbursed	ODA	Grant	Cross-cutting	Industry
UNOPS Myanmar			54,884.80	60,881.64	Disbursed	ODA	Grant	Cross-cutting	Other (Government and Civil Society, general)
UNRWA West Bank and Gaza			400,000.00	443,704.94	Disbursed	ODA	Grant	Adaptation	Other (Emergency Response)
WFP El Salvador			291,847.60	323,735.55	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Specialized United Nations bodies	42,880,192.29	47,565,382.47	41,634,123.28	46,183,165.05					
1. United Nations Development Programme	3,906,000.00	4,332,778.70	294,000.00	326,123.13					

UNDP Voluntary Contribution	3,906,000.00	4,332,778.70	294,000.00	326,123.13	Disbursed	ODA	Grant	Cross-cutting	Not applicable
2. United Nations Environment Programme			3,300,000.00	3,660,565.72					
UNEP Voluntary Contribution			2,400,000.00	2,662,229.62	Disbursed	ODA	Grant	Adaptation	Other (Environmental Policy and Administrative Management)
UNEP CCAC			450,000.00	499,168.05	Disbursed	ODA	Grant	Mitigation	Cross-cutting
Climate and Clean Air Coalition Trust Fund			450,000.00	499,168.05	Disbursed	ODA	Grant	Cross-cutting	Not applicable
3. Other	38,974,192.29	43,232,603.77	38,040,123.28	42,196,476.20					
FAO	14,302,919.99	15,865,690.51	7,945,803.60	8,813,980.70	Disbursed	ODA	Grant	Adaptation	Not applicable
FAO Emergency Projects			200,000.00	221,852.47	Disbursed	ODA	Grant	Adaptation	Other (Emergency Response)
FAO International Alliance on Climate Smart Agriculture			400,490.01	444,248.49	Disbursed	ODA	Grant	Adaptation	Other (Environmental Policy and Administrative Management)
World Food Programme	6,324,168.00	7,015,161.40	4,216,112.00	4,676,774.27	Disbursed	ODA	Grant	Adaptation	Not applicable
IFAD	8,116,416.30	9,003,234.94	18,938,304.70	21,007,548.20	Disbursed	ODA	Grant	Cross-cutting	Not applicable
UNECE Water Convention			100,000.00	110,926.23	Disbursed	ODA	Grant	Adaptation	Water and sanitation
UNCCD			118,318.00	131,245.70	Disbursed	ODA	Grant	Cross-cutting	Not applicable
UNIDO	5,807,996.00	6,442,591.24			Disbursed	ODA	Grant		Not applicable
United Nations World Tourism Organization			137,106.40	152,086.97	Disbursed	ODA	Grant	Cross-cutting	Other (Tourism)
UNOPS			5,051,469.77	5,603,405.18	Disbursed	ODA	Grant	Mitigation	Other (Environmental Policy and Administrative Management)
CERF	600,000.00	665,557.40	400,000.00	443,704.94	Disbursed	ODA	Grant	Cross-cutting	Not applicable
IAEA TCF	2,622,692.00	2,909,253.47			Disbursed	ODA	Grant		Not applicable
UNESCO WWAP			532,518.80	590,703.05	Disbursed	ODA	Grant	Adaptation	Water and Sanitation
UNFPA	1,200,000.00	1,331,114.81			Disbursed	ODA	Grant	Cross-cutting	Not applicable
2016									
Total contributions through multilateral channels	461,851,541.55	510,728,233.48	139,627,804.87	154,404,295.98					
Multilateral climate change funds	14,848,000.00	16,419,329.87	31,504,736.12	34,838,810.27					
1. Global Environment Facility	14,848,000.00	16,419,329.87	22,272,000.00	24,628,994.80	Disbursed	ODA	Grant	Cross-cutting	Not applicable

2. Least Developed Countries Fund			1,793,078.72	1,982,836.14	Disbursed	ODA	Grant	Adaptation	Other (Environmental policy and administrative management)
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			7,439,657.40	8,226,979.33					
African Climate Change Fund			4,700,000.00	5,197,390.25	Disbursed	ODA	Grant	Mitigation	Energy
IPCC			250,000.00	276,456.93	Disbursed	ODA	Grant	Cross-cutting	Not applicable
UNFCCC Contributions			2,489,657.40	2,753,132.15	Disbursed	ODA	Grant	Cross-cutting	Not applicable
Multilateral financial institutions, including regional development banks	426,362,468.24	471,483,432.74	77,080,269.72	85,237,498.30					
1. World Bank	170,988,563.40	189,083,891.85	35,043,296.60	38,751,848.50	Disbursed	ODA	Grant	Cross-cutting	Not applicable
2. International Finance Corporation									
3. African Development Bank	44,896,982.16	49,648,327.06	11,699,121.84	12,937,213.14	Disbursed	ODA	Grant	Cross-cutting	Not applicable
4. Asian Development Bank	19,725,474.28	21,812,976.09	3,211,123.72	3,550,949.60	Disbursed	ODA	Grant	Cross-cutting	Not applicable
5. European Bank for Reconstruction and Development	4,299,900.00	4,754,948.58	2,215,100.00	2,449,518.96	Disbursed	ODA	Grant	Cross-cutting	Not applicable
6. Inter-American Development Bank	4,887,330.50	5,404,545.50	1,001,019.50	1,106,955.10	Disbursed	ODA	Grant	Cross-cutting	Not applicable
7. Other	181,564,217.90	200,778,743.66	23,910,608.06	26,441,013.00					
Caribbean Development Fund - Special Development Fund	1,525,000.00	1,686,387.26	975,000.00	1,078,182.02	Disbursed	ODA	Grant	Cross-cutting	Not applicable
Caribbean Development Bank	1,128,609.80	1,248,047.99	721,570.20	797,932.32	Disbursed	ODA	Grant	Cross-cutting	Not applicable
AIIB	158,416,531.00	175,181,390.03			Disbursed	ODA	Grant	Cross-cutting	Not applicable
IRENA			1,230,260.58	1,360,456.24	Disbursed	ODA	Grant	Mitigation	Not applicable
UNIDO ITPO (Investment and Technology Promotion Office) - Iran			59,850.00	66,183.79	Disbursed	ODA	Grant	Cross-cutting	Industry
Bioversity International			2,500,000.00	2,764,569.28	Disbursed	ODA	Grant	Cross-cutting	Agriculture
UNFCCC - SIDS			250,000.00	276,456.93	Disbursed	ODA	Grant	Mitigation	Other (Environmental policy

									and administrative management)
REC - Building Bridges - Caribbean			40,000.00	44,233.11	Disbursed	ODA	Grant	Cross-cutting	Other (Environmental policy and administrative management)
International Institute for Sustainable Development			200,000.00	221,165.54	Disbursed	ODA	Grant	Cross-cutting	Other (Environmental policy and administrative management)
REC - CEE			100,585.00	111,229.68	Disbursed	ODA	Grant	Cross-cutting	Other (Environmental policy and administrative management)
EBRD Montenegro Water Sector Reform	42,000.00	46,444.76	28,000.00	30,963.18	Disbursed	ODA	Grant	Cross-cutting	Water and Sanitation
EBRD Former Yugoslav Republic of Macedonia / Europe / public solar lamps donation			38,786.00	42,890.63	Disbursed	ODA	Grant	Mitigation	Other (Government and civil society general)
EBRD CEI Fund	25,590.00	28,298.13	17,060.00	18,865.42	Disbursed	ODA	Grant	Mitigation	Agriculture
EBRD Serbia	44,400.00	49,098.75	29,600.00	32,732.50	Disbursed	ODA	Grant	Cross-cutting	Industry
EBRD Serbia	14,897.40	16,473.96	9,931.60	10,982.64	Disbursed	ODA	Grant	Adaptation	Other (Disaster prevention and preparedness)
EBRD Serbia	18,444.60	20,396.55	12,296.40	13,597.70	Disbursed	ODA	Grant	Cross-cutting	Other (Disaster prevention and preparedness)
EBRD Europe	9,078.00	10,038.70	6,052.00	6,692.47	Disbursed	ODA	Grant	Cross-cutting	Other (Disaster prevention and preparedness)
IOM - International Organisation for Migration			465,312.50	514,555.46	Disbursed	ODA	Grant	Adaptation	Other (Population policies)
OSA Organization States of America			33,026.00	36,521.07	Disbursed	ODA	Grant	Cross-cutting	Water and Sanitation
IILA Istituto Italo latino Americano			200,000.00	221,165.54	Disbursed	ODA	Grant	Adaptation	Other (Government and civil society general)
IEA International Energy Agency - IGAD-Intergovernamental Authority on Development	300,000.00	331,748.31	200,000.00	221,165.54	Disbursed	ODA	Grant	Cross-cutting	Other (Government and civil society general)
IEA International Energy Agency - Climate Change Carribean Community Center			268,499.80	296,914.52	Disbursed	ODA	Grant	Cross-cutting	Energy
IEA International Energy Agency - UN Global Compact Trust Fund	36,000.00	39,809.80	24,000.00	26,539.87	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
CIHEAM - Ethiopia	599,949.00	663,440.23	399,966.00	442,293.49	Disbursed	ODA	Grant	Mitigation	Agriculture
CIHEAM - Libya	660,000.00	729,846.29	440,000.00	486,564.19	Disbursed	ODA	Grant	Mitigation	Other (Fishing)
CEM - Clean Energy Ministerial Secretariat - CEAP	30,000.00	33,174.83	20,000.00	22,116.55	Disbursed	ODA	Grant	Mitigation	Energy
UNDP - Somalia	1,200,000.00	1,326,993.25	800,000.00	884,662.17	Disbursed	ODA	Grant	Cross-cutting	Other (Education Unspecified)

UNDP - Albania	120,000.00	132,699.33	80,000.00	88,466.22	Disbursed	ODA	Grant	Cross-cutting	Other (Education post-secondary)
UNDP - Somalia	600,000.00	663,496.63	400,000.00	442,331.08	Disbursed	ODA	Grant	Cross-cutting	Energy
UNDP - Lebanon	50,100.00	55,401.97	33,400.00	36,934.65	Disbursed	ODA	Grant	Cross-cutting	Industry
UNDP - Morocco			1,000,000.00	1,105,827.71	Disbursed	ODA	Grant	Cross-cutting	Other (Environmental policy and administrative management)
UNEP United Nations Environment Programme - DTIE Egypt	390,431.88	431,750.39	260,287.92	287,833.60	Disbursed	ODA	Grant	Mitigation	Energy
UNEP United Nations Environment Programme - Serbia	66,600.00	73,648.13	44,400.00	49,098.75	Disbursed	ODA	Grant	Adaptation	Other (Biosphere protection)
UNEP United Nations Environment Programme - Biodiversity for sustainable development in the Caribbean	113,948.41	126,007.31	75,965.60	84,004.87	Disbursed	ODA	Grant	Mitigation	Other (Bio-diversity)
UNEP - Inquiry into the Design of a Sustainable Financial System	762,606.05	843,310.90	508,403.95	562,207.18	Disbursed	ODA	Grant	Mitigation	Other (Banking and financial services)
UNICEF - Lebanon	1,440,000.00	1,592,391.91	960,000.00	1,061,594.60	Disbursed	ODA	Grant	Cross-cutting	Other (Education Basic)
WMO - Climate Change Adaptation and Disaster Risk Reduction in Agriculture, South Sahara	493,705.96	545,953.73	329,137.31	363,969.16	Disbursed	ODA	Grant	Adaptation	Other (Education post-secondary)
FAO - Mediterranean Region	180,000.00	199,048.99	120,000.00	132,699.33	Disbursed	ODA	Grant	Cross-cutting	Other (Health Basic)
FAO - South Sahara			1,300,000.00	1,437,576.03	Disbursed	ODA	Grant	Cross-cutting	Agriculture
FAO - Bolivia	483,606.00	534,784.92	322,404.00	356,523.28	Disbursed	ODA	Grant	Cross-cutting	Other (Developmental food aid/Food security assistance)
FAO Bilateral Emergency Fund	1,200,000.00	1,326,993.25	800,000.00	884,662.17	Disbursed	ODA	Grant	Adaptation	Other (Emergency Response)
UNECE - United Nations Economic Commission for Europe - Western Balkans			165,000.00	182,461.57	Disbursed	ODA	Grant	Adaptation	Water and Sanitation
UNHCR - U.N. Office of the United Nations High Commissioner for Refugees - Iraq	264,901.80	292,935.75	176,601.20	195,290.50	Disbursed	ODA	Grant	Cross-cutting	Other (Recontruction relief and rehabilitation)
UNICEF - Ethiopia	1,200,000.00	1,326,993.25	800,000.00	884,662.17	Disbursed	ODA	Grant	Mitigation	Other (Emergency Response)
UNHCR - U.N. Office of the United Nations High Commissioner for Refugees	1,800,000.00	1,990,489.88	1,200,000.00	1,326,993.25	Disbursed	ODA	Grant	Cross-cutting	Other (Emergency Response)
UNICEF Bilateral Emergency Fund	1,800,000.00	1,990,489.88	1,200,000.00	1,326,993.25	Disbursed	ODA	Grant	Cross-cutting	Other (Emergency Response)
UNOPS - Afghanistan			700,000.00	774,079.40	Disbursed	ODA	Grant	Adaptation	Transport

UNIDO - Ethiopia	590,538.00	653,033.29	393,692.00	435,355.52	Disbursed	ODA	Grant	Cross-cutting	Agriculture
UNIDO - China and Cuba	35,280.00	39,013.60	23,520.00	26,009.07	Disbursed	ODA	Grant	Cross-cutting	Industry
UNIDO - Ethiopia	870,000.00	962,070.11	580,000.00	641,380.07	Disbursed	ODA	Grant	Cross-cutting	Industry
UNESCO - Myanmar	252,000.00	278,668.58	168,000.00	185,779.06	Disbursed	ODA	Grant	Cross-cutting	Other (Site preservation)
United Nations Office of Co-ordination of Humanitarian Affairs - Bilateral Emergency Fund	600,000.00	663,496.63	400,000.00	442,331.08	Disbursed	ODA	Grant	Cross-cutting	Other (Emergency Response)
WFP - Syria	600,000.00	663,496.63	400,000.00	442,331.08	Disbursed	ODA	Grant	Cross-cutting	Other (Developmental food aid/Food security assistance)
WFP Somalia	600,000.00	663,496.63	400,000.00	442,331.08	Disbursed	ODA	Grant	Cross-cutting	Other (Emergency Response)
WFP - Syria	1,200,000.00	1,326,993.25	800,000.00	884,662.17	Disbursed	ODA	Grant	Cross-cutting	Other (Emergency Response)
WFP Bilateral Emergency Fund	1,800,000.00	1,990,489.88	1,200,000.00	1,326,993.25	Disbursed	ODA	Grant	Cross-cutting	Other (Emergency Response)
Specialized United Nations bodies	20,641,073.31	22,825,470.87	31,042,799.03	34,327,987.41					
1. United Nations Development Programme	4,650,000.00	5,142,098.86	350,000.00	387,039.70					
UNDP	4,650,000.00	5,142,098.86	350,000.00	387,039.70	Disbursed	ODA	Grant	Cross-cutting	Not applicable
2. United Nations Environment Programme			7,176,197.84	7,935,638.44					
UNEP - CACC (Climate & Clean Air Coalition) Trust Fund			61,000.00	67,455.49	Disbursed	ODA	Grant	Cross-cutting	Other (Environmental policy and administrative management)
UNEP - GEO 6			210,000.00	232,223.82	Disbursed	ODA	Grant	Cross-cutting	Other (Environmental policy and administrative management)
UNEP - IRP			80,000.00	88,466.22	Disbursed	ODA	Grant	Cross-cutting	Other (Environmental policy and administrative management)
UNEP- Global District Energy in Cities initiative (DES)			102,311.84	113,139.27	Disbursed	ODA	Grant	Mitigation	Energy
UNEP Multilateral Fund for the Implementation of the Montreal Protocol			6,722,886.00	7,434,353.64	Disbursed	ODA	Grant	Mitigation	Other (Biosphere Protection)
3. Other	15,991,073.31	17,683,372.01	23,516,601.19	26,005,309.27					
UN PEACE OPERATION			470,411.14	520,193.67	Disbursed	ODA	Grant	Cross-cutting	Other (Environmental policy and administrative management)
UNCCD			1,332,160.00	1,473,139.44	Disbursed	ODA	Grant	Adaptation	Other (Environmental policy

									and administrative management)
UNESCO - WWAP			991,800.00	1,096,759.92	Disbursed	ODA	Grant	Adaptation	Water and Sanitation
FAO	9,888,052.74	10,934,482.74	5,000,000.00	5,529,138.56	Disbursed	ODA	Grant	Cross-cutting	Agriculture
FAO - International Alliance on Climate Smart Agriculture			639,967.22	707,693.49	Disbursed	ODA	Grant	Adaptation	Other (Environmental policy and administrative management)
IFAD - International Fund for Agricultural Development	2,117,444.06	2,341,528.32	4,940,702.82	5,463,566.09	Disbursed	ODA	Grant	Cross-cutting	Agriculture
CIHEAM - International Centre for Advanced Mediterranean Agronomic Studies (UNFAO)			7,664,509.00	8,475,626.45	Disbursed	ODA	Grant	Adaptation	Agriculture
UNDESA - High Level Political Forum	270,000.00	298,573.48			Disbursed	ODA	Grant	Cross-cutting	Not applicable
World Food Programme	3,715,576.51	4,108,787.47	2,477,051.01	2,739,191.65	Disbursed	ODA	Grant	Adaptation	Not applicable

Note: Explanation of numerical footnotes is provided in the documentation box after tables 7, 7(a) and 7(b).

Abbreviations: ODA = official development assistance, OOF = other official flows, USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2015 and 2016, where 2018 is the reporting year.

[b] Parties should explain, in their biennial reports, the methodologies used to specify the funds as disbursed and committed. Parties will provide the information for as many status categories as appropriate in the following order of priority: disbursed and committed.

[c] Parties may select several applicable sectors. Parties may report sectoral distribution, as applicable, under “Other”.

[d] This refers to support to multilateral institutions that Parties cannot specify as being climate-specific.

[e] Parties should explain in their biennial reports how they define funds as being climate-specific.

[f] Please specify.

[g] This refers to funding for activities that are cross-cutting across mitigation and adaptation.

Table 8 - Provision of public financial support: contribution through bilateral, regional and other channels in 2013-16

2013	Mitigation									
	Agriculture		Environment		Industry		Water and sanitation		Other	
	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD
Afghanistan										
Africa	60.000	79.660							490.000	650.558
Angola			160.000	212.427						
Brazil									50.000	66.383
China			20.000	26.553						
Ethiopia	2.420.000	3.212.958			20.000	26.553				
Guinea									10.000	13.277
Kenya			150.000	199.150						
Mexico									100.000	132.767
Middle East									400.000	531.067
Mozambique							20.000	26.553		
Pakistan									80.000	106.213
People's Republic of Korea			100.000	132.767						
Philippines									30.000	39.830
South Africa									130.000	172.597
Sudan									10.000	13.277
Tunisia	530.000	703.664								

2013	Adaptation									
	Agriculture		Energy		Environment		Water and sanitation		Other	
	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD
Afghanistan	730.000	969.198								
Africa					20.000	26.553				
Albania	2.000.000	2.655.337							180.000	238.980
Argentina					10.000	13.277				
Cameroon	20.000	26.553					730.000	969.198		
China										
Cuba	1.770.000	2.349.973								
Ecuador					60.000	79.660				
El Salvador									540.000	716.941

Ethiopia	20.000	26.553					80.000	106.213		
Ghana					710.000	942.645				
Haiti									10.000	13.277
Lebanon									20.000	26.553
Mauritania	10.000	13.277								
Middle East	770.000	1.022.305								
Mozambique					1.390.000	1.845.459				
Other (South Sudan)									1.240.000	1.646.309
Senegal					10.000	13.277			630.000	836.431
SIDS			380.000	504.514						
Turkmenistan									50.000	66.383
Viet Nam									60.000	79.660
Zimbabwe					10.000	13.277				

2013	Cross-cutting											
	Agriculture		Energy		Environment		Forestry		Water and sanitation		Other	
	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD
Africa					40.000	53.107					30.000	39.830
Albania	1.200.000	1.593.202										
Argentina			80.000	106.213	20.000	26.553						
Benin									10.000	13.277		
Bolivia			310.000	411.577	10.000	13.277						
Brazil			3.020.000	4.009.559	20.000	26.553						
Burundi	10.000	13.277									30.000	39.830
China			8.350.000	11.086.033	2.080.000	2.761.551						
Democratic Republic of the Congo											40.000	53.107
Eastern Europe			2.880.000	3.823.686	180.000	238.980						
Ecuador					60.000	79.660						
Haiti					10.000	13.277						
Iraq											2.070.000	2.748.274
Kenya	20.000	26.553										
Mauritania	590.000	783.324										
Mediterranean Area			360.000	477.961								
Middle East	320.000	424.854										
Montenegro					2.850.000	3.783.856						
Mozambique											160.000	212.427
Nicaragua											40.000	53.107
Niger											20.000	26.553
Peru							10.000	13.277				
Senegal	200.000	265.534									30.000	39.830
SIDS					900.000	1.194.902						

Tanzania	30.000	39.830										
Timor-Leste	20.000	26.553										
Viet Nam					20.000	26.553						

2014	Mitigation									
	Agriculture		Energy		Forestry		Water and sanitation		Other	
	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD
Albania	60.000	79.607								
Benin									20.000	26.536
Bolivia			430.000	570.519			390.000	517.447		
Bosnia and Herzegovina									1.200.000	1.592.145
Brazil	10.000	13.268								
Guinea Bissau	130.000	172.482	200.000	265.358						
Kenya									120.000	159.215
Lebanon			840.000	1.114.502					30.000	39.804
Mozambique									40.000	53.072
Niger	8.000.000	10.614.303								
Peru			20.000	26.536	170.000	225.554				
Senegal	10.000	13.268					20.000	26.536		
South Africa							10.000	13.268		
Sri Lanka	130.000	172.482								
Tanzania			40.000	53.072						
Togo			20.000	26.536						
Uganda			40.000	53.072						
Viet Nam	60.000	79.607					560.000	743.001		

2014	Adaptation									
	Agriculture		Energy		Forestry		Water and sanitation		Other	
	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD
Afghanistan									10.000	13.268
Africa							200.000	265.358		
Bolivia	10.000	13.268								
Burkina Faso	190.000	252.090								
Cameroon							50.000	66.339		
Ethiopia							40.000	53.072	10.000	13.268
Guinea Bissau							20.000	26.536		
Lebanon									180.000	238.822
Malawi							20.000	26.536		
Middle East	10.000	13.268								
Morocco	10.000	13.268								
Mozambique	10.000	13.268					220.000	291.893		
Myanmar					80.000	106.143				

Nicaragua					20.000	26.536					
Niger										10.000	13.268
Other (South Sudan)										400.000	530.715
SIDS			390.000	517.447							
Sri Lanka	10.000	13.268									
Tanzania							20.000	26.536			

2014	Cross-cutting													
	Agriculture		Energy		Environment		Forestry		Industry		Water and sanitation		Other	
	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD	Domestic currency	USD
Africa													450.000	597.055
Algeria											10.000	13.268		
Angola					250.000	331.697								
Bolivia	60.000	79.607					470.000	623.590						
Brazil			650.000	862.412										
Burkina Faso	60.000	79.607												
China			670.000	888.948									160.000	212.286
Congo			30.000	39.804										
Democratic Republic of the Congo	40.000	53.072												
Eastern Europe													740.000	981.823
Ecuador	10.000	13.268												
Egypt	400.000	530.715												
Eritrea											30.000	39.804		
Ethiopia	330.000	437.840							50.000	66.339				
Guinea Bissau														
Honduras	60.000	79.607											140.000	185.750
Kenya											430.000	570.519		
Maldives													30.000	39.804
Mali			10.000	13.268							60.000	79.607		
Mexico													10.000	13.268
Middle East	30.000	39.804											1.120.000	1.486.002
Montenegro			2.040.000	2.706.647										
Morocco			30.000	39.804							30.000	39.804		
Mozambique			10.000	13.268										
Myanmar													190.000	252.090
Nepal	10.000	13.268												
Nicaragua													40.000	53.072
Pakistan													40.000	53.072
Senegal	630.000	835.876	90.000	119.411									150.000	199.018
Serbia													320.000	424.572
Seychelles	10.000	13.268											10.000	13.268

SIDS												50.000	66.339		
Tanzania	70.000	92.875												40.000	53.072
Tunisia			790.000	1.048.162										210.000	278.625
Zimbabwe			20.000	26.536											

2015	Mitigation													
	Agriculture		Energy		Environment		Forestry		Industry		Water and Sanitation		Other	
	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD
Afghanistan													51.000	56.572
Africa			1.400	1.553										
Africa			15.093.579	16.742.739										
Albania	241	267									118	131		
Algeria			20.000	22.185										
Argentina	60.149	66.721			36.433	40.414								
Asia Pacific			600.000	665.557										
Belarus														
Benin	5.554	6.160					53.513	59.360			38.000	42.152	12.060	13.378
Bolivia	17.808	19.753			806	894					355.711	394.577		
Bosnia and Herzegovina	89	98												
Brazil	147.863	164.019			45.000	49.917							34.217	37.955
Burkina Faso	188.399	208.984					9.474	10.510			27.920	30.971	3.418	3.792
Burundi			1.160	1.287										
Cameroon	20.004	22.189	30.000	33.278										
Chad	24.767	27.473					3.296	3.656					17.433	19.338
China					7.880	8.741								
Colombia	10.020	11.115									8.000	8.874	5.730	6.356
Congo											20.000	22.185		
Côte d'Ivoire											12.000	13.311		
Cuba	154.695	171.597												
Democratic People's Republic of Korea	135.572	150.385												
Democratic Republic of the Congo	34.340	38.093											236.328	262.149
Ecuador	258.362	286.591											21.165	23.478
Egypt													30.000	33.278
El Salvador					424.000	470.327					10.000	11.093		
Ethiopia	363.262	402.952					40.000	44.370	68.000	75.430	194.711	215.986	121.497	134.772
Ghana					3.754	4.164	20.000	22.185			2.640	2.928		
Guatemala	1.600	1.775			1.500	1.664								
Guinea	130.955	145.263												
Guinea-Bissau	112.858	125.189												
Haiti	8.050	8.930											4.511	5.004

Honduras	4.831	5.359												
India	78.593	87.180			8.924	9.899							374.932	415.898
Indonesia							22.000	24.404						
Kenya	548.019	607.897	755	837	76.750	85.136							218.815	242.723
Latin America and the Caribbean											4.000	4.437		
Lebanon			897.732	995.820	1.562.109	1.732.788					20.000	22.185		
Lesotho														
Madagascar							5.196	5.764			10.000	11.093	32.931	36.529
Mauritania	527.841	585.514												
Mexico	16.174	17.941									8.000	8.874	4.000	4.437
Middle East and North Africa													505.210	560.410
Morocco			9.320	10.338										
Mozambique	542.407	601.672			641.461	711.549					105.281	116.784	280.051	310.650
Myanmar	377.432	418.671			248.924	276.122							42.226	46.840
Nepal	4.608	5.111			136.553	151.474								
Nicaragua	4.867	5.399												
Niger	179.312	198.904					11.835	13.128						
Nigeria													5.540	6.146
Other (North and Central America)	48.000	53.245			83.200	92.291							160.000	177.482
Other (South Sahara)													34.221	37.960
Other (West Bank and Gaza)	737.292	817.850	11.964	13.271							264.506	293.406	2.000	2.219
Pakistan			11.440	12.690									46.309	51.369
Peru	26.075	28.924	20.000	22.185					8.721	9.674			9.803	10.874
Philippines	67.371	74.732											13.938	15.461
Republic of Moldova											9.600	10.649		
Senegal	43.446	48.193	41.755	46.317	3.526	3.911					184.661	204.837	127.239	141.142
Serbia	5.761	6.391												
Sierra	8.043	8.922												
Somalia	174.815	193.916									56.192	62.331		
Sri Lanka	146.229	162.206												
Sudan													262.156	290.799
Tanzania	4.000	4.437	1.000	1.109							40.600	45.036	54.000	59.900
Togo											7.000	7.765		
Tunisia	6.565	7.282			7.400	8.209					16.000	17.748	4.000	4.437
Uganda	28.822	31.971	4.200	4.659							11.722	13.003		
Uruguay					13.320	14.775							1.360	1.509
Vietnam	62.342	69.154									187.840	208.364		
Zambia											5.091	5.647	16.830	18.669
Developing countries	2.016	2.236	87.277	96.813			21.770	24.149						

2015	Adaptation											
	Agriculture		Environment		Industry		Transport		Water and Sanitation		Other	
	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD
Afghanistan	196.216	217.655									435.796	483.412
Africa	4.000.000	4.437.049										
Algeria									123.000	136.439	90.000	99.834
Angola	20.667	22.925										
Argentina			6.600	7.321							13.320	14.775
Bangladesh											260.207	288.638
Benin	62.419	69.239							64.965	72.063		
Bolivia	20.000	22.185			15.000	16.639			6.340	7.033		
Bosnia and Herzegovina					9.392	10.418	10.000	11.093	5.806	6.440		
Brazil									10.000	11.093		
Burkina Faso	318.717	353.541							2.334.903	2.590.019	20.527	22.769
Burundi	20.000	22.185										
Cameroon	170.651	189.297							76.680	85.058	279.525	310.067
Cape Verde	46.936	52.064										
Chad	103.916	115.270							9.238	10.248	2.000	2.219
China											1.500	1.664
Colombia									6.300	6.988		
Côte d'Ivoire									8.000	8.874	6.708	7.441
Cuba											1.000	1.109
Democratic Republic of the Congo	83.408	92.521							97.840	108.530	113.779	126.211
Ecuador					13.600	15.086			6.386	7.084		
Egypt	36.000	39.933										
El Salvador											22.304	24.741
Eritrea	19.824	21.990									90	100
Ethiopia	51.260	56.861			10.098	11.201			83.968	93.143	1.309.553	1.452.638
Ghana											39.800	44.149
Guatemala									30.832	34.201	146.020	161.974
Guinea-Bissau	11.569	12.833										
Haiti	64.964	72.062									4.672	5.182
Honduras											143.904	159.627
India	62.639	69.483							33.297	36.935	173.963	192.971
Indonesia									5.820	6.456		
Iran (Islamic Republic of)			13.200	14.642								
Iraq			389.124	431.641					84.160	93.356		
Jordan									154	170		
Kenya									146.290	162.273	400.730	444.515
Lebanon									90.234	100.093	10.430	11.570
Lesotho			5.000.000	5.546.312								
Madagascar									18.750	20.799	9.356	10.379
Mali	16.166	17.932							20.016	22.203	1.695.000	1.880.200
Montenegro	34.000	37.715										

Morocco	7.696	8.537										
Mozambique	53.801	59.680							190.251	211.038	566.389	628.274
Myanmar									14.080	15.618	18.695	20.737
Nepal									7.441	8.254	41.694	46.250
Nicaragua									10.579	11.735		
Niger	69.670	77.282	52.821	58.592							6.429	7.131
Nigeria									44.551	49.419		
Other (Kosovo)							1.498	1.661				
Other (South Sahara)											70.123	77.785
Other (South Sudan)	3.855	4.276									70.470	78.170
Other (West Bank and Gaza)	400	444							30.000	33.278		
Palau			224.572	249.109								
Paraguay	17.254	19.139									67.912	75.332
Peru	3.226	3.578							4.520	5.014	16.387	18.177
Philippines											1.200	1.331
Republic of Moldova											35.400	39.268
Rwanda									9.344	10.365		
Sao Tome and Principe	88.884	98.596										
Senegal	221.854	246.094							38.267	42.448	1.235.805	1.370.832
Sierra	7.600	8.430										
Somalia									106.518	118.156	38.747	42.981
Sudan											515.000	571.270
Tanzania	5.200	5.768							66.926	74.238		
Thailand											69.844	77.475
Togo	80.615	89.423							6.600	7.321		
Tunisia	1.102.645	1.223.123							2.500	2.773		
Turkmenistan									20.000	22.185		
Uganda	80.457	89.248										
Vanuatu											1.000.000	1.109.262
Vietnam			5.123	5.682					16.606	18.420		
Developing countries			25.000	27.732					7.064	7.836		

2015	Cross-cutting													
	Agriculture		Energy		Environment		Forestry		Industry		Other		Water and Sanitation	
	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD
Afghanistan											2.000.000	2.218.525		
Africa	111.376	123.546									1.084.513	1.203.009		
Albania	15.000	16.639			55.000	61.009					433.881	481.288		
Algeria	17.800	19.745												
Angola					211.601	234.721								
Argentina											120.453	133.614		

Armenia	96.333	106.859												
Asia Pacific			6.000.000	6.655.574										
Belarus											1.789	1.984		
Benin	365.871	405.847											4.000	4.437
Bolivia	570.479	632.811	498.135	552.562	901.273	999.748					944	1.047	60.000	66.556
Bosnia and Herzegovina	15.123	16.775									105.455	116.978		
Botswana					2.000.000	2.218.525								
Brazil	496.728	551.002			18.000	19.967	99.035	109.856			3.416	3.790		
Burkina Faso	1.359.518	1.508.062	24.000	26.622									8.220	9.118
Burundi	36.000	39.933												
Cambodia	44.680	49.562												
Cape Verde	16.057	17.811												
Chad	361.953	401.501												
China	29.827	33.086			600	666					416.358	461.851		
Colombia	155.261	172.225			13.200	14.642								
Comoros					1.352.250	1.500.000								
Côte d'Ivoire	37.000	41.043									16.006	17.754		
Cuba	503.011	557.971			41.000	45.480					5.455	6.051		
Democratic People's Republic of Korea	36.324	40.292												
Democratic Republic of the Congo	538.750	597.615									16.450	18.248	24.000	26.622
Eastern Europe											827	917		
Ecuador	51.220	56.816									8.000	8.874		
Egypt	4.000.000	4.437.049			3.606.000	4.000.000					11.267	12.498		
El Salvador											3.241	3.595	150.026	166.418
Eritrea	108.183	120.003											34.400	38.159
Ethiopia	383.045	424.897							79.172	87.822	5.029.490	5.579.024	1.556.993	1.727.114
Gabon	208.866	231.687												
Ghana	88.805	98.508			2.000.000	2.218.525					52.606	58.353	8.000	8.874
Guatemala	173.587	192.55							10.400	11.5	35.822	39.736		

		4								36				
Guinea-Bissau	65.228	72.355							5.324	5.906			18.800	20.854
Haiti	5.455	6.051									5.600	6.212		
Honduras	967	1.072												
India	487.643	540.924									71.791	79.635		
Indonesia	22.000	24.404												
Iran (Islamic Republic of)											3.053.453	3.387.080		
Iraq											1.400	1.553		
Jordan											5.453	6.049		
Kenya	583.248	646.976									120.933	134.147	18.918	20.985
Lebanon	333.325	369.745			32.841	36.429					814.453	903.442	36.412	40.390
Madagascar	49.575	54.992			340	377			9.920	11.004	70.645	78.363		
Malawi	101.427	112.509												
Maldives					4.000.000	4.437.049								
Mali	38.733	42.965											4.671	5.182
Mauritania	25.000	27.732									573	636		
Mexico	11.800	13.089			5.280	5.857					480	532		
Middle East and North Africa	432	479									800	887		
Montenegro											5.455	6.051		
Morocco	41.500	46.034									2.000.000	2.218.525	16.112	17.873
Mozambique	404.584	448.790					45.000	49.917			177.362	196.741	41.235	45.740
Myanmar	763	846									8.255.131	9.157.106		
Namibia											243	270		
Nepal	66.874	74.181												
Nicaragua	7.550.000	8.374.931									33.260	36.894		
Niger	25.045	27.782												
Other (Kosovo)	60.000	66.556												
Other (North and Central America)	1.464	1.624												
Other (South Sahara)											146.782	162.819		
Other (South Sudan)	1.426	1.582									1.256.508	1.393.797	28.000	31.059
Other (West Bank and Gaza)	40.355	44.764			50.658	56.193			6.000	6.656	11.812.390	13.103.039		
Pakistan											15.627	17.334		
Paraguay	20.000	22.185												
Peru	557.735	618.674					30.515	33.849			90.588	100.486		

Philippines	90.000	99.834									27.371	30.361		
Republic of Moldova	18.111	20.090												
Rwanda	94.200	104.493									36.000	39.933		
Senegal	6.092.223	6.757.874			1.280	1.420					127.220	141.120		
Serbia									8.628	9.570	12.173	13.503		
Sierra	20.000	22.185												
Somalia	24.041	26.668			58.934	65.373					14.897	16.524		
South Africa											10.844	12.028		
Sri Lanka	107.425	119.163									11.368	12.610		
Sudan	305	338									296	328		
Syrian Arab Republic											2.000	2.219		
Tanzania	48.046	53.296									9.600	10.649	14.742	16.352
The former Yugoslav Republic of Macedonia													2.236	2.481
Togo	58.914	65.351			11.452	12.703								
Tonga					94.271	104.572								
Tunisia	55.468	61.528			14.500.000	16.084.304					246.528	273.464	1.411	1.565
Turkey					3.520	3.905					16.361	18.149		
Uganda	66.866	74.172									52.422	58.149	16.000	17.748
Uruguay					13.320	14.775								
Vietnam	14.012	15.543									46.819	51.934	560	621
Zambia	23.000	25.513												
Developing countries	801.200	888.741			10.251.903	11.372.050					8.342.921	9.254.488		

2016	Mitigation													
	Agriculture		Energy		Environment		Industry		Transport		Water and Sanitation		Other	
	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD
Afghanistan													39.471	43.648
Africa			25.348	28.030										
Angola			53.678	59.359										
Asia Pacific									44.000	48.656				
Belarus													860	951
Benin	16.000	17.693					13.416	14.835			21.137	23.374	37.610	41.591

Bolivia	29.060	32.135									16.309	18.035	11.200	12.385
Brazil	39.620	43.812									9.257	10.237	38.765	42.868
Burkina Faso	93.867	103.801									17.622	19.487		
Cameroon	1.799	1.990	18.000	19.905									24.000	26.540
Cape Verde	208.884	230.989												
Central African Republic													59.533	65.833
Chile	12.312	13.615												
Colombia	93.976	103.921									17.410	19.253	12.000	13.270
Congo			30.000	33.175										
Costa Rica													814	901
Cuba	317	350												
Democratic Republic of the Congo											33.299	36.823	154.409	170.750
Djibouti													7.794	8.618
Dominican Republic	5.264	5.821												
Eastern Europe											3.200	3.539		
Ecuador	21.666	23.959												
El Salvador	7.599	8.403			11.000	12.164								
Eritrea											32.000	35.386		
Ethiopia	16.000	17.693	3.000	3.317									414.800	458.697
Gambia											10.404	11.505		
Guatemala	38.124	42.159	22.771	25.181										
Guinea-Bissau	78.267	86.550									12.052	13.327		
Haiti	151.061	167.048	72.417	80.081							36.136	39.961		
India	11.183	12.367												
Indonesia											3.600	3.981		
Iraq	95.800	105.938												
Jordan													160.812	177.830
Kenya	108.165	119.611	12.857	14.217									15.581	17.230
Latin America and the Caribbean					155.418	171.865							140.000	154.816
Lebanon	247.200	273.361	5.053.143	5.587.906	470.276	520.045							18.000	19.905
Madagascar	5.632	6.228			92.469	102.254							49.862	55.139
Mali			14.262	15.772							600	663		
Middle East and North Africa													248.605	274.914
Mozambique	90.773	100.379	18.000	19.905							6.000	6.635	268.415	296.820
Myanmar	191.930	212.241											45.378	50.180
Nepal	12.673	14.014	15.960	17.649	95.587	105.703							16.306	18.032
Nicaragua													20.000	22.117
Other (South Sahara)	14.509	16.044											30.264	33.467
Other (South Sudan)	12.554	13.883											35.926	39.728
Other (West Bank and Gaza)	15.808	17.481	32.860	36.337							9.612	10.630	54.968	60.786
Peru	138.278	152.912	4.590	5.076			16.166	17.877					12.565	13.895
Philippines	59.200	65.465												

Rwanda	136.672	151.135												
Senegal	28.241	31.230											67.239	74.355
Serbia	9.788	10.824												
Sierra Leone	7.246	8.012												
South Africa			12.280	13.580										
Sri Lanka	29.166	32.253												
Tanzania	16.000	17.693									13.474	14.899	15.519	17.162
Togo					792	876								
Turkey													160.359	177.330
Uganda	7.684	8.497									900	995		
Uruguay	139.176	153.905												
Viet Nam	76.278	84.351												
Developing countries			30.662	33.906	200.000	221.166								

2016	Adaptation									
	Agriculture		Environment		Forestry		Water and Sanitation		Other	
	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD
Afghanistan	893	987							1.806	1.997
Algeria									5.600	6.193
Benin							6.682	7.389		
Bhutan									2.556	2.826
Bolivia							26.000	28.752		
Bosnia and Herzegovina							65.039	71.922		
Burkina Faso	40.800	45.118					105.916	117.125	54.770	60.566
Burundi	5.600	6.193								
Cameroon							20.833	23.038		
Central African Republic									2.000.000	2.211.655
China									117.134	129.530
Colombia							49.460	54.694		
Côte d'Ivoire							23.000	25.434	32.308	35.727
Cuba									8.400	9.289
Djibouti									8.554	9.459
Dominican Republic							36.075	39.893		
Ecuador							9.114	10.079	30.779	34.037
Egypt									80.000	88.466
Eritrea							32.000	35.386		
Ethiopia	33.840	37.421					6.070.670	6.713.115	898.367	993.439
Gambia									33.182	36.694
Georgia									1.200	1.327
Guatemala									1.000	1.106
Guinea-Bissau							43.600	48.214	40.000	44.233

Haiti									12.598	13.931
India	5.600	6.193							152.710	168.871
Indonesia					12.000	13.270			11.200	12.385
Iraq			194.562	215.152						
Kenya							12.000	13.270	30.000	33.175
Lebanon							10.598.043	11.719.610	43.400	47.993
Madagascar									5.600	6.193
Mali							4.488.780	4.963.817	400.000	442.331
Mexico	2.000	2.212								
Middle East and North Africa	8.945	9.892								
Nepal							72.709	80.403	32.894	36.376
Nicaragua							12.000	13.270	5.600	6.193
Niger	67.785	74.959					27.000	29.857	23.103	25.548
Other (Kosovo)									920	1.017
Other (South Sahara)	10.169.961	11.246.225							3.624.000	4.007.520
Other (South Sudan)							88.000	97.313	43.000	47.551
Other (West Bank and Gaza)									51.050	56.453
Pakistan							19.179	21.208	2.410	2.665
Peru									51.000	56.397
Philippines									4.000	4.423
Rwanda									128.991	142.642
Senegal	5.903	6.528	190.000	210.107			3.200	3.539	47.351	52.362
Serbia									50.000	55.291
Somalia									194.480	215.061
South Africa			25.080	27.734						
Syrian Arab Republic							4.000	4.423	21.000	23.222
Tanzania			21.000	23.222			82.212	90.912	76.517	84.614
Thailand									58.000	64.138
Togo	11.964	13.230					26.667	29.489		
Tunisia									36.141	39.966
Uganda	69.992	77.399					64.062	70.842		
Uruguay									47.584	52.620
Venezuela									25.000	27.646
Viet Nam									1.400	1.548
Developing countries									46.692	51.634

2016	Cross-cutting															
	Agriculture		Energy		Environment		Forestry		Industry		Transport		Water and Sanitation		Other	
	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD	Domestic Currency	USD
Afghanistan															2.230.447	2.466.490
Africa													40.614	44.913	871.158	963.351
Albania	17.308	19.140														
Algeria															680	752
Angola															10.844	11.991
Argentina	53.622	59.296							36.000	39.810					16.974	18.770
Armenia	33.333	36.861														
Asia Pacific					2.997.985	3.315.255										
Bangladesh															4.664	5.157
Benin			3.600	3.981											29.363	32.470
Bolivia	187.543	207.391							8.000	8.847					60.532	66.938
Bosnia and Herzegovina	74.760	82.672													63.200	69.888
Brazil	60.039	66.393													41.274	45.642
Burkina Faso	104.488	115.546					10.160	11.235					22.729	25.135	150.983	166.961
Burundi															31.300	34.612
Cambodia	1.590	1.758													8.000	8.847
Cameroon	195.327	215.998	4.835	5.346											62.648	69.278
Central African Republic	65.045	71.928														
Chad	31.808	35.174													7.200	7.962
Chile	14.210	15.714											3.926	4.341	1.600	1.769
Colombia	278.257	307.704											8.972	9.921	19.533	21.600
Congo					25.371	28.056							14.450	15.979	1.800	1.990
Costa Rica	13.373	14.788													800	885
Côte d'Ivoire	115.113	127.295							3.600	3.981					6.000	6.635
Cuba	36.270	40.108														
Democratic Republic of the Congo	231.324	255.804			89.564	99.043	19.920	22.028					97.840	108.194	227.604	251.691
Djibouti	8.050	8.902														
Dominican Republic	36.066	39.883														
Eastern Europe													1.080	1.194		
Ecuador	118.851	131.429			6.288	6.953									116.099	128.385
Egypt															79.803	88.248
El Salvador	66.008	72.993			5.280	5.839									9.111	10.075
Eritrea																
Ethiopia	240.168	265.584							67.577	74.729			892	986	6.050.013	6.690.272

Gambia	44.745	49.480													1.999	2.211
Ghana													2.667	2.949	36.844	40.743
Guatemala	216.796	239.739														
Guinea-Bissau															42.615	47.125
Haiti	209.313	231.464									96.674	106.905			17.130	18.942
Honduras					16.668	18.432										
India	30.168	33.361			120.706	133.480									31.059	34.346
Indonesia	30.000	33.175			25.000	27.646									12.000	13.270
Iran (Islamic Republic of)															5.812	6.427
Iraq					18.000	19.905									55.056	60.882
Jordan	239.841	265.223													480.000	530.797
Kenya	97.367	107.671											65.669	72.619	38.910	43.027
Lebanon	361.068	399.279											88.047	97.365	138.172	152.794
Libya					4.000	4.423										
Madagascar													19.040	21.055	28.185	31.168
Malawi	9.820	10.859											5.647	6.244		
Mali	11.277	12.470											84.000	92.890		
Mauritania	100.412	111.038													100.000	110.583
Mexico	12.354	13.661			6.103	6.749										
Middle East and North Africa	44.030	48.690													201.760	223.112
Mongolia	50.000	55.291														
Montenegro															5.812	6.427
Morocco													242	268		
Mozambique	49.247	54.459													336.814	372.458
Myanmar	12.404	13.717							9.702	10.729					10.286	11.375
Namibia	10.000	11.058														
Nepal	26.704	29.530													15.962	17.652
Nicaragua	15.910	17.594			27.356	30.251									7.318	8.093
Niger	8.689	9.609													20.000	22.117
Nigeria	33.600	37.156													6.773	7.490
Other (Kosovo)															4.000	4.423
Other (North and Central America)															15.800	17.472
Other (South Sahara)															1.953.645	2.160.395
Other (South Sudan)	62.554	69.174													2.167.800	2.397.213
Other (West Bank and Gaza)	38.115	42.149	6.941.350	7.675.937											7.217.200	7.980.980
Pakistan													11.120	12.297	33.839	37.420
Paraguay															27.230	30.112
Peru	124.736	137.937	1.600.000	1.769.324	35.000	38.704									35.947	39.751
Philippines	48.661	53.811													7.352	8.130

Rwanda															34.200	37.819
Senegal	430.778	476.367											10.560	11.678	65.057	71.942
Serbia															54.048	59.768
Sierra Leone	14.616	16.163													8.000	8.847
Somalia	14.110	15.603											12.743	14.092	10.032	11.094
Sri Lanka	24.354	26.931														
Sudan													960.000	1.061.595	15.275	16.892
Syrian Arab Republic															1.200.000	1.326.993
Tanzania	490.515	542.425	16.830	18.611											46.377	51.285
Timor-Leste															45.600	50.426
Togo	36.401	40.254													2.667	2.949
Tunisia	25.076	27.730														
Turkey															17.768	19.648
Uganda	10.000	11.058													29.199	32.289
Uruguay					19.034	21.048										
Viet Nam	4.000	4.423											21.022	23.247	17.040	18.843
Zambia							5.520	6.104							101.192	111.901
Zimbabwe															11.184	12.368
Developing countries	921.200	1.018.688	32.021	35.409	17.815.674	19.701.066							3.910	4.324	8.578.613	9.486.468

The summary table format is based on Guidelines for the preparation of national communications included in Part II of UNFCCC guidelines on reporting and review (FCCC/CP/1999/7). Sectoral grouping takes into account the relevant sectors suggested in the draft guidelines under discussion.

According to the OECD DAC sector classification, “Environment” includes the following sectors: Environmental policy and administrative management, Biosphere protection, Bio-diversity, Site preservation, Flood prevention/control, Environmental education/training, Environmental research. “Other” includes all the other sectors detailed in the Biennial Report 2 and 3.

7.4 Activities related to transfer of technology

Enhancing climate technology development and transfer to developing countries for adaptation and mitigation actions and increase energy efficiency is crucial for addressing the global challenges of energy security, climate change and economic development with the aim to improve resilience to climate change and to reduce GHG emissions.

In order to contribute actively to this process, Italy is involved in several bilateral cooperation activities mainly focused on the energy sector with many developing countries with a particular attention to African Countries and Small Islands Developing States.

In recent years, Italy has significantly intensified the number of Memorandum of Understanding with developing countries to implement projects related to mitigation and adaptation measures, which foresee the transfer of technologies according to the needs and specific circumstances of the receiving countries. All the projects implemented, under implementation or planned, consider knowledge transfer and adequate and specific training courses for the installation and maintenance of the equipment (soft technologies) in addition to the essential transfer of technologies (hard technologies).

Taking into account lessons learned and previous failures, during the implementation phase of each relevant project, endogenous people are constantly involved in the installation and operation startup of plants. Following this phase, tailored training programmes to local beneficiaries are organized to ensure proper control, function and routine maintenance.

With regard to reporting and monitoring activities, the Guiding Principles for the bilateral cooperation Mechanism foresee that each project shall be monitored, through the production of periodic reports and technical evaluations approved by the Joint Committee, including, as appropriate, field missions and on-site visits. The Parties annually prepare a report on the activities under the MoU and a third independent party carries out a final audit within six months of termination or expiration of the MoU.

Such evaluation system, foreseen for each MoU, allows to verify both the status of technology transfer and the realization of training courses including the results achieved in the various phases of the project implementation.

Regarding the private sector involvement, as a general approach, when drafting bilateral cooperation agreements, IMELS investigates the potential contribution of the private sector, mainly through provision of technologies core and expertise, and shapes the collaboration with the partners to facilitate private sector contribution to the technical and practical implementation of the projects. In particular, IMELS uses two different ways of involving the private sector: the first consists in publishing calls for interest for a specific sector, for a country or a region on the Ministry's website before organizing the technical missions to define the needs with the beneficiary country; the second concerns the identification of companies holding specific technologies to implement projects already established with the receiving countries. Finally, IMELS organizes seminars, workshops and events to disseminate opportunities related to bilateral cooperation and technology transfer activities, involving companies from the pertinent sectors and organizing business-to-business meetings.

Table 4 Success and failure stories related to technology transfer

Project / Program title			
Heat Pump Project – Phase 1 under the technical agreement on sustainable development cooperation between the Italian Ministry for the Environment Land and Sea (IMELS) and the Lebanese Center for Energy Conservation (LCEC)			
Purpose			
Support to the Lebanese Government in addressing the climate change mitigation challenges presented in the NDC under the UNFCCC by introducing "heat pump" technologies in the heating, domestic hot water production and cooling sectors (for residential and tertiary applications mainly) through knowhow and technology transfer in line with the European legislation and the phasedown of the high global warming potential refrigerant gases (hydrofluorocarbons HFCs) established under the Montreal Protocol.			
Recipient Country	**Sector**	**Total funding**	**Years in operation**
Lebanon	Energy	1.976.766 €	2016ongoing
Description			
The project aims to: - Ensure the quality of products on the market, in line with the European legislation and Montreal Protocol's phasedown of the HFCs; - Establish a capacity and infrastructure which can make Lebanon a landmark for Energy Efficiency in Middle Eastern countries for Lebanese assemblers of components, for potential future local manufacturers of heat pumps and air conditioners, for research institutes working on heating and cooling technologies; - Ensure the quality in design and installation of technologies for domestic hot water, heating and cooling plants; - Demonstrate the economic and environmental advantage of such systems through pilot applications in Lebanese buildings (residential and tertiary sectors mainly).			
Indicate factors which led to project's success:			
Collaboration among the Lebanese public administration, private sector and research institutes.			
Technology transferred			
Vapour compression technologies (e.g. air conditioners and heat pumps)			
Impact on greenhouse gas emission/sinks (optional):			

Project / Program title

Arrangement on sustainable development finance between the Italian Ministry for the Environment, Land and Sea and the Bank of Lebanon

Purpose

Support energy saving and efficiency investments in Lebanon through a grant from Italian Ministry for Environment, Land and Sea to the the Bank of Lebanon to support National Energy Efficiency and Renewable Energy Action (NEEREA) in all economic sectors except the residential one.

Recipient Country	Sector	Total funding	Years in operation
Lebanon / Bank of Lebanon	Energy renewables	5.000.000,00 €	2016ongoing

Description

The Agreement signed in 2016 between the Ministry for the Environment and the Protection of the Territory and Sea and the Bank of Lebanon aims to create a financial mechanism to facilitate, through the Lebanese trading banking system, an eased financing line for projects in the field of renewable energies and energy saving.

Indicate factors which led to project's success:

Driving force behind the project is a substantial private sector involvement

Technology transferred

Soft and hard technologies for mitigation of and adaptation to climate change

Impact on greenhouse gas emission/sinks (optional):

The technology that will be promoted and deployed will contribute to reducing GHG emissions and increasing energy efficiency.

Project / Program title

Sustainable Program of a widespread rural electrification for water and energy security

Purpose

The Pilot Project aims in: (1) promoting the sustainability of renewable energy technologies in rural area, (2) deploying energy services, (3) creating awareness and (4) providing training and employment opportunities at the community level in renewable energy sector.
Environmental objectives will be achieved ensuring renewable energies, contributing to reduce the use of fossil fuels avoiding CO_2 emissions. In addition, the installation of water, telecommunication and sanitary facilities will provide the population with stronger adaptation measures to extreme weather events.

Recipient Country	Sector	Total funding	Years in operation
Pacific region / Solomon Islands	Energy renewable	956.129,00 €	2016 ongoing

Description

This project resulted from a Joint Declaration signed in 2016 in New York between Solomon Islands and Italy during the week of the Ceremony for the Paris Agreement, by which Italy renewed its commitment on climate cooperation within the PSDISItaly MoU and envisioned new activities on technology and capacities transfer supported also by Italian technical missions to the Pacific.
Therefore, in June 2016, the Italian Ministry for Environment charged Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) for carrying out a technical mission to the Solomon Islands.
The main addressed purposes comprised to monitor results of concluded projects, put together lessons learnt and pilot new activities directly evaluated onsite, in a followup process.
Hence Italian technicians were firstly guided by the local Government representatives in the outer Islands on the sites of the rural electrification projects concluded almost six years before. In these places, technicians had the opportunity of talking with the rural people directly involved and to gather useful findings for the forthcoming activities requested by the local Governments.
The main outcome of the mission was the revealing of a widespread malfunction of the solar systems installed between 2008 and in 2010, due to a shortage of maintenance for a lack of technical knowledge and capacities.
Therefore a new project of rural electrification was planned during different steps of consultation among the stakeholders with the aim of establishing even more local and tailor made solutions for the small scale needs. The new project will install 16 plants in two provinces of the Solomon Islands (such as Malaita and Western) and, since it has been planned for small villages of an average size of 200 inhabitants, it has been estimated that it will involve almost 3.000 people who lives in absence of essential energy services. The local communities will be selected, informed and committed for the correct system maintenance. In addition, 30 people, among teachers and students, will be trained on topics as design, selection and maintenance of a PV system in order to obtain, at the end of the course, the availability of a local and skilled group able to operate a low cost and effective maintenance service for the installed plants.

Indicate factors which led to project's success:

Robustness in the time of the solar systems installed is an important goal that will be achieved through the technical economic optimized selection of reliable and high efficiency components, the creation of microenterprises for maintenance, a choice of beneficiary communities to commit themselves, at the end of the project, to pay for the maintenance of the plant.

Technology transferred

A specific set of training activities in Technical Don Bosco Institute (TDBI) in Solomon Islands will be implemented consisting of a theoretical and practical course on design, selection, installation and maintenance of photovoltaic and pumping systems. Handbooks, presentations and ancillary software will be prepared; a didactic workshop will set up. A fulltime course for 30 people will be implemented: two groups of about 10 young people will be selected also from those who are already training at the TDBI. Among participants 10 teachers of the TDBI will be included. The learning group will attend a theoretical course of 15 days including workshop activities. At the end the students will be involved in an internship during the installation of the 16 PV systems.

At the end of the training, the project will support the creation of two Youth MicroEnterprises (YME) in the two provinces to provide maintenance service to the 16 PV system installed and to operate as a local Energy Service Company (ESCO). Each YME will be equipped with an operating office, working and measurement tools, stock of spare parts and all equipment to ensure prompt action in the plant maintenance. The YME will be assisted for the improvement of their market visibility (website, brochure, local events, spot radio, etc.). Assistance will be provide for the legal and financial aspects related to the possibility to operate as ESCO. The YME will be assisted by the possible formation of joint venture with Italian companies in the sector.

Impact on greenhouse gas emission/sinks (optional):

The emission avoided by the operation of the 16 photovoltaic systems compared with the exercise of diesel power generators is 64 t CO2/year.

Project / Program title

Donor agreement between the Italian Ministry for the Environment Land And Sea (IMELS) and United Nations Environment Programme (UNEP)

Purpose

The aim of the project is promoting strategy and paving the way for the deployment renewable energy technologies in Egypt, contributing to the Programme entitled “Mediterranean Investment Facility (MIF)”.

Recipient Country	Sector	Total funding	Years in operation
Egypt / Africa (North of Sahara)	Energy renewables	2.169.066,10 €	2016ongoing

Description

Contribution to the Programme to put in place financial mechanisms to support renewable energy and energyefficiency systems, to ensure the sustainability of the market by strengthening the capacity of local stakeholders. Implementation project and financing arrangements include:

- identification of the key stakeholders;
- proposed financial support mechanism, including identification of possible cofinancing sources such as any ongoing of planned Government programs, other multi or bilateral support, private sector financing;
- capacity building measures;
- policy measures to create an enabling environment to promote the identified technology.

Indicate factors which led to project’s success:

Strengthening the capacity of local stakeholders

Technology transferred

Renewable energy and energyefficiency systems, such as SWH systems, solar PV systems and compact fluorescent lamps

Impact on greenhouse gas emission/sinks (optional):

Project / Program title

Installation of a water desalination plant on the island of Magoodhoo Faafu Atoll – Maldives

Purpose

Provide a production of about 350 litres per hour to island of Magoodhoo

Recipient Country	Sector	Total funding	Years in operation
Maldives	Water, energy	167.200 €	20162017

Description

The project aims at setting up a desalinating sea water plant through the reverse osmosis plant and a photovoltaic cell to electrically power this latter. Notice is hereby given that the process is called reverse osmosis and is the foundation of many desalination plants around the world. The water is forced through polymer membranes that allow water molecules to pass, blocking the salts and other inorganic impurities .

Indicate factors which led to project's success:

- First desalinization system in the island.
- Reduction of the dependence from the imported bottled water
- Reduction of the dependence on the imported fossil fuels in terms of fuel storage capacity and vulnerability to price fluctuations
- Awareness between the availability of drinking water and health of citizens.
- Promote the integration between the actions of various institutions at the local level (school, Health Center, the Island Council).

Technology transferred

Photovoltaic cell

Impact on greenhouse gas emission/sinks (optional):

8 RESEARCH AND SYSTEMATIC OBSERVATION

8.1 Introduction

This chapter describes the relevant activities in climate change research and climate systematic observations. It focuses on the national policy framework for research and in particular on climaterelated programs. The chapter details also the main national achievements and projects in the field of climate change research and systematic observation.

Italy has continued to participate in the overall effort to develop scientific results that will contribute to the upcoming AR6 IPCC report. It is participating to the coordinated climate numerical experiments to upgrade the scenarios data and it is also very active in the economic and social impacts with expertise and numerical economic models.

8.2 General policy on research and systematic observation

8.2.1 Research

The policy framework on research in Italy changed significantly compared to the previous period. The Italian Ministry of Education, University and Research (*MIUR – Ministero dell'Istruzione, dell'Univerità e della Ricerca*) and the Ministry of Economic Development (*MiSE – Ministero dello sviluppo economico*) made an effort to harmonize national policies with the European ones. The **National Smart Specialisation Strategy** (*SNSI – Strategia Nazionale di Specializzazione Intelligente*[198]) represents the cornerstone between the European Horizon 2020 program and the National Research Program. In fact, the SNSI identifies the national priorities for research, in the frame of European strategies. The SNSI selects five main areas of specialisation:

- Smart and sustainable industry, energy and environment
- Health, nutrition and quality of life
- Digital agenda, smart communities and smart mobility
- Turism, cultural heritage and creative industry
- Aerospace and defence.

In the frame of these general thematic priorities, the SNSI identifies 12 areas for applied research which are strategical for Italy and in particular for southern regions, which have to adopt them for their own local development policies:

1. Aerospace
2. Agrifood;
3. Cultural Heritage;
4. Blue growth;
5. Green sustainable chemistry;
6. Design, creativity and Made in Italy;
7. Energy;
8. Smart Manufacturing
9. Sustainable Mobility

[198] http://www.agenziacoesione.gov.it/it/S3/S3_Nazionale/Strategia_nazionale_di_specializzazione_intelligente.html

10. Health
11. Smart, Secure and Inclusive Communities;
12. Technologies for life environments

The whole strategy is oriented to sustainability and, in particular, climate is a transversal theme, embedded in several of the abovementioned fields such as aerospace, agrifood, blue growth, energy and mobility.

The **National Research Program 20152020** (*PNR – Programma Nazionale della Ricerca*[199]) is the main national policy on research. It used to be a threeyears financial plan until 2013, but the actual program evolved and it is quite innovative compared with the previous ones: it sets a longterm (six years) general action to coordinate coherently several subprograms and funds with the European Horizon 2020 program, and with other national and regional policy instruments. The main objectives of the new PNR are to strengthen the Italian research system, to make it more competitive and at the same time to promote international cooperation on research.
In addition to basic research, the PNR promotes applied research through publicprivate partnerships and the technological transfer from research institute to market. The PNR foresees the institution of 12 innovative clusters (one for each area identified by the SNSI) involving research institutes, universities, SMEs and large enterprises.
The PNR is financed through several funds for total investments of 2,5 Billion €:

- **Fund for Investments in Scientific Research and Technology** (*FIRST Fondo per gli Investimenti nella Ricerca Scientifica e Tecnologica).* It finances both basic research and industrial research.
- **Financial Ordinary Fund** (*FFO – Fondo di finanziamento ordinario*). The primary contribution of the MIUR to finance all Italian universities.
- **Ordinary fund for research institutes and bodies** (*FOE Fondo ordinario per il finanziamento degli enti e istituzioni di ricerca*). The primary contribution of the MIUR to fund research activities conducted by public research bodies and institutes acting under the supervision of the Ministry
- **Supplementary Special Fund for Research** (*FISR – Fondo integrativo speciale per la ricerca*). It finances specific strategical projects, as stated in the PNR.

Beside the PNR, the MiSE and the MIUR developed the **National Operative Program "Research and Innovation" 20142020** (*PON RI 20142020 – Programma Operativo Nazionale "Ricerca e Innovazione"*). The program is financed through the European Regional Development Fund (ERDF) and Social European Fund (SEF) and it focuses on the southern regions, with the aim of increase the research infrastructure of the less developed areas of Italy. Coherently with the general policy architecture, the PON RI targets the same research areas identified by the SNSI and it has the same objectives of PNR.

Outside the scheme described so far, the MIUR also financed the **Relevant National Interest Projects** (*PRIN Progetti di Rilevante Interesse Nazionale*[200]), a threeyear program to fund specific research

[199] http://www.miur.gov.it/web/guest/programma-nazionale-della-ricerca
[200] http://prin.miur.it/

projects with 90M € of resources available. The last program, approved by the government in 2015, focuses on Life science, Physical Science and Engineering and Social science and Humanities and the beneficiaries are national partnerships composed by Italian universities.

Moreover, the MIUR supports also the **National Research Program in Antarctica** (*PNRA – Programma Nazionale di Ricerca in Antartide*[201]). In 2014 the MIUR set a new strategy for the threeyears period 20142016 in continuity with the previous programming period. Scientific priorities of the PNRA cover a wide range of climate specific or climate related topic:

- Dynamics of atmosphere and climate processes
- Dynamics of the polar cap
- Dynamics of solid Earth
- Dynamics of polar oceans
- EarthSun relations and space weather
- Universe over Antarctica
- Evolution, adaptation and biodiversity
- Man in extreme environments
- Environmental contamination
- Paleoclimatology
- Environmental risks
- Technology: experimentation and innovation

The PNRA accounts for 74M € funds, which are annually distributed through specific administrative orders.

Also the Ministry of agricultural, food and forestry policies (MiPAAF – Ministero per le politiche agricole, alimentary e forestali), contributes to shape the Italian landscape on climate research. In 2016 it developed a strategy to drive different sectoral policies at different administrative levels concerning agriculture, forestry and fisheries: the **Strategical Plan for Research and Innovation in the agricultural, food and forestry sectors 20142020** (Piano strategico per l'innovazione e la ricerca nel settore agricolo, alimentare e forestale 20142020[202]). The plan identifies six research areas and climate change is one of the priorities:

1. Sustainable increase of productivity, profitability and efficiency of resources in agroecosystems
2. Climate change, biodiversity, soil functionality and other social and ecosystem services in agriculture
3. Coordination and integration of value chains and development of the role of agriculture
4. Quality, traditional products and food security for healthy lifestyles
5. Sustainable use of biological resources for energy and industrial purposes
6. Development and reorganisation of the research system for agriculture, food and forestry sectors

The plan is a soft law and does not foresee an action plan with financial provisions. Its aims is to coordinate national agricultural laws, the PNR and the national and regional policies cofinanced through

[201] http://www.miur.gov.it/web/guest/programma-nazionale-di-ricerca-in-antartide
[202] https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/9065

European funds (ERDF, EMFF, SEF, etc.) in order to give to national research a coherent direction on this topic in the programming period 20142020.

8.2.2 Observations

According to the *PNR 20112013*, the climate system observations and monitoring must overcome the current dispersion and multiannual planning. A more efficient network for Earth observations would facilitate the Italian contribution to the *Copernicus Climate Change Services* (former *GMES Global Monitoring for Environment and Security*) and *GEOSS (Global Earth Observation System of Systems)* and the increase of the competitiveness of research programs within the EU. Toward that direction, in 2016 GEOItaly was established as the national coordination of the Italian contribution to GEO (www.geoitaly.org/). The main topics include: monitoring the Earth's surface, changes in the composition of the atmosphere, water cycle, impacts on land, emergency response, climate change, marine monitoring and security; support for national infrastructure and ESFRI initiatives (ICOS, EUFARCOPAL, SIOS, JERICO, EMSO, ACTRIS).

8.2.3 Major Italian research institutions and organisations working in the field of Climate and Climate Change

A quite large number of national universities, public and private institutes and other organizations are involved in climate research and climaterelated research and systematic observation. The major Italian universities consortium, research institutions and organisations conducting climate and climate change research are the following ones:

- ***Abdus Salam International Centre for Theoretical Physics*** *(ICTP),* http://www.ictp.it/;
- ***Agricultural Research Council*** (*CRA Consiglio per la Ricerca e la sperimentazione in Agricoltura*), http://www.entecra.it/;
- ***ENI Enrico Mattei Foundation*** *(FEEM Fondazione ENI Enrico Mattei)*, http://www.feem.it/;
- ***EuroMediterranean Centre on Climate Change*** *(CMCC Centro EuroMediterraneo sui Cambiamenti Climatici)*, http://www.cmcc.it/;
- ***Institute for Environmental Protection and Research*** *(ISPRA – Istituto Superiore per la Protezione e la Ricerca Ambientale)*, http://www.isprambiente.it;
- ***Institute of Agroenvironmental and Forest Biology of the National Research Council*** *(IBAF CNR Istituto di Biologia Agroambientale e Forestale del Consiglio Nazionale delle Ricerche)*, http://www.ibaf.cnr.it/;
- ***Institute of Atmospheric Sciences and Climate of the National Research Council*** *(ISAC CNR Istituto di Scienze dell'Atmosfera e del Clima del Consiglio Nazionale delle Ricerche),* www.isac.cnr.it;
- ***Institute of Biometeorology of the National Research Council*** *(IBIMET CNR Istituto di Biometeorologia del Consiglio Nazionale delle Ricerche),* http://www.clima.ibimet.cnr.it/;
- ***Institute of Marine Sciences of the National Research Council*** *(ISMAR CNR Istituto di Scienze Marine del Consiglio Nazionale delle Ricerche),* http://www.ismar.cnr.it/;
- ***National Agency for New Technologies, Energy and Sustainable Economic Development*** *(ENEA – Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile),* www.enea.it;

- ***Italian Air Force Met Service*** *(Servizio Meteorologico dell'Aeronautica Militare),* http://www.meteoam.it/;
- ***National Consortium of Universities for Atmospheric and Hydrospheric Physics*** *(CINFAI Consorzio Interuniversitario Nazionale per la Fisica delle Atmosfere e delle Idrosfere),* http://www.cinfai.it/;
- ***National Institute of Experimental Oceanography and Geophysics*** *(OGS Istituto Nazionale di Oceanografia e di Geofisica Sperimentale),* http://www.ogs.trieste.it/
- ***National Institute of Geophysics and Volcanology*** *(INGV Istituto Nazionale di Geofisica e Vulcanologia),* www.bo.ingv.it;
- ***National Interuniversity Consortium for Marine Sciences***, *Local Research Unit: Department of Geological Sciences and Geotechnologies MilanoBicocca (CoNISMa Consorzio Nazionale Interuniversitario per le Scienze del Mare, Unità locale di ricerca: Dipartimento di Scienze Geologiche e Geotecnologie, Università degli Studi di MilanoBicocca),* http://www.conismamibi.it/;
- ***Water Research Institute of the National Research Council*** *(IRSA CNR Istituto di Ricerca sulle Acque),* http://www.irsa.cnr.it/;
- ***Zoological Station Anton Dohrn of Naples*** *(Stazione Zoologica Anton Dohrn di Napoli),* http://www.szn.it/.

In addition, several regional *Agencies For Environment Protection (ARPAs)* are actively conducting research on climate data monitoring, regional climate modelling and regional impacts assessments.

8.2.4 Research

Italy fully contributes to the main international projects and programmes in climate prediction and simulation activities. In particular, Centro Euro–Mediterraneo sui Cambiamenti Climatici (CMCC), with its new Earth System Model (CMCCESM) is involved in the main research and operational activities in the seasonal–to–decadal (S2D) forecast field.

For the operational seasonal prediction activity, the new CMCC model has been implemented and extensively tested in the configuration with a ¼degree in the ocean coupled to a 1degree atmosphere. The number of ensemble members has also been increased to 50. Starting from early 2016, this configuration is used to produce the operational seasonal outlook on a monthly basis for the 1993topresent time frame. The full consistency between the oceanic component of the new CMCCESM and the ocean model used at CMCC to produce ocean state reanalyses, has improved the initialization of the seasonaltodecadal forecasts, leading, as a consequence, to higher quality climate predictions. Furthermore, based on the outcomes of the explorative tests conducted on seaice and land surface initialization, an improved strategy for the initialization of these components has also been routinely introduced in the operational seasonal forecasting system. In particular, the status of vegetation, snow cover, soil moisture and other land surface state variables are inferred from an offline run of the standalone land surface scheme, driven by the best observational meteorological forcings.

Italy, through CMCC's operational seasonal forecast activities, contributes to international programs of multimodel ensemble predictions such as, for example, the preoperational Copernicus C3s Multi–model Ensemble, the Asian Pacific Climate Center Multi–model Ensemble and WMO endorsed Climate Outlook Forum MedCOF.

CMCC is also engaged in several scientific and coordination activities concerning model development,

design of new strategies and tools for evaluating global highresolution simulations at a process level. On this regard, activities have been performed aimed at the provision of new highresolution protocols and flagship simulations for the World Climate Research Programme (WCRP)'s Coupled Model Intercomparison Project (CMIP6) project, to inform the Intergovernmental Panel on Climate Change (IPCC) assessment report (AR6) and in support of emerging Climate Services.

The WRCP views regional downscaling as an opportunity to engage a broader community of climate scientists in its activities. The CORDEX program has been established as a catalyst to achieve this goal. More specifically, CORDEX aims to understand relevant regional/local climate phenomena through dynamical downscaling of global data, producing coordinated sets of regional downscaled projections worldwide, considering selected subdomains. Over Italy, data are available through EUROCORDEX, MEDCORDEX and MENACORDEX subdomains. EUROCORDEX is the European branch of the program: regional simulations have been performed by several modelling groups in different research centres (some of them in Italy, operating for different proposes and aims). Selected spatial resolutions have been employed (0.44°, 022° and 0.11°), both for the historical period (19712005) and for the future period (20062100) according with the IPCC RCP2.6, RCP4.5 and RCP8.5 scenarios. Data from several Regional Models (RCM) are available, driven by different Global Models (GCM); with an increasing number of simulations available and institutions involved in the program. The output of climate simulations are data sets of relevant atmospheric and surface variables. These data are freely available for research purposes and can be downloaded through the ESGF portal. EUROCORDEX simulations over Italy show negative temperature biases, especially in winter at high altitudes, and a generally high precipitation overestimation, with some exceptions in Po Valley and Tuscany, in summer.
MedCORDEX has been proposed for the Mediterranean climate as a followup of previous and existing initiatives. It represents a framework where research community make use of regional atmospheric, land surface, river and oceanic climate models and coupled regional climate system models for increasing the reliability of climate information. Twenty different modelling groups are involved, from nine different countries, employing overall 12 Regional Climate System Models. Data are available at resolutions of 0.44° and 0.11°, according with RCP4.5 and RCP8.5 scenarios.
MENACORDEX is one of the last domain defined in CORDEX, driven by several needs, such as the assessment of impacts on water resources in the Arab region, whose importance is confirmed by the establishment of the RICCAR initiative. Seven modelling groups are involved in this activity. Most of the Italian territory is enclosed in this domain (with the exception of northern Italy). Data are available at resolutions of 0.44° and 0.22°, according with RCP4.5 and RCP8.5 scenarios.

At CMCC, results of regional simulations over Italy have been published using the COSMOCLM model at spatial resolution of 0.0715° (about 8 km) over the period 19712100, driven by the GCM CMCCCM employing the IPCC RCP4.5 and RCP 8.5 scenario. This higher resolution allowed the possibility to obtain more detailed climate analysis and scenarios, which can be useful for several applications, especially as input for impact models, for evaluation of climate change effects on different hydrogeological hazards (drought, flooding and landslides). This makes it possible to help bridge the gap between climate and impact models, creating a more realistic coupling especially in regions with complex topography. Results have revealed a good capability of the model in reproducing the climate features of Italy, thanks to the optimized model configuration and to the high resolution, which provides good improvements in complex

orography areas. Climate projections highlight a general warming expected in Italy (about 3.2°C per century), along with a reduction of precipitation in summer, and an increase in winter over north Italy. This information is relevant, since it is connected with flood risk in winter and with water resources management in summer. These results represent a step forward with respect to previous projections available over Italy, obtained at lower resolution in the frame of other European projects (e.g. PRUDENCE, ENSEMBLES).

8.2.5 National Projects

Table 8.1 Relevant National Projects on climate process and climate system studies, including paleoclimate studies; modelling and prediction, including general circulation models; research on the impacts of climate change; socioeconomic analysis, including analysis of both the impacts of climate change and response options; research and development on mitigation and adaptation technologies

Acronym	Title and Web site	Sponsor / Recipient	Start date End Date	Coordinator	Involved Italian Partner(s)	Budget (€)
ARGO ITALY	Italian contribution to global ocean monitoring http://nettuno.ogs.trieste.it/jungo/argoitaly/	MIUR	N.A.	OGS	OGS	N.A.
BEOI	Beyond EPICA Oldest Ice	Miur through PNRA	20182019	CNRIDPA	CNRIDPA, Univ. of Venezia, ENEA, Univ. of Bologna, INGV, Univ. Of Milano Bicocca, Univ. of Firenze	138.300
BioAPRoS	Correlation between biogenic aerosol and primary production in the Ross Sea	Miur through PNRA	20182019	University of Firenze	University of Firenze, ENEA, Univ. of Venezia, Univ. of Tuscia	106.600
Black Cat	BLACK CArbon Tool	Fondazione Cariplo	20152017	CNRISAC	CNR	N.A.
BSRNOBS	Misure dei flussi di radiazione solare ed IR alla superficie sul Plateau Antartico presso DomeC	MIURPNRA	N.A.	CNRISAC	CNR	N.A.
CARBOTREES	Climate change mitigation strategies in tree crops and forestry in Italy *(Strategie nazionali per la mitigazione dei Cambiamenti Climatici in sistemi arborei agrari e forestali)* http://cercauniversita.cineca.it/php5/prin/cerca.php?codice=201049EXTW&testo=clima	MIUR PRIN 20102011	3 years (Period N.A.)	University of Tuscia	University of Tuscia, Molise University, Sassari University, Napoli University, Padova University, Palermo University, Firenze University, Basilicata University, Perugia University	864.500
CATARSI	Climaticallydriven changes of Antarctic sea ice and their role in the climate system	MIUR (PNRA)	Jun. 2014 – Jun. 2016	CMCC		125.000
EEE	Highenergy efficiency buildings (*Edifici ad*	PNR (National	3 years	Piattaforma	Piattaforma Tecnologica italiana	20.000.000

	alta efficienza energetica) Website N.A.[203]	Research Programme) 20112013 "Project of Interest"	(Period N.A.)	Tecnologica italiana delle Costruzioni, ANCE, Federcostruzioni	delle Costruzioni, ANCE, Federcostruzioni	(estimated)
GEISCA	Insects and globalization sustainable control of exotic species in agroforest ecosystems (*Insetti e globalizzazione: controllo sostenibile di specie esotiche in ecosistemi agroforestali*) http://cercauniversita.cineca.it/php5/prin/cerca.php?codice=2010CXXHJE&testo=clima	MIUR PRIN 20102011	3 years (Period N.A.)	Bologna University	Bologna University, Milano University, Torino University, Catania University, Padova University, Reggio Calabria "Mediterranea" University, CNR	661.500
GSLAISS	Global Sea Level Rise & Antarctic Ice Sheet Stability predictions: guessing future by learning from past	MAECI	Dec. 2016 – Nov. 2017	OGS	CMCC, CNRISMAR	90.000
IAMICA	Infrastructure of High Technology for Integrated Climate and Environmental Monitoring. http://www.iamica.it	MIURPON 2007 2013	Jan. 2012 Jul 2015	CNR ISAC	CNR	**12.047.000.**
ICFAR	Evaluation of the uncertainty associated with the projections of climate change impact on Italian herbaceous cropping systems, through longterm observations and mathematical models of the farming system, in support to adaptation strategies (*Valutazione dell'incertezza associata alle previsioni di impatto dei cambiamenti climatici sui sistemi colturali erbacei italiani, attraverso osservazioni di lunga durata e modelli matematici di sistema colturale, a supporto di strategie di adattamento*) http://cercauniversita.cineca.it/php5/prin/cerca.php?codice=2010FRE7J4&testo=clima	MIUR PRIN 20102011	3 years (Period N.A.)	Sassari University	Sassari University, Bologna University, Basilicata University, Padova University, Firenze University, Polytechnic Marche University, Torino University, Udine, Pisa University, Perugia University, CNR	868.000
ICOS ETC	ICOS Ecosystem Thematic Centre:	CNR	Nov. 2016 –	CMCC	University of Tuscia	160.000

[203] Source: PNR (National Reasearch Programme) 2011-2013 (http://www.miur.it/Documenti/ricerca/pnr_2011_2013/PNR_2011-2013_23_MAR_2011_web.pdf).

	gestione e coordinamento https://www.icosri.eu/icoscentralfacilities/icosetc		Dec. 2017			
LO@DC	Lidar Observatory @ Dome C	MIURPNRA	N.A.	CNRISAC	CNR	N.A.
MALOX	Mass lost in wind flux	MIUR through PNRA	July 2014June 2016	ENEA	ENEA, INAF, CNRISAC	267.000
METROPOLIS	Metodologies and integrated sustainable technologies for the adaptation and safety of urban system. http://www.progettometropolis.it/	MIUR	2013	Stress District Consortium	CMCC	n.d.
N.A.	Bromine and mercury, cycles and transport processes on the Antarctic plateau	Miur through PNRA	20182019	CNRIDPA	CNRIDPA, ENEA, Univ. of Venezia, CNR IIA	128.200
N.A.	Climate change in the Mediterranean area: evolution scenarios, economic impacts, mitigation policies and technological innovation (*I cambiamenti climatici nell'area del Mediterraneo: scenari evolutivi, impatti economici, politiche di mitigazione e innovazione tecnologica*) http://cercauniversita.cineca.it/php5/prin/cerca.php?codice=2010S2LHSE&testo=clima	MIUR PRIN 20102011	3 years (Period N.A.)	Milano University	Milano University, Ferrara University, Venezia University "Ca' Foscari", Roma University TRE, Padova University, Siena University, Catholic University "Sacro Cuore", Roma University "Tor Vergata", Roma University "La Sapienza"	496.824
N.A.	CO_2 excess in the geological past: responses of biota to global changes of extreme heat and ocean acidification (*Eccesso di CO_2 nel passato geologico: risposte del biota a cambiamenti globali di caldo estremo e acidificazione degli oceani*) http://cercauniversita.cineca.it/php5/prin/cerca.php?codice=2010X3PP8J&testo=clima	MIUR PRIN 20102011	3 years (Period N.A.)	University of Milano	University of Milano, University of Modena and Reggio Emilia, University of Padova, CNR, "Carlo BO"University of Urbino	421.887
N.A.	Crisis and recovery of carbonate systems and the potential for the formation of reservoir: the roles of climate, tectonics	MIUR PRIN 20102011	3 years (Period N.A.)	University of Roma "La Sapienza"	University of Roma "La Sapienza", University of Padova, University of Ferrara, University	279.226

	and magmatism (*Crisi e ripresa di sistemi carbonatici e potenziale per la formazione di reservoir: i ruoli di clima, tettonica e magmatismo*) http://cercauniversita.cineca.it/php5/prin/cerca.php?codice=20107ESMX9&testo=clima				of Modena And Reggio Emilia, University of Milano	
N.A.	Dynamics of morphoclimatic systems in response to global change and induced geomorphological hazards (*Dinamica dei sistemi morfoclimatici in risposta ai cambiamenti globali e rischi geomorfologici indotti*) http://cercauniversita.cineca.it/php5/prin/cerca.php?codice=2010AYKTAB	MIUR PRIN 20102011	3 years (Period N.A.)	Pisa University	Pisa University, Bari University, Modena and Reggio Emilia University, Torino University, Roma University “La Sapienza”, Milano University, Padova University, INGV	488.690
N.A.	Effects of climate on populations of species of fauna omeotermamodel: development of predictive models of climate change (*Effetti del clima su popolazioni di speciemodello di fauna omeoterma: sviluppo di modelli predittivi legati ai cambiamenti climatici*) http://cercauniversita.cineca.it/php5/prin/cerca.php?codice=20108TZKHC&testo=clima	MIUR PRIN 20102011	3 years (Period N.A.)	Sassari University	Sassari University, Palermo University VareseComo “INSUBRIA” University, Pavia, CNR	672.187
N.A.	Environmental variability, climatic changes and anthropic impacts: adaptive response in benthic species, communities and benthic systems https://www.researchitaly.it/en/understanding/projectandsuccessstories/mainprojects/adaptiveresponsestoenvironmentalvariabilityclimatechangesandanthropicimpacts/	MIUR through PNRA	Jan. 2013 De. 2015	Stazione Zoologica Anton Dohrn (SZN)	SZN	N.A.
N.A.	Innovative methodologies for water resources management under scenarios of hydroclimatic uncertainty (*Metodologie innovative per la gestione delle risorse idriche in scenari di incertezza idroclimatica)*	MIUR PRIN 20102011	3 years (Period N.A.)	Trento University	Trento University; Modena and Reggio Emilia University, Padova University, Roma University "TRE” Milano University, Napoli University “Federico II”, CNR	735.000

	http://cercauniversita.cineca.it/php5/prin/cerca.php?codice=2010JHF437&testo=clima					
N.A.	Mechanisms that regulate biological processes and ecology of plankton https://www.researchitaly.it/en/understanding/projectandsuccessstories/mainprojects/mechanismsthatregulatebiologicalprocessesandecologyofplankton/	MIUR through PNRA	Jan. 2013 De. 2015	Stazione Zoologica Anton Dohrn (SZN)	SZN	N.A.
N.A.	Italian Antarctic MeteoClimatological Observatory at MZS and in the Victoria Land	MIUR through PNRA	Feb. 2017 Feb. 2019	ENEA	ENEA	70.300
N.A.	Italian Antarctic MeteoClimatological Observatory at Concordia	MIUR through PNRA	Feb. 2017 Feb. 2019	ENEA	ENEA	75.000
N.A.	Influence of Antarctic ice sheet on Southern Hemisphere lowlatitude climate teleconnections across the PlioPleistocene transition (3,5Ma 2,5 Ma)	MIUR (PNRA)	Jun. 2014 – Jun. 2016	CMCC	INGV	80.000
NextData	A national system for the retrieval, storage, access and diffusion of environmental and climate data from mountain and marine areas (*Un sistema nazionale per la raccolta, conservazione, accessibilità e diffusione dei dati ambientali e climatici in aree montane e marine*) http://www.nextdataproject.it/?q=it	MIUR through PNR 20112013 "Project of Interest"	Jan. 2012 Dec. 2018	CNR	CGI, CINECA, CNR, CMCC, ENEA, ICTP, INGV, Gran Paradiso National Park, Milano University Bicocca, Torino University	22.000.000
OASISYOPP	Observations of the Arctic Stratosphere In Support of the Year Of Polar Prediction	MIUR through PNRA	July 2016Decem ber 2018	INGV	INGV, ENEA, Univ. of Rome Sapienza	113.000
OPLAM	Open Lab per l'Atmosfera e il Mare	Regione Lazio	20162018	CNRISAC	CNR	N.A.
PANACEA	PANACEA – The role of frazil and PANcake ice in the mass and energy budgets of the AntarctiC sEA ice cover	MIUR Ministero dell'Istruzione, dell'Università e della Ricerca	20142016	CNRISAC	CNR	N.A.

PNACC	Italian National Adaptation Plan	MATTM	May 2016 – May 2017	CMCC		430.000€
PNRA 2013/B3.01	Telerilevamento da satellite della tipologia di precipitazione sulla regione antartica	MIUR Ministero dell'Istruzione, dell'Università e della Ricerca	20142016	CNRISAC	CNR	N.A.
REACT	IntegRated operational rEsponse forecasting system to mAjor offshore and Coastal deepwater oil spill pollution evenTs	Fondazione per il SUD	Oct. 2016 – Sep. 2020	CMCC		360.000
Ritmare	Italian Research for the sea (*Ricerca italiana per il mare*) http://www.ritmare.it/en	MIUR through PNR 20112013 with cofinancing by Research Institutes "Flagship project"	Jan. 2012 Dec. 2017	CNR	CNR, ENEA, CoNISMa, OGS, INGV, SZN, CINFAI	250 Million
SNAC	Elements to develop a National Adaptation Strategy to Climate Change http://www.cmcc.it/website/projects/snacelementstodevelopanationaladaptationstrategytoclimatechange	IMELS	Jul. 2012 Jul. 2014	CMCC	CMCC	180.000
SOLARICE	Study of the Solar Forcing over the Holocene from a new Dome C Ice Core	MIUR through PNRA	20182019	University of MilanoBicocca	University of MilanoBicocca , ENEA, CNR, University of Parma	135.000
SOLAS Italy	Surface Ocean Lower Atmosphere Study	Future Earth	20152020	CNR	http://www.isac.cnr.it/solas/participants	N.A.
START	SysTem of rApid mapping and monitoRing of coastal and marine environmenT The general objective of "START" project is to improve and consolidate the awareness and the knowledge of Apulian coastal environment integrating the observing systems with the operational and forecasting numerical modelling. The services will be integrated with technological platforms of dissemination	Apulia Region – Regional Technological Cluster	Dec. 2015 – May 2018	Links S.p.a.	CMCC, University of Salento, ENSU	3.000.000

	of information for the 'Coastal Situational Awareness'.					
STRAAPB	Progetto di Ricerca 2013/AC3.06 Studio dei regimi radiativi sul plateau antartico	MIUR	20142016	CNRISAC	CNR	N.A.
SVAAP	Study of the water vapour in the polar atmosphere	MIUR through PNRA	July 2014March 2017	ENEA	ENEA, INGV, Univ. of Rome Sapienza	Total budget 81.000
TANGO	TANGO –Tropospheric hAlogeNs from satellite Observations	MIUR Ministero dell'Istruzione, dell'Università e della Ricerca	20142016	CNRISAC	CNR	N.A.
TESSA	Development of technologies for the "Situational Sea Awareness" http://www.seaconditions.com/web/tessa/home	MIUR through the National Operative Programme (PON) for Research and Competitiveness 20072013 and cofunding by the Research subsidy fund (FAR)	Jan. 2012 Dec. 2014	Links S.p.a.	Links S.p.a., CMCC, CNRIAMC	Total Budget: N.A. CMCC: 6.665.754
TreeCity	Designing the green city in the era of global change: functions of urban trees and their adaptability in future climate conditions (*Progettare la città verde nell'era del cambiamento globale: funzioni degli alberi urbani e loro adattabilità nelle future condizioni climatiche*) http://cercauniversita.cineca.it/php5/prin/cerca.php?codice=20109E8F95&testo=clima	MIUR PRIN 20102011	Next 3 years (Period N.A.)	Pisa University	Pisa University, University of Tuscia, CNR, "Sacro Cuore" Catholic University, "La Sapienza" Rome University, Palermo University, Firenze University, Trieste University	812.000

8.2.6 International Projects

Table 8.2 Relevant International Projects on climate process and climate system studies, including paleoclimate studies; modelling and prediction, including general circulation models; research on the impacts of climate change; socioeconomic analysis, including analysis of

both the impacts of climate change and response options; research and development on mitigation and adaptation technologies

Acronym	Title and Web site	Sponsor / Recipient	Start date End Date	Coordinator	Involved Italian Partner(s)
ACCENTPLUS	Atmospheric Composition Change: the European NetworkPolicy Support and Science http://www.accentnetwork.org	EC, FP7 (ENVIRONMENT)	Nov. 2010 Oct. 2014	CNRISAC	CNRISAC, Urbino University "Carlo Bo"
ACLIMAS	Climate Change Adaptation of the Mediterranean Agricultural Systems http://www.aclimas.eu/	EC, Sustainable Water Integrated Management – (SWIM) programme	Dec. 2011 Dec. 2014	Istituto Agronomico Mediterraneo di Bari (CIHEAMIAMB)	Mediterranean Agronomic Institute of Bari (CIHEAMIAMB), CMCC, Institute for Mediterranean Agriculture and Forest Systems (CNRISAFOM) of the National Research Council (CNRISAFOM)
ACTRISPPP	Aerosol, Clouds and Trace gases Research Infrastructure Network – Preparatory Phase Project	EC	20172019	CNRS France	CNR
AFRICA – GHG	The role of African tropical forests on the Greenhouse Gases balance of the atmosphere http://www.cmcc.it/projects/africaghgtheroleofafricantropicalforestsonthegreenhousegasesbalanceoftheatmosphere2#anchorpartners	EC, FP7 (ERCIDEASERC)	April 2010 March 2014	CMCC through UNITUS Università degli Studi della Tuscia	
AFRISCAT	Technical Assistance for the Deployment of TowerBased Radar and Geophysical Measurements during the AfriScat Experiment	European Space Agency (ESA)	Nov. 2014 – Apr. 2016	University of Paul Sabbatier	CMCC
AFV	Arctic Fog Variability in a Warming Arctic and Its Impact on Maritime Human Activities	Belmont Forum 2014	20152019	CNR	CNR
AGRO ADAPT 2016	Service for local and economy wide assessment of adaptation actions in agriculture http://wateragora.eu/	ClimateKIC	Oct. 2016 – Dec. 2017	CMCC	CNRIBIMET, Fondazione Edmund Mach
AirSea Lab	AirSea Lab: Climate air pollution	CNR Joint Lab Project	20152017	CNRISAC	CNR, ENEA

	interaction in coastal environment				
AMARE	Actions for Marine Protected Areas https://amare.interregmed.eu/	Interreg MED 20142020	Nov. 2916 – Oct. 2019	CONISMA Consorzio Nazionale Interuniversitario per le Scienze del Mare	CMCC
AMPERE	Assessment of Climate Change Mitigation Pathways and Evaluation of the Robustness of Mitigation Cost Estimates http://ampereproject.eu	EC, FP7 (ENVIRONMENT)	Feb. 2011 Jan. 2014	Potsdam Institut Fuer Klimafolgenforschung (Germany)	FEEM
AtlantOS	Optimizing and Enhancing the Integrated Atlantic Ocean Observing System https://www.atlantosh2020.eu/	EC, Horizon 2020	Apr. 2015 – Jun. 2019	GEOMAR Helmholtz Centre for Ocean Research Kiel	CMCC
AVOID 2	The effects of incomplete and delayed participation on the cost of climate policy 2 http://www.avoid.uk.net/	UK Government	Sep. 2014 – Jan. 2015	MET OFFICE	CMCC
BACCHUS	BACCHUS Impact of Biogenic versus Anthropogenic emissions on Clouds and Climate: towards a Holistic UnderStanding	EC	20132018	ETHZurig	ISACCNR
BASE	Bottomup Climate Adaptation Strategies towards a Sustainable Europe http://www.baseadapt.eu/	EC, DG Research (CooperationEnvironment)	Oct. 2012 Sep. 2016	Aarhus Universitet (Denmark)	CMCC, ISPRA
BEOI	Beyond EPICAOldest Ice http://www.beyondepica.eu	EC, H2020	Oct. 2016 Sep. 2019	AWI	ENEA, University of Bologna
Blue Action	Arctic Impact on Weather and Climate. http://www.blueaction.eu/index.php?id=3498	EC, H2020	Dec. 2016 – Feb. 2021	DMI Danmarks Meteorologiske Institut	CMCC
BLUEAP	Bologna Local Urban Environment Adaptation Plan for Resilient City http://www.blueap.eu/site/en/	EC, LIFE+ Program	Jan. 2014 – Jul. 2015	Municipality of Bologna	CMCC
BlueHealth	Linking Up Environment, Health and	EC, H2020	Jan. 2016 – Jun. 2020	University of Exeter	CMCC, Istituto Superiore di Sanità

	Climate for Intersector Health Promotion and Disease Prevention in a Rapidly Changing Environment https://bluehealth2020.eu/				
BOOSTER BLUE	Economic instruments for sustainable water management and resilient growth in water stressed areas	AXA Research Grant	Oct. 2016 – Mar. 2018	CMCC	
C3 ALPS	C3Alps – Capitalising Climate Change Knowledge for Adaptation in the Alpine Space http://www.c3alps.eu/index.php/it/	Interreg Alpine Space 20072013	Jan. 2012 Dec. 2014	Environment Agency Austria	Veneto Region, ARPA Piemonte, CMCC, European Academy of Bolzano
CASCADE	Climate Change Impacts on WAter ReSources in the Coastal Zones of Small IslAnd Developing StatEs http://www2.sta.uwi.edu/cascade/	EC, EuropeAid (EuropeAid/130381/D/ACT/ACP)	Aug. 2012 Jul. 2014	UWI University of the West Indies	CMCC
CDLINKS	Linking Climate and Development Policies Leveraging International Networks and Knowledge Sharing http://www.cdlinks.org/	EC, Horizon 2020	Sep. 2015 – Aug. 2019	IIASA International Institute for Applied Systems Analysis	CMCC
CHAKE OU	Strengthening of institutional and community preparedness and coordination capacities for disaster risk reduction in Paraguay	EC, DG ECHO	Jul. 2016 – Feb. 2017	COOPI Cooperazione Internazionale	CMCC
CIRCLE2	Climate Impact Research and Response Coordination for a Larger Europe – Science meets Policy http://www.circleera.net/	EC, FP7 (ENVIRONMENT) ERANet2009RTD	May 2010 Apr. 2014	Fundacao Da Faculdade De Ciencias Da Universidade De Lisboa (Portugal)	CMCC
ClimAfrica	Climate change predictions in SubSaharan Africa: impacts and adaptations http://www.climafrica.net/index_en.jsp	EC, FP7 (ENVIRONMENT)	Oct. 2010 Sep. 2014	CMCC	CMCC
CLIMATE FOR CULTURE	Damage risk assessment, economic impact and mitigation strategies for sustainable preservation of cultural heritage in the times of climate change	EC, FP7 (ENVIRONMENT)	Nov. 2009 Oct. 2014	FraunhoferGesellschaft Zur Foerderung Der Angewandten	CNR, Fondazione Salvatore Maugeri Clinica Del Lavoro E Della Riabilitazione

	http://www.climateforculture.eu/			Forschung E.V (Germany)	
CLIMRUN	Local Climate Informations to Respond to Users Needs http://www.climrun.eu	EC, FP7 (ENVIRONMENT)	Mar. 2011 Feb. 2014	ENEA	ENEA, CMCC, ICTP
CLIMTOUR	Operational climateservice for European tourism operators	ECMWF	Oct. 2017 Apr 2019	TOURISME TRANSPORT TERRITOIRES ENVIRONNEMENT CONSEIL(TEC) (France)	ENEA, CMCC
COBHAM	The role of consumer behavior and heterogeneity in the integrated assessment of energy and climate policies http://www.cobhamerc.eu/"	EC, FP7	Aug. 2014 – Jul. 2019	POLIMI Politecnico di Milano	CMCC
COMPASS	Concordia MultiProcess Atmospheric Studies	MIUR	2016	CNRISAC	CNR
CONNECTinGEO	Coordinating an Observation Network of Networks EnCompassing saTellite and INsitu to fill the Gaps in European Observations http://www.connectingeo.net/	EC, Horizon 2020	Feb. 2015 – Jan. 2017	Centro de Investigacion Ecologica y Aplicaciones Forestales	CMCC
COP 21 RIPPLES	COP21: Results and Implications for Pathways and Policies for Low Emissions European Societies https://www.cop21ripples.eu/	EC, Horizon 2020	Dec. 2016 – Nov. 2019	IDDRI Fondation Institut de Recherche pour le Developpement Durable et les Relations Internationales	CMCC, ENEA
Copernicus	Copernicus – ECMWF (Climate Toolbox)	EC	20162019	CNRISAC	CNR
Copernicus 23GLORAN	Copernicus Global Ocean Reanalysis http://marine.copernicus.eu/	Mercator Ocean	Apr. 2016 – Dec. 2018	CMCC	
CMEMS BS MFC	Copernicus Black Sea Monitoring Forecasting Centre http://marine.copernicus.eu/	Mercator Ocean	Apr. 2016 – Apr. 2018	IOBAS Institute of Oceanology Bulgarian Academy of	CMCC

				Sciences	
CMEMS MED MFC	Copernicus Mediterranean Monitoring Forecasting Centre http://marine.copernicus.eu/	Mercator Ocean	May 2015 – Apr. 2018	CMCC	INGV, OGS
CORDEX4CDS	CORDEX for the Copernicus Data Store	C3S_34b Lot 1 Copernicus Climate Change Service	Jun2017Apr. 2021	ECMWF	ENEA
COSTADAPT	Adaptation service for regional assessment of climate risks	ClimateKIC	Jul. 2015 – Dec. 2015	CMCC	
CRESCENDO	Coordinated Research in Earth Systems and Climate: Experiments, kNowledge, Dissemination and Outreach https://www.crescendoproject.eu	EC, H2020	Nov. 2015 Oct. 2020	University of Leeds (UK)	CMCC, ENEA, CNR
DEMOCLOCK	Demonstration of a cost effective medium size Chemical Looping Combustion through packed beds using solid hydrocarbons as fuel for power production with CO_2 capture http://www.sintef.no/Projectweb/DemoClock/	EC, FP7(ENERGY)	Jun. 2011 May 2015	Stiftelsen Sintef (Norway)	Milano Polytechnic, Foster Wheeler Italiana SRL
DYNAMIX	DYNAmic policy MIXes for absolute decoupling of environmental impact of EU resource use from economic growth http://dynamixproject.eu/	EC, FP7 (ENVIRONMENT)	Sept 2012 Dec. 2015	Ecologic Institute (Germany)	CMCC (formally through FEEM)
EC2	The EuropeChina Clean Energy Center http://www.ec2.org.cn/	European Commission, National Energy Administration of China and the Ministry of Commerce of China, with the support of the IMELS.	Apr. 2010 Mar. 2015	POLITO Politecnico di Torino	POLITO Politecnico di Torino, UNICAL Università della Calabria, CMCC
ECEM	European Climatic Energy Mixes http://ecem.climate.copernicus.eu/	Copernicus Climate Change Service (C3S) – Sectorial Information Systems (SIS)	Nov. 2016Jan 2018	University of East Anglia (United Kingdom)	ENEA
ECLISE	Enabling CLimate Information Services for Europe http://www.ecliseproject.eu/	EC, FP7 (ENVIRONMENT)	Feb. 2011 Jan. 2014	Koninklijk Nederlands Meteorologisch Instituut KNMI (Nederland)	CNR

ECMWF C3S_433 Seasonal Forecasts	Seasonal Forecast	ECMWF	Jan. 2016 – Mar. 2018	CMCC	
ECONADAPT	Economics of climate change adaptation in Europe http://www.bath.ac.uk/ipr/events/news0024.html	EC, FP7 (ENVIRONMENT)	Oct. 2013 Sep. 2016	University of Bath (United Kingdom)	CMCC
ECOPOTENTIAL	Improving future ecosystem benefits through Earth Observations www.ecopotentialproject.eu	EC, H2020	June 2015 May 2019	CNR	EURAC, University of Salento, Polytechnic of Milano
ENHANCE	Enhancing risk management Partnerships for catastrophic natural disasters in Europe http://enhanceproject.eu/	EC, FP7 (ENVIRONMENT)	Dec. 2012 Nov. 2016	IVM (The Nerthlands)	CMCC (formally through FEEM), ARPA EmiliaRomagna
EP FWC Lot 2	Provision of external expertise on regulatory and policy issues in the field of Climate Change (Lot 2)	European Parliament		Milieu	CMCC
ERA4CS	ERANET Cofund for Climate services http://www.jpiclimate.eu/ERA4CS	EU, H2020 (ERANET)	Jan 2016 Dec 2020	ANR France	CNR, CMCC
ERACLIM2	European Reanalysis of the Global Climate System http://www.eraclim.eu/	EC, FP7	Jan. 2014 – Dec. 2016	ECMWF	CMCC
ESiWaCE	Excellence in Simulation of Weather and Climate in Europe https://www.esiwace.eu/	EC, Horizon 2020	Sep. 2015 – Aug. 2019	DKRZ Deutsches Klimarechenzentrum	CMCC
ETCCCA 20142018	European Topic Centre on Climate Change impacts, vulnerability and adaptation 20142018 http://cca.eionet.europa.eu/	European Environment Agency	Jan. 2014 – Dec. 2018	CMCC	
ETCICM 20142018	European Topic Centre on Inland, coastal and marine waters 20142018 http://icm.eionet.europa.eu/	European Environment Agency	Jan. 2014 – Dec. 2018	Helmholtz Zentrum für Umweltforschung (UFZ)	CMCC
EU CISE 2020	EUropean test bed for the maritime Common Information Sharing	EC, FP7	Dec. 2014 – Mar. 2017	Agenzia Spaziale Italiana (ASI)	CMCC

	Environment in the 2020 perspective http://www.eucise2020.eu/				
EUBrazilCC	EUBrazil Cloud Connect http://www.eubrazilcloudconnect.eu/ (Further info: http://www.cmcc.it/projects/eubrazilcceubrazilcloudconnect)	Small or mediumscale focused research project (STREP) partially funded by the European Commission under the Cooperation Programme, Framework Programme Seven (FP7)	Oct. 2013 Sep. 2015	Universidad Politécnica de Valencia Centro Valenciano de Estudios del Riego (UPV)	CMCC
EUBRABIGSEA	Europe Brazil collaboration of big data scientific research through cloudcentric applications http://www.eubrabigsea.eu/	EC, Horizon 2020	Jan. 2016 – Dec. 2017	Universitat Politecnica de Valencia (UPV)	CMCC, Polytechnic of Milan (POLIMI)
EUFAR	European Facility for Airborne Research	EC	20142018	UK Met Office	CNR
EUMACS	European Market for Climate Services http://eumacs.eu/#	EC, Horizon 2020	Nov. 2016 – Oct. 2018	FMI Finnish Meteorological Institute	CMCC, CNRIRSA
EUPORIAS	European Provision Of Regional Impacts Assessments on Seasonal and Decadal Timescales http://www.euporias.eu/	EC, FP7(ENVIRONMENT)	Nov. 2012 Jan. 2017	UK Met Office	ENEA, WORLD FOOD PROGRAMME Italy
EUROAGRIWAT	Assessment of EUROpean AGRIculture WATer use and trade under climate change http://www.costes1106.eu/	EU RTD Framework Programme COST Action ES1106	Apr. 2012 Apr. 2016	University of Firenze	University of Firenze, CRA, INEA
EUROCHAR	Biochar for Carbon sequestration and largescale removal of greenhouse gases (GHG) from the atmosphere http://www.eurochar.org/	EC, FP7 (ENVIRONMENT)	Jan. 2011 Jun. 2014	CNR	CNR, A.G.T. Advanced Gasification Technology, Bolzano University
EUROFLEETS	New operational steps towards an alliance of European research fleets http://www.eurofleets.eu/np4/home.html	Research Infrastructures project under the EC FP7 (Combination of Collaborative project and Coordination and Support Actions for Integrating Activities)	Mar. 2013 Feb. 2017	Ifremer French Research Institute for Exploitation of the Sea	OGS, CNR
FICC	An analysis of indirect impacts of Climate	SYKE Suomen Ymparistokeskus	May 2015 – Feb. 2016	CMCC	

	Change on the Finnish society				
GEOC	Geo Carbon and GHG Initiative www.earthobservations.org/activity.php?id=113	GEO – Group on Earth Observations	2016	CMCC	CMCC
GEOCARBON	Operational Global Carbon Observing System http://www.geocarbon.net/	EC, FP7 (ENVIRONMENT)	Oct. 2011 Sep. 2014	CMCC	CMCC, Second University of Napoli, University of Tuscia
GLOBAL IQ	Impacts Quantification of global changes http://www.globaliq.eu/	EC, FP7(SSH)	Aug. 2011 Jul. 2014	Toulouse School of Economics TSE	CMCC (formally through FEEM), Institute of Studies for the Integration of Systems (Istituto di Studi per l'Integrazione dei Sistemi – ISIS)
GNSS4SWEC	Advanced Global Navigation Satellite Systems tropospheric products for monitoring severe weather events and climate http://www.cost.eu/domains_actions/essem/Actions/ES1206?	EU RTD Framework Programme COST Earth System Science and Environmental Management (ESSEM) Action ES1206	May 2013 May 2017	UK Met Office	Centre for Space Geodesy / Italian Space Agency
GREENSEAS	Development of global plankton database and model system http://greenseas.nersc.no/home	EC, FP7	Jan. 2011 Jun. 2014	NERSC Stiftelsen Nansen Senter for Fjernmaaling	CMCC
GROOM	Gliders for Research, Ocean Observation and Management http://www.groomfp7.eu	EC, FP7	Oct. 2011 Sep. 2014	Université PierreetMarieCurie (UPMC)	NATO Undersea Research Center (NURC), OGS
HAITI	Technical assistance for the support programme to take climate change into account in the national development of Haiti	EC, EuropeAid		Agriconsulting	CMCC
HIMALAYAN BROWN CARBON	HimalayaBrownCarbon Quantification and source apportionment of brown carbon aerosols in the high Himalayas	EC European Commission	20142016	CNRISAC	CNR ISAC
HiMetCom	Exploiting HIghfrequency bands by radioMETeorological modeling and Suntracking microwave radiometry for satellite COMmunications and site diversity optimization	Air Force Research Laboratory	23 Dec 2016 to 22 Dec 2017	CNRISAC	CNR

HSAF Federated Activity H_SAF_FA15_01	Cooperation on the use of combined spaceborne active and passive MW observations for precipitation retrieval	EUMETSAT	20152017	CNRISAC	CNRISAC
IBECA (Albania)	Technical assistance for institution building of the Ministry of Environment in enforcing environmental and climate 'acquis' – Albania	EC, EuropeAid (IPA National Program 2013)	Jun. 2015 – Dec. 2017	Agrotec	CMCC
ICARUS	Integrated Climate forcing and Air pollution Reduction in Urban Systems http://icarus2020.eu/	EC, Horizon 2020	May 2016 – Apr. 2018	Aristotelio Panepistimio Thessalonikis	CMCC, EUC (Centro Europeo di Formazione e Ricerca in Ingegneria Sismica)
ICEARC	Ice, Climate, and Economics Arctic Research on Change	EC	20142017	British Antarctic Survey	CNRISAC
ICOSESFRI	Integrated Carbon Observing System www.icosri.eu/	EC, ESFRI infrastructure	20152035	ICOSERIC	CNR, CMCC , CREA , ENEA, ARPA, FEEM, University of Tuscia , University of Sassari, University of Padua, University of Genoa, University of Sacro CuoreMilano, Autonomous Province of Bolzano, University of Udine ,OGS
INDIGOData Cloud	INtegrating Distributed data Infrastructures for Global ExplOitation https://www.indigodatacloud.eu/	EC, Horizon 2020	Apr. 2015 – Sep. 2017	INFN	CIRMMP, CMCC, CNR, ICCU, INAF, INGV
INDOMARECLIM	IndoEuropean research facilities for studies on marine ecosystem and climate in India http://www.indomareclimnerci.in/	EC, FP7 (EU INCO.20117.3 India Cooperation Programme)	Feb. 2012 Jan. 2015	NERCI Nansen Environmental Research Centre India Ltd	CMCC
INNOPATHS	Innovation pathways, strategies and policies for the LowCarbon Transition in Europe http://www.innopaths.eu/	EC, Horizon 2020	Dec. 2016 – Nov. 2020	UCL University College London	CMCC, European University Institute
INTACT	On the impact of extreme weather on critical infrastructues http://www.intactproject.eu/	EC, FP7	May 2014 – Apr. 2017	TNO Netherlands Organisation for Applied Scientific Research	CMCC
ISENES 2	Infrastructure for the European Network	EC DG Research	Apr. 2013	Centre National de	CMCC

	for Earth System modelling Phase 2 https://verc.enes.org/ISENES2/	(Capacities – Infrastructures)	Mar. 2016	la Recherche Scientifique (CNRSIPSL), France	
IWMRDL (DOJRAN LAKE)	Integrated Water Resources Management at Dojran Lake	Critical Ecosystem Partnership Fund (CEPF)	Apr. 2014 – Dec. 2015	CMCC	
JERICO	Towards a Joint European Research Infrastructure network for Coastal Observatories http://www.jericofp7.eu/	EC FP7 Integrating Activities (IA)	May 2011April 2015	Institut Français de Recherche pour l'Exploitation de la Mer Ifremer (France)	INGV, CMCC, CNR, OGS
JERICONEXT	Joint European Research Infrastructure network for Coastal Observatory – Novel European eXpertise for coastal observaTories http://www.jericori.eu/	EC, Horizon 2020	Sep. 2015 – Aug. 2019	Ifremer (Institut Francaise de Recherche pour l'Exploitation de la Mer)	CMCC, CNRISMAR, ETT, OGS
JPI FACCE	Joint Programming Initiative on Agriculture, Food Security and Climate Change http://www.faccejpi.com/	MIPAAF, MIUR and European Commission Call for proposal	Maximum duration: 36 months (from 2014 onwards)	N.A.	N.A.
JPIClimateCSA	Joint Programming Initiative Connecting Climate Knowledge for Europe Coordination and Support Action http://www.jpiclimate.eu	EC, FP7 (ENV.2012.6.16)	Jan. 2013 Dec. 2015	PTDLR (Germany)	CMCC
JRC MARSOP	Framework service contract supporting the MARS Crop Yield Forecasting System MARSOP 4 JRC/IPR/2014/H.4/0011/OC	Joint Research Center	Aug. 2014 – Aug. 2016	CMCC	
LIFE PRIMES	Preventing flooding RIsks by Making resilient communitiES http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=5247	EC, LIFE+ Program	Oct. 2015 – Jul. 2018	Arpae	Regione Abruzzo, Regione Emilia Romagna, UNIVPM(Università Politecnica delle Marche, Regione Marche
MaPFGR	Strengthening conservation: a key issue for adaptation of marginal/peripheral	EU RTD Framework Programme	Nov. 2012 Nov. 2016	Council for Research and	CRA SEL, CNR IGV

	populations of forest tree to climate change in Europe http://www.cost.eu/domains_actions/fps/Actions/FP1202?parties	COST Action FP1202		Experimentation on Agriculture, Research Centre fo Forestry (CRA SEL)	
MED SEA CHECK POINT	Growth and innovation in ocean economy Gaps and priorities in sea basin observation and data	EC, DG MARE	Oct. 2015 – Dec. 2016	CMCC	
MEDGOLD	Turning climaterelated information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems	EC, Horizon 2020 (SC5012017)	Dec. 2017 Dec. 2021	ENEA	ENEA,CNR, Barilla, Beetobit, Horta srl, CREA (third party of ENEA)
MEDNICE	MED programme Networks for an Innovative Cooperation in Energy efficiency https://efficientbuildings.interregmed.eu/	Interreg MED 20142020	Nov. 2016 – Oct. 2019	Metropole Nice Cote d'Azur	CMCC
MEDSEA	MEDiterranean Ocean Acidification in a changing climate http://medseaproject.eu/	EC, FP7 (ENVIRONMENT)	Feb. 2011 Jan. 2014	Universitat Autonoma De Barcelona	CMCC, OGS, CoNiSMa
MEXICO Laguna Tabasco	Plan of Adaptation Measures to reduce Vulnerability of Lagoon System CarmenPajonalMachona, Tabasco, to Impacts created by Climate Change and Human Activities	Government of Mexico	Dec. 2014 – Oct. 2015	Thetis	CMCC
MILES	Improve modelling capacity to support low emission development strategies	EC, EuropeAid	Sep. 2014 – Sep. 2017	IDDRI Fondation Institut de Recherche pour le Developpement Durable et les Relations Internationales	CMCC
MYOCEAN 2	Prototype Operational Continuity for GMES Ocean Monitoring and Forecasting System http://www.myocean.eu/	EC, FP7 (SPACE)	Apr. 2012 Oct. 2014	Mercator Ocean (France)	CMCC, CNR, ENEA, INGV, ISPRA, OGS, Italian Air Force Met Service
OceanCOST	Evaluation of Ocean Syntheses	COST (European Cooperation in Science and Technology)	Jul 2014 – May 2018	University of Liege	CMCC

ODISHA RMSI	Non Lending Technical Assistance to Support Implementation of Odisha State Climate Action PlanUrban Resilience	World Bank	Oct. 2014 – Sep. 2015	CMCC	
ORIENTGATE	A structured network for integration of climate knowledge into policy and territorial planning http://www.orientgateproject.org/	Interreg South East Europe 20072013	Jul. 2012 Dec. 2014	CMCC	CMCC
PAST4FUTURE	Climate change Learning from the past climate http://www.past4future.eu/	EC, FP7 (ENVIRONMENT)	Jan. 2010 Dec. 2014	Københavns Universitet (Denmark)	CNR
PEGASOS	PanEuropean GasAeroSolclimate interaction Study http://pegasos.iceht.forth.gr/	EC, FP7 (ENVIRONMENT)	Jan. 2011 Dec. 2014	Foundation For Research And Technology Hellas (Greece)	CNR
PERSEUS	Policy oriented marine Environmental Research in the Southern European Seas http://www.perseusnet.eu	EC, FP7 (ENVIRONMENT)	Jan. 2012 Dec. 2015	Hellenic Center For Marine Research (Greece)	CMCC, CoNISMa, CNR, ENEA, OGS, SZN, CLU srl
PLACARD	Platform for Climate Adaptation and Risk reduction http://www.placardnetwork.eu/	EC, Horizon 2020	May 2015 – Apr. 2020	FFCUL Faculdade de Ciências da Universidade de Lisboa	CMCC
PRIMAVERA	PRocessbased climate sIMulation: AdVances in highresolution modelling and European climate Risk Assessment https://www.primaverah2020.eu/"	EC, Horizon 2020	Nov. 2015 – Oct. 2019	Met Office	CMCC
PROLINE	Efficient Practices of Land Use Management Integrating Water Resources Protection and Nonstructural Flood Mitigation Experiences http://www.interregcentral.eu/Content.Node/PROLINECE.html	Interreg Central Europe 20142020	Jul. 2016 – Jun. 2019	Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management	CMCC, Arpae
PURGE	Public health impacts in URban environments of Greenhouse gas	EC, FP7 (ENVIRONMENT)	Feb. 2011 Jul. 2014	London School Of Hygiene And	FEEM

	Emissions reduction strategies http://purge.lshtm.ac.uk/			Tropical Medicine (UK)	
RISESAM	Responses to coastal climate change: Innovative Strategies for high End Scenarios – Adaptation and Mitigation http://www.cmcc.it/it/projects/risesamresponsestocoastalclimatechangeinnovativestrategiesforhighendscenariosadaptationandmitigation	EC, FP7 (ENVIRONMENT2013twostage)	Nov. 2013 Oct. 2016	UPC Universitat Politècnica de Catalunya	CMCC
S2S4E	Subseasonal to Seasonal climate forecasting for Energy	EC, Horizon 2020 (SC501 RIA)	Dec 2017 – Dec 2020	Barcelona Supercomputing Center (BSC)	ENEA
SeaBasin checkpoints Lot 4. Black Sea	SeaBasin checkpoints Lot 4. Black Sea (MARE/2014/09)	EC, DG MARE	Aug. 2015 – Jul. 2018	IOBAS Institute of Oceanology, Bulgarian Academy of Sciences	CMCC
SECLIFIRM	The Added Value of Seasonal Climate Forecasts for Integrated Risk Management Decisions	EC, Horizon 2020	Feb. 2018 Jan 2022	University Of East Anglia (United Kingdom)	ENEA, ENEL, Accademia Europea di Bolzano
SECTEUR (ECMWF C3S_52)	Secteur engagement for the Copernicus Climate Change service: translating European User Requirements http://climate.copernicus.eu/secteur	ECMWF	May 2015 – Aug. 2017	IEA Institute for Environmental Analytics at the University of Reading	CMCC
SIOS	Svalbard Integrated Earth Observing System	EC	20152019	CNRISAC	
SOCLIMPACT	DownScaling CLImate imPACTs and decarbonisation pathways in EU islands, and enhancing socioeconomic and nonmarket evaluation of Climate Change for Europe, for 2050 and beyond	EC, Horizon 2020	Jan. 2018 – Dec. 2020	The University of Las Palmas de Gran Canaria	ENEA, CMCC
SPECS	Seasonal to decadal climate prediction for the improvement of European Climate Services http://www.specsfp7.eu/SPECS/Home.ht	EC, FP7	20122017	Fundació Institut Català de Ciències del Clima (IC3), Spain	ENEA

	ml				
SQUARE4ECVs	Scientific Quality Assessment and Reports for Essential Climate Variables	ECMWF C3S_511 Copernicus Climate Change Service	Nov.2017 Oct.2021	CNR	CNR, ENEA (as Subcontractor)
21MEDCMEMS	StatisticalDynamical Observation Operator for SST Data Assimilation	Mercator Ocean	Mar. 2016 – Feb. 2018	CMCC	
StratoClim	Stratospheric and upper tropospheric processes for better climate predictions	EC European Commission	20132018	AWI HelmholtzZentrum für Polarund Meeresforschung	CNRISAC
STRATUS	Environmental Strategies for Sustainable Tourism	20142020 INTERREG VA Italy – France (Maritime)	Feb. 2017 – Feb 2019	Università degli Studi di Cagliari CIREM Sez.CRENoS	ENEA, Area Marina Protetta "Capo Carbonara", POLISTE S.r.l
TangoSAT	Study of L and Pband SAR Tomography Synergies	European Space Agency (ESA)	Nov. 2014 – Mar. 2015	Polytechnic of Milan (POLIMI)	CMCC
TOSCA	Towards a more complete assessment of the impact of solar variability on the Earth's climate http://lpc2e.cnrsorleans.fr/~ddwit/TOSCA/Home.html	EU RTD Framework Programme COST Action ES1005	May 2011 May 2015	LPC2E CNRS University of Orleans (France)	INAF Astronomical Observatory in Rome, University of L'Aquila
UHI	Urban Heat Island Development and application of mitigation and adaptation strategies and measures for counteracting the global Urban Heat Islands phenomenon http://www.euuhi.eu/	Interreg Central Europe 20072013	Oct. 2011 Apr. 2014	Regional Agency for Environment Protection in EmiliaRomagna (ARPA EmiliaRomagna)	ARPA EmiliaRomagna, Emilia Romagna Region, Veneto Region, Consortium for Coordination of Research Activities Concerning the Venice Lagoon System (CORILA)
UV4growth	UVB radiation: A specific regulator of plant growth and food quality in a changing climate http://www.ucc.ie/en/uv4growth/	EU RTD Framework Programme COST Action FA0906	Apr. 2010 Apr. 2014	University Colege Cork (Ireland)	Italy
VALUE	Validating and Integrating Downscaling Methods for Climate Change Research http://www.valuecost.eu/	EU RTD Framework Programme COST Action ES1102	Dec. 2011 Dec. 2015	Agencia Estatal de Meteorología (Spain)	HydroMeteoClimatological Service of the Italian EmiliaRomagna Region

VECTORS	Vectors of Change in Oceans and Seas Marine Life, Impact on Economic Sectors http://www.marinevectors.eu/	EC, FP7(OCEAN)	Feb. 2011 Jan. 2015	Plymouth Marine Laboratory, Plymouth, UK.	CONISMA, CNRIAMC, CMCC (formally through FEEM), Pisa University, Pavia University, OGS
WatEnerCast	Adapt, thorugh tailored weatherrelated forecast, the water and energy operations to the increased weather fluctuations and to climate change http://www.climatekic.org/projects/watenercast/	ClimateKIC	Jan. 2015 – Dec. 2017	ARIA Tecnologies	CMCC

8.3 Systematic observation

A comprehensive observational network, used also for climate studies, covers the Italian territory. Furthermore, Italy contributes significantly to international programmes involving land, ocean and spacebased measurements by means of its very long instrumental temperature record. Italy also fully participates to the GCOS Surface Network (GSN), the GCOS Upper Air Network (GUAN) and the GAW (Global Atmospheric Watch). More, Italy is actively contributing to longterm observations of polar regions, both in Antarctica in the frame of PNRA programme that in the Arctic thanks to the station Dirigibile Italia and its observing platforms in Ny Alesund (Svalbard),all managed and supported by CNR, and activities in Thule (Greenland) supported by PNRA (see below for more details). All national observations and data sets that have been declared as contributions to GCOS or GAW are regularly submitted to the appropriate Data Centres.

8.3.1 Atmospheric Climate Observing System, including those measuring atmospheric constituents

The Italian observing network is managed by several institutions and agencies: the Agrarian Research Council, the Italian Air Force Meteorological Service, ENEA, CNR, ISPRA, several Universities, the Civil Protection and the Regional Environmental Agencies. All together they compose the national system and they also contribute to the international network.

Agrarian Research Council

The *Agrarian Research Council–Climatology and Meteorology applied to Agriculture* (CRACMA, http://cma.entecra.it/homePage.htm) manages a network of about 83 agrometeorological stations and observatories, most of which include very long historical data of daily minimum and maximum temperature and precipitation. Other meteorological data are collected by Regional EnvMetAgro Agencies (see Table 8.3).

Italian Air Force Meteorological Service

The *Italian Air Force Meteorological Service* (http://www.meteoam.it) manages a network of 72 manned surfacestations and of 58 automatic surfacestations (57 Data Collection Platforms + 1 SWS). Other meteorological data are collected by the *National Agency for Aviation Aids* (ENAV, http://www.enav.it), which operates a network of 35 stations. Most of these data is distributed through the GTS and ICAO networks.

Table 8.3 The Italian meteorological observation networks

Administration	Station type	Number	Network/Circuit	Average timelength of records
Air Force Met Service	surfacemanned	72	WMOGTS, ICAOAFTN	~ 63 years
Air Force Met Service	surfaceautomatic (DCP)	57	synoptic use	~ 11 years (not continuously)

Air Force Met Service	surfaceautomatic (SWS)	1	WMOGTS, ICAOAFTN	More than 2 years
Air Force Met Service	surface solar radiation and sunshine	40	WMOGTS	~ 55 years
ENAV	surfacemanned	~ 35	WMOGTS, ICAOAFTN	~ 63 years
CRACMA	surfacemanned	~ 20	agromet and climatological use	~ 60 years
CRACMA	surfaceautomatic	~ 43	agromet and climatological use	~ 15 years
CRACMA	thermalrain	~ 20	agromet and climatological use	~ 60 years
Regional EnvMet Agencies	surfaceautomatic	~ 50 per region	met/climaological local use	~ 20 years
Regional AgroMet Services	surfaceautomatic	~ 50 per region	agromet and climatological local use	~ 20 years

Italy contributes to GCOS Surface Network (GSN) with five stations of the Air Force Met Service (see Table 8.4).

Table 8.4 The Italian GCOS Surface Network (GSN) stations

Station WMO Index	Station Name	Latitude (°, ')	Longitude (°, ')	Elevation (m a.s.l.)	Measurements since
16022	PAGANELLA	46, 08	11, 02	2129	1951
16134	MONTE CIMONE	44, 12	10, 42	2173	1946
16224	VIGNA DI VALLE	42, 05	12, 13	266	1954
16258	MONTE SANT'ANGELO	41, 42	15, 57	847	1952
16550	CAPO BELLAVISTA	39, 56	9, 43	150	1951

The Italian Air Force Met Service has developed a new *Standard Weather System* (SWS), based on the EUMETNET *AWS* (automatic weather station) Program requirements, in order to substitute gradually the acquisition tool and sensors in each meteorological station. The system is able to operate both in manual and fully automatic way, with possibility to interface, in a simple way, every digital sensor and to monitor and regulate the functioning of its devices through a local or remote control. The implementation program started on 1st April 2015 and it's on its way on.

The Italian Air Force Meteorological Service collects atmospheric routine CO_2 measurements on the top of **Mt. Cimone** (2173 m a.s.l.) since March 1979, the longest in continuum record in Europe, and stratospheric O_3 in three stations: **Sestola** (1020 m a.s.l., close to Mt. Cimone), **Vigna di Valle** and **Messina** by means of spectrophotometers Dobson and Brewer. Ozone data are regularly transmitted to the Canadian WOUDC (World Ozone and Ultraviolet Radiation Data Centre, http://www.woudc.org/index_e.html). A comprehensive overview concerning the special observations carried out by the Air Force Meteorological Service is shown in Table 8.6.

The Italian upperair observation network is shortly summarized in Table 8.5. The Air Force Met Service contributes to GCOS UpperAir Network (GUAN) with one station (see Table 8.6).

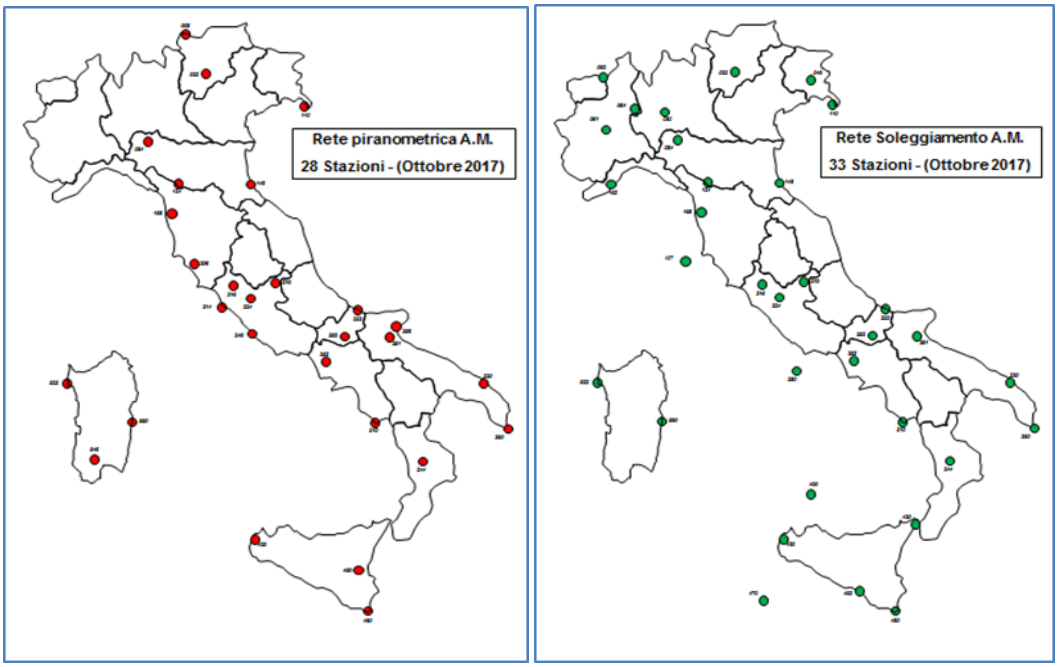
Table 8.5 The Italian upperair observation network

Administration	Station type	Number	Network/Circuit	Average timelength of records
Air Force Met Service	upperair	6	WMOGTS	~ 60 years
Regional EnvMet Services	upperair	2	WMOGTS	~ 20 years

Table 8.6 The Italian GCOS Upperair Network (GUAN) station

Station WMO Index	Station Name	Latitude (°, ')	Longitude (°, ')	Elevation (m a.s.l.)	Measurements since
16245	PRATICA DI MARE	41, 39	12, 26	21	1986

Figure 8.1 The Italian Air Force Met Service solar radiation (a) and sunshine duration (b) networks



(a) (b)

Table 8.7 The Italian GAW stations on national territory

GAWID	Station Name	Station Type	Administration	Elevation (m a.s.l.)
AST	Aosta	Contributing	Arpa Valle d'Aosta	569
CEO	CETEMPS/DSFC Università Degli Studi dell'Aquila	Contributing	CETEMPS/DSFC Università Degli Studi dell'Aquila (http://cetemps.aquila.infn.it)	656
POT	CNRIMAA Atmospheric Observatory (CIAO)	Contributing	CNRIMAA Atmospheric Observatory (CIAO, http://www.ciao.imaa.cnr.it)	760
IPR	Ispra	Regional	Joint Research Centre (JRC), located at Ispra (http://abcis.jrc.ec.europa.eu/index.php)	209
LMP	Lampedusa	Regional	ENEA	45
LMT	Lamezia Terme	Regional	National Research Council Institute for Atmospheric Science and Climate (CNRISAC)	6
ECO	Lecce	Regional	National Research Council Institute for Atmospheric Science and Climate (CNRISAC)	36
CUR	Monte Curcio	Regional	National Research Council Institute of Atmospheric Pollution Research (CNRIIA) (http://mtcurcio.iia.cnr.it)	1780
MES	Messina	Regional	Italian Air Force Met Service	54
CMN	Monte Cimone	Global	Italian Air Force Met Service	2165
CGR	Capo Granitola	Regional	National Research Council Institute for Atmospheric Science and Climate (CNRISAC)	5
MLI	Montelibretti	Contributing	National Research Council Institute for Atmospheric Pollution (CNRIIA) http://www.iia.cnr.it)	48
PRS	Plateau Rosa		Italian Air Force Met Service	3480
ROM	Rome University	Regional	Sapienza University of Rome	75
SML	S.Maria di Leuca	Regional	Italian Air Force Met Service	104
SES	Sestola	Regional	Italian Air Force Met Service	1030
TRP	Trapani	Regional	Italian Air Force Met Service	7
VDV	Vigna di Valle	Regional	Italian Air Force Met Service	262
VTB	Viterbo	Regional	Italian Air Force Met Service	300
	Paganella		Italian Air Force Met Service	2129
	Monte S.Angelo		Italian Air Force Met Service	848
	Capo Caccia		Italian Air Force Met Service	204
	Ustica		Italian Air Force Met Service	243

Cooperation between the Department of Civil Protection (DPC), the Air Force Met Service and the Regions allowed the *Italian radar network project* to start. The project regularly provides a realtime national SRI (*surface rainfall intensity*) composite (http://www.protezionecivile.gov.it/jcms/it/mappa_radar.wp), used to monitor cloud systems and to determine the structure of storms and their potential to cause severe weather. The radar network provides a good coverage of the national territory and enables comparison

with groundtruth data from a network of landbased precipitation stations. The nominal number of contributing radar systems is 23 Cband plus 2 Xband, but hardware and software failures reduce the average number of efficient systems to about 19.

Table 8.8 The Italian Air Force Met Service Special observation network

Measurement or analysis	Instrument	Frequency	Number of Stations	Time length of records
Stratospheric Ozone and Surface UVB Radiation	Brewer and Dobson spectrophotometers	daily	3 (Sestola, Vigna di Valle, Messina)	Dobson data time series since 1947; Brewer data time sereis since 1987
Ozone Vertical Profile	Upperair sounding system equipped with an ozone sonde sensor (an electrochemical concentration cell)	two times a month	1 (Vigna di Valle)	data time series since 2011
Global Solar Radiation	Kipp & Zonen CM11 (21) and IA/FMQ16 (7)	hourly and daily	28	data time series since 1958 for most of historical stations
Sunshine Duration	CampbellStokes sunshine recorder	daily	33 (Eliofonografi)	data time series since 1958 for most of historical stations
Chemical Analysis of Precipitation	Precipitation sampler MTX Wet & Dry	weekly	10 (no more used since 2015)	data time series since 1975 for 5 stations, since 2012 for 4 stations
Solar Photometry (atmospheric turbidity)	Kipp & Zonen sunsky photometers (Prede POM01)	hourly	4	data time series since 2013, only for experimental purposes
UVA and UVB radiation	DeltaOHM pyranometer (LP_UVA02 and LP_UVB02)	hourly and daily	10	the operational phase of regular collection of data has not yet started
CO_2	ULTRAMAT SIEMENS 6E – NonDispersive Infrared Analyzer	1minute averages	1	since March 1979
CH_4	PCF ELETTRONICA 529 FID (Flame Ionization Detector) Gaschromatograph	instantaneous measurements every 3 minutes	1	since December 2011 (currently in a experimental stage)

ISPRA

ISPRA is responsible for standardization, collection and delivery of environmental data, including those of interest for climate monitoring and analysis. National environmental data and indicators are transmitted to EEA (European Environmental Agency) and to other international bodies such as EMEP (*European Monitoring and Evaluation Programme*). For over 10 years ISPRA has developed and manages, in collaboration with the most important national and regional meteorological networks, the National System for Climate Data Collection and Dissemination (*SCIA,* www.scia.isprambiente.it). In agreement

with the National Permanent Representative, climate data, indices and indicators, including those representing variations and trends of mean and extreme climate variables, are transmitted to and made available for the bulletins and publications of the World Meteorological Organisation.

ENEA

ENEA is responsible for climate observations at the station on the island of **Lampedusa** (http://www.lampedusa.enea.it), in the central Mediterranean sea. The station is an integrated system which comprises an atmospheric (35.52°N, 12.63°E) and an oceanographic observatory (35.49°N, 12.47°E). The atmospheric observatory has been operational since 1997, and is dedicated to the monitoring of atmospheric composition, properties, and the radiative budget at the surface. Many parameters are continuously measured such as: CO_2 (weekly samples, since 1992; continuous, since 1998), several greenhouse gases (CH_4, N_2O, CFC11 and CFC12 weekly samples, since 1997; continuous, since 2006) and total ozone measurements. Furthermore, aerosols (optical properties, chemical composition), water vapour and clouds, meteorological parameters, CO, ultraviolet, solar, and infrared radiation are routinely measured. Lampedusa station contributes to the GCOS through the Global Atmosphere Watch program and participates in different global measurements networks (AERONET; Carboeurope; NOAA/ESRL/GMD CCGG cooperative air sampling network; MWRnet). The oceanographic observatory has been activated in 2015 and is dedicated to the investigation of airsea interactions, surface energy budget, and measurements along the water column; in cooperation with CNR, the observatory is also a site for validation of ocean colour measurements. In addition, several intensive measurements campaigns were carried out at Lampedusa (e.g., Photosynthetic Actinic radiation Modulation Experiment at LAmpedusa in 2017), also as a contribution to large international experiments (Hydrological cycle Mediterranean experiment, Hymex in 2012; Chemistry and Aerosol Mediterranean Experiment, Charmex in 2013). Activities at Lampedusa are supported by the MIUR, through the *NextData* and *Ritmare* projects.

ENEA also participates, jointly with other Institutes (NCAR/USA; INGV, University of Roma and Firenze), in an international effort aimed at the study of the Arctic climate through observations carried out at the **Thule High Arctic Atmospheric Observatory** (76.5°N, 68.8°W), Greenland (http://www.ndsc.ncep.noaa.gov/sites/stat_reps/thule/; http://www.thuleatmosit.it). The station is dedicated to the observation of tropospheric and stratospheric composition and structure; the Italian measurements at Thule started in 1990 and are part of a longterm program. Thule measurements contribute to GCOS through the Network for the Detection of Atmospheric Composition Change (http://www.ndsc.ncep.noaa.gov/). Italian activities are presently supported by the Italian Antarctic Programme; they were supported also by the European Union, the MIUR and by the US National Science Foundation.

Furthermore ENEA participates to the study of the Antarctic climate through observations carried out by the **Italian MeteoClimatological Antarctic Observatory** (http://www.climantartide.it). Started in 1987, the Observatory currently operates 16 Automatic Weather Stations (AWS), active throughout the year. The AWS's monitoring network covers all the Victoria Lands territory, from the Italian Base "Mario Zucchelli" (MZS, 74° 41' S, 164° 05' E) to the innermost area of the Antarctic Plateau at the FrenchItalian Base "Concordia" (DC, 75° S, 123° E), and towards the Wilkes Lands territory in the direction of the French Scientific Base "Dumont D'Urville" (DDU, 66° 40' S, 140° 01' E). Seven of the AWSs have a WMO identifier and their Synop messages are disseminated to the GTS network. Upper air weather information

is acquired by two radiosounding stations: one at MZS (since 1987, two launches per day, at 00 and 12 UTC) and one at DC (since 2005, one launch per day, at 12 UTC). Temperature messages automatically generated from both stations are disseminated to the GTS network. The Italian MeteoClimatological Antarctic Observatory is supported by the *Italian Antarctic Programme*.

CNR

CNRIDASC (*National Research Council Institute of Acoustics and Sensors*), together with the *Dirección Nacional Del Antártico (Argentina)* and the *International Center for Earth Sciences*, manages the GAW station installed in **Jubany (Antarctic Peninsula)** and collects CO_2 data since 1994 (http://www.idasc.cnr.it). Trace gases measurements of all stations can be found at link http://gaw.kishou.go.jp/wdcgg.html.

Since the early '90s of the last Century, continuous observations of atmospheric composition have been carried out in Italy at **Mt. Cimone** (44°12' N, 10°42' E, 2165 m a.s.l.) at the **"O. Vittori" atmospheric observatory** (www.isac.cnr.it/cimone) managed by the **National Research Council of Italy (CNR) – Institute for Atmospheric Science and Climate (ISAC)** and hosted by Italian Air Force – Centro Aeronautica Militare di Montagna. Nowadays, at this location, thanks to the collaboration with the **University of Urbino,** several longterm scientific programmes covering a large suite of climate altering species (including Montreal and Kyoto gases as well as shortlived climate forcers, chemical and physical aerosol particle properties) are carried out in the framework of international measurement networks (WMO/GAW, AGAGE, ACTRIS).

Observations	Starting year	Lead institution
Surface O_3	1996	CNRISAC
NO,NO_2	2012	CNRISAC
SO_2	2014	CNRISAC
CO	2008	CNRISAC/Uniurb
CH_4	2008	Uniurb
N_2O	2008	Uniurb
SF_6	2008	Uniurb
CFCs, HCFCs	2002	Uniurb
HFCs	2002	Uniurb
Columnar NO_2	1993	CNRISAC
Aerosol size distribution (10 – 500 nm)	2005	CNRISAC
Aerosol size distribution (300 nm – 10 μm)	2000	CNRISAC
Aerosol scattering	2005	CNRISAC
Aerosol absorption	2005	CNRISAC
Equivalent BC	2005	CNRISAC
Aerosol chemistry (PM1 –PM10)	2005	CNRISAC
Solar photometry	2016	CNRISAC
Meteorological parameters and solar radiation	1996	CNRISAC

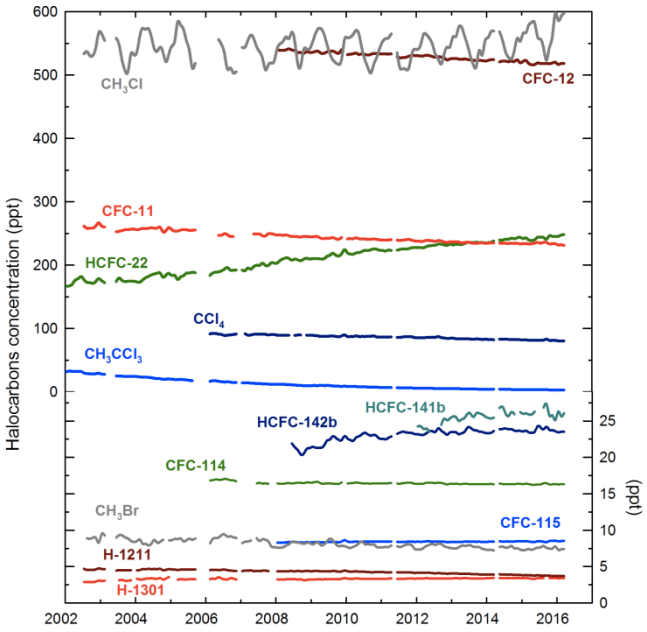
List observation programmes running at the "O. Vittori" observatory at Mt. Cimone (Uniurb: Urbino University; Unibo: Bologna University)

Even if carbon dioxide is the major anthropogenic contributor to radiative forcing, other gases such as

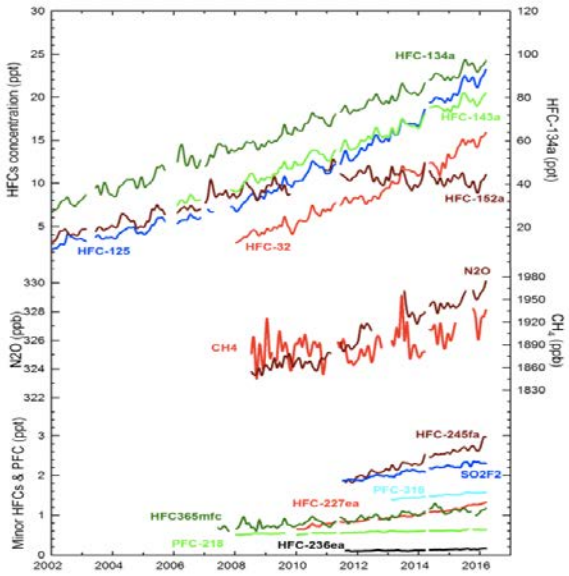
methane, **nitrous oxide**, **SF6**, and **halogenated gases** (**CFCs, HCFCs, PFCs, HFCs**), are extremely relevant in climate issues because of their very high Global Warming Potential. Moreover, other **shortlived climate forcers –SLCF** (e.g. **tropospheric ozone** and **black carbon**), further exacerbate (especially at regional scale) the climate forcing by GHG. All these species are continuously observed at the CNR "O. Vittori" Observatory at Mt. Cimone.

This research activity includes the observation of a wide range on compounds that are measured continuously at the site, in most cases since more than a decade, representing the most important dataset on nonCO2 GHGs and SLCFs over the Italian territory. The inclusion of CMN in important global networks (e.g. https://agage.mit.edu/) makes these data comparable with those measured in other sites across the globe and allows the inclusion of these highquality data in studies that are interested both at the global and at the regional (European) scale. The analysis of these data using inverse modelling approaches (e.g. *Graziosi, F. et al., Emissions of carbon tetrachloride from Europe, Atmos. Chem. Phys., 16, doi:10.5194/acp16128492016, 2016; Graziosi F, et al. 2017. European emissions of the powerful greenhouse gases hydrofluorocarbons inferred from atmospheric measurements and their comparison with annual national reports to UNFCCC. Atmospheric Environment. 158, 2017*) has already allowed to provide emission estimates (topdown) at the regional scale that constitute an important support to improve bottomup emission data that each country is required to submit every year in the frame of the most important international global protocols aimed at combatting climate change. Such activity is within the scopes of the IG3IS (Integrated Global Greenhouse Gas Information System) of the World Meteorological Organisation, a framework capable of accepting and promoting a range of advanced GHG emission quantification capabilities in order to improve the quality of and confidence in GHG emission inventories.

Time series of the ozone depleting radiatively active gases measured at Mt. Cimone by the University of Urbino and CNRISAC.



Time series of the nonCO_2 Kyoto gases measured at Mt. Cimone by the University of Urbino and CNRISAC.



Moreover, thanks to the participation to the IAMICA Project (www.iamica.it), in 2015 **CNRISAC** implemented in the Southern Italy three new permanent observatories (**Capo Granitola, Lamezia Terme and Lecce**), and **CNRIIA** implemented Monte Curcio Observatory. At these observatories, part of the WMO/GAW network (GAW ID: CGR, LMT, ECO, and CUR), continuous observations of GHG (CO_2, CH_4) and SLCF (nearsurface O_3, black carbon) are currently carried out and data are submitted yearly to the World Data Centre for Greenhouse Gases (WDCGG), for Reactive Gases (WDCRG) and for Aerosol (WDCA) managed by WMO/GAW. CNRISAC collects total ozone data in Antarctica at **Belgrano II** station by Brewer spectrometer since 1992, thanks to a cooperation with the *Dirección Nacional Del Antártico (Argentina)*, and since 2006 manage the BSRN (Baseline Surface Radiation Network) site/observatory in Concordia on the Antarctic Plateau. Measurements include downwelling and upwelling (at two levels) solar and atmospheric radiation as well as Aerosol columna rcontent and UV spectral radiation thanks to custom instrumentation developed at the Istitute (UVRAD).

Since 2016, always in Concordia and always by CNRISAC, a new observatory devoted to carry out continuous lidar profiles have been implemented.

CNR together with ENEA contributetogether with french colleagues to the Concordia CRYONET site, recently (spring 2017) officially established by WMO in the frame of the Global Criospheric Watch programme (GCW). Together with observations of the cryosphere, Italian groups assure the relevant meteo and radiation ancillary data.

All activities in Antarctica are supported by PNRA. (Programma Nazionale ricerche in Antartide)..

In the Arctic, the main Italian contributions to systematic observation are carried out at the Dirigibile Italia station. The **Italian Arctic Station Dirigibile Italia** is a multidisciplinary research facility located in **NyÅlesund** (78°55' N, 11°56' E) in the Norwegian Archipelago of Spitzbergen (Svalbard). The station is managed by CNR and the activities are coordinated by the Earth and Enviromnment Department (DTA) . The station was opened in 1997 and together with longterm observation activities, supports interdisciplinary research programmes/projects covering all climate system spheres (atmosphere, hystosphere, cryosphere, biosphere ad litosphere). At the station since 2009 several complex observing platforms have been implemented and more and more instrumented. They include the AmundsenNobile Climate Change Tower (CCT), the aerosol laboratory of Gruvebadet and a mooring installed in the inner

part of Kongsfjiorden. Since 2005, a deep borehole (50 m) and a CALM Grid have been realized near the CCT together with system for automatic observations. Last implementation, planned for spring 2018, include a sodar system and a minilidar improve observations of ABL and improvement of aerosol samplings up to include all organics. Largest part of longterm activities are performed in the frame of the Climate Change Tower Integrated Project (CCTIP). More information on activities, scientific targets and collected data can be obtained at the CCTIP web site (www.isac.cnr.it/~radiclim/CCTower). In addition to activities ivolving above indicated observing platforms, of relevance are auroral activities carried out by INAF research groups, ionospheric measurements performed by INGV, and UV and ozone measurements carried out by CNR thanks to custom as well standard instrumentation (brewer and UVRAD)

8.3.2 Ocean Climate Observing System

Italy contributes to the GOOS international initiative through the participation to EUROGOOS (CMCC, OGS, CNR, ISPRA and ENEA are partners of EUROGOOS) and to MONGOOS (CMCC coordinates MONGOOS, while CNR, OGS, ISPRA and ARPAE are partners). The development of operational oceanography in Italy is coordinate within MONGOOS and has been developed in the last year through several projects such as RITMARE, ARGOIT and CMEMS. Italian research agencies and institutions are contributing to GOOS through the *insitu* and satellite ocean monitoring systems, the basinscale Mediterranean forecast for hydrodynamics and marine biochemistry (CMEMS), Mediterranean and globalscale reanalyses, and limitedarea forecasts for the Italian seas. The actual observing system is composed of a specific implementation of VOSSOOP, ARGO, meteooceanographic buoys, gliders and analysed satellite data that are both archived in real time. The *insitu* observations have been collected since the early 2000s. The products derived from satellite observations have been improved and consist of Sea Surface Temperature, Sea Level Anomaly and Chla concentration.
The Italian participation to CMEMS (Coordination of MEDMFC and Ocean Color TAC, contribution to the BSMFC, contribution to the CMEMS *insitu* TAC) is fundamental for the EU Copernicus program for the systematic monitoring of the Earth system (http://www.copernicus.eu/). Copernicus organises the access to multiple sources of data, from Earth Observation satellites to *insitu* platforms and provides users with reliable and uptodate information through a set of services related to environmental and security issues. For the ocean and the climate Copernicus organises two services and CMCC has the responsibility of the Mediterranean Monitoring and Forecasting Centre (with the partnership of INGV and OGS) and CNRISAC the responsibility of the Ocean Color Thematic Assembly Centre. Moreover Italy contributes to the CMEMS *insitu* TAC and CMCC contributes to the Global Ocean Reanalysis of CMEMS.

ARGOITALY is the Italian component of a worldwide *in situ* global observing system, based on autonomous profiling floats, surface drifters, gliders and shipofopportunity measurements. It is primarily focused on the Italian seas, the Mediterranean and Black seas, and includes observations of temperature, salinity, currents and other water mass properties. ARGOITALY contributes to international programs such as Argo and EuroArgo (global monitoring of water properties with profiling floats), GDP (Global Drifter Program to measure nearsurface temperature and currents), EGO (gliding vehicles to measure water properties) and SOOP (ShipOfOpportunity Program to temperature profiles), developed to monitor the entire World Ocean on a long term basis.

Together with the Italian Air Force Met Service, INGV, CMCC, OGS and ISPRA participate to the *RECMMOMed (REgional Centre specialized for Marine Meteorology and Oceanography over Mediterranean Sea)*, in order to build a specialized hub, according to WIS concept (DCPC), for marine meteorology and oceanography. These above mentioned components are:

- ISPRA, responsible for the national tide gauge network (*RMN Rete Mareografica Nazionale,* with 36 tide gauges http://www.mareografico.it) and for the national data buoy or wave measurement network (*RON Rete Ondametrica Nazionale*, with 15 moored oceanographic buoys http://www.telemisura.it);
- OGS (http://www.ogs.trieste.it), responsible for the MedARGO program;
- CMCC (http://www.cmcc.it) and INGV (http://www.ingv.it) responsible for the oceanographic analyses and forecasts for the Mediterranean Sea (http://gnoo.bo.ingv.it/mfs/myocean); since 2012 INGV coordinates an international project called EMSO (*European Multidisciplinatry Seafloor Observatory* http://www.emsoeu.org/management), a network of marine observatories devoted to monitor and study climate change of natural origin or induced by human activity and the evolution of marine ecosystems.

Furthermore, CNRISMAR operates several multiparametric observing systems (buoys, platforms, moorings and other fixed sites http://www.ismar.cnr.it/infrastructures/observationalsites), most of them are placed along the Italian coasts and transmit data in real time to the receiving stations at coast.
Finally, to be noticed is the activity of the Mareographic station of Trieste, operated by the University of Trieste (http://www.meteo.units.it) and performing the monitoring every 10 minutes of the sea level and temperature (surface and 2 m. below sea level) since 1995 (conventional meteorological and radiation data are monitored since 1979 in the same station).
ENEA has developed, as part of the RITMARE project, and oceanographic observatory (35.49°N, 12.47°E) South of the Sicily channel, close to the island of Lampedusa. The Lampedusa oceanographic observatory is dedicated to the investigation of airsea interactions, surface energy budget, and measurements along the water column; in cooperation with CNR, the observatory is also a site for validation of ocean colour measurements.

8.3.3 Terrestrial Climate Observing System

In Italy the hydrological cycle monitoring, as well as that relating to land use, evapotranspiration and soil conditions, is carried out by regional networks and functional centres since 2002; the analysis and assessment of resulting data are performed both at regional (Regional Agencies for Environmental Protection) and national level (ISPRA).
The State Forestry Corps (Corpo Forestale dello Stato, CFS) has been reformed by the Legislative Decree 177/2016 which reduced the police forces from 5 to 4 and redistributed the CFS personnel among the remaining bodies. The Arma dei Carabinieri (Comando unità per la tutela forestale, ambientale e agroalimentare, CUTFAA) takes on the forest inventorying and monitoring activities performed in the framework of the CONECOFOR (Forest Ecosystems Controls) and the INFC (National Inventory of Forests and forest Carbon pools, http://www.sian.it/inventarioforestale); the latest together with the scientific patronage of the CREA (Centro di ricerca Foreste e Legno del Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria) and the information technology support of Almaviva Spa.

The Arma dei Carabinieri has also an active role, in the ordinary statute Regions, in fire prevention, intervention and repression activities (on a continuous basis throughout the year) and collection of all the information accompanying each fire event (e.g. recording the hectares covered by fire and describing the damaged vegetation). In the special statute Regions, other autonomous entities (such as the Corpo Forestale e di Vigilanza ambientale in Sardinia or the Corpo forestale della Regione Siciliana in Sicily) are appointed to these duties.

Monitoring and measurements of underground water resources (aquifers) are conducted by CNR IGG in collaboration with private and public local water management institutions. Ecosystem monitoring is performed by CNR in the framework of the national LongTerm Ecological Research Network and of European projects and programmes (eLTER, ECOPOTENTIAL).

Italy (CMCC) is also the coordinator of the Ecosystem Thematic Center (ETC) of the European Integrated Carbon Observation System (ICOS) for measuring carbon and greenhouse gas fluxes, as well as water and energy and other parameters, over terrestrial ecosystems.

8.3.4 Space Climate and Polar Observing System

Climate changes and global warming are more and more evident. Their scientific understanding is increasing thanks to the observations from Earthorbiting satellites, that have been a key component in monitoring climate change on a global scale in the last decades. This type of technology has enabling scientists to have an overall view collecting a huge amount of data about our planet. All these data, collected over many years, confirm the signals of a changing climate proving as the human influence has been the dominant cause of the observed warming since the mid20th century, as indicated in the Report of the United Nations Intergovernmental Panel on Climate Change IPCC, 2014. The effects of global warming have been felt most notably in the coldest regions on Earth. In the last two decades glaciers were reduced on the whole globe and the melting of the permanent Arctic ice caps is increasingly rapid revealing open ocean. It is wellknown that the polar regions are extremely important in terms of their global impact on weather and climate and functioning of the Earth system. In addition to this, human presence and related activities are increasing in these regions. The cryosphere is a component of the Earth system that includes elements as solid precipitation, snow cover, sea ice, lake and river ice, glaciers, ice caps, ice sheets, permafrost, seasonally frozen ground, etc.
In a changing climate scenario there is a need to monitor all of these changes and to model their behaviour in order to develop adaptation responses to deal with the inevitable impacts and to support political decisionmakers choices. In this context, the Italian Earth Observation System COSMOSkyMed, based on a constellation of four LowEarthOrbit midsize satellites, each equipped with a multimode highresolution SAR (Synthetic Aperture Radar) operating in Xband, is providing its contribution since many years, for example through the Italian Space Agency's (ASI) membership in the Polar Space Task Group (PSTG). This is an international organization, established in 2011 under the auspice of the World Meteorological Organization's(WMO) and the Executive Council Panel of Experts on Polar Observations Research and Services (ECPORS). The PSTG is a successor of the successful International Polar Year Space Task Group (IPYSTG), with the mandate to provide coordination across Space Agencies to facilitate acquisition and distribution of fundamental satellite datasets and to support research and applications in the cryosphere. PSTG requirements concern with satellite information, particularly with SAR sensor, for the study of ice sheets,

permafrost, snow and floating ice. The PSTG activities are supported by the SAR Coordination Working Group (CWG), a subgroup of the PSTG which has the aim to better harmonize the collection and utilization of different SAR data sets. SAR instruments, represent a reliable tool for ice monitoring because they are able to provide a synoptic view that complements the accurate but low coverage reports from ships and airborne sources. SAR data are able to provide information on the ice coverage, the size and shape of ice floes. In particular, SAR data provide the crucial advantage to be independent from weather and day–night conditions and it is even more a key feature in the glacier environment where persistent clouds hamper data acquisitions by mean of optical sensors and where the polar night imposes a prolonged period of darkness. Timely and variable information on sea ice conditions are essential also for all the operations in icecovered areas: the safety and efficiency of sea transportation, offshore operations, fisheries and other activities in regions covered by sea ice require highresolution and ice forecasts.

With the aim to meet the objectives of the PSTG and to assure the data continuity through spaceborne data collection over ice sheets, ASI implemented acquisitions of interferometry series over 53 glaciers in Greenland and 33 glaciers in Antarctica and the complete and interferometric mapping of the Antarctic coast starting from September 2014. These handbooks were activated in the framework of the COSMOSkyMed Background Mission (CSK BCK Mission), a low priority acquisition plan which allows to populate a substantial data archive for future applications, without undermining in any way other acquisition opportunities, since it is subordinated to users acquisition requests. For each orbital cycle (16 days) around 1000 acquisitions are performed over Greenland and Antartica with a time resolution of 4 or 8 days for higher level priority glaciers. The data sets are available in the COSMOSkyMed mission catalogue.

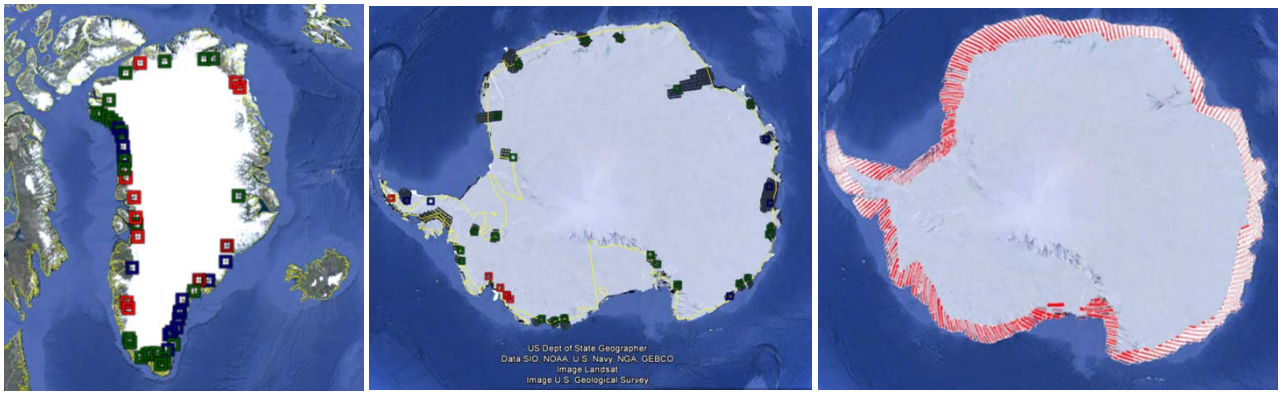
Table 8.8 – COSMOSkyMed acquisition plans in the context of the Background Mission: ASI's contribution to the Polar Space Task Group

	Number of monitored Glaciers	Number of acquisitions per orbital cycle
Greenland	53	156
Antartica	33	244
Antartic Coast		496

Acquisition geometry:

- Stripmap mode (35 m resolution, 40 km swath;
- HH polarization, ASC/DESC direction, Right LooK Side;
- Incidence Angle in the range 25°45°
- Time resolution 48 days for highest priority glaciers (level 3), 16 days for glaciers of level 2 and 1 and Antartic Coast;

Details of the areas of interest systematically monitored using the COSMOSkyMed mission in the context of the Italian contribution to the Polar Space Task Group



On arctic lands, SAR technology can provide monitoring of land instability due to permafrost thawing and melting. Permafrost is acknowledged by WMO and UNFCCC (United Nations Framework Convention on Climate Change) as Essential Climate Variable (ECV). Its monitoring as part of the cryosphere has been identified as grand challenge by the World Climate Research Programme (WCRP) Joint Science Committee and a draft white paper on this topic published in 2012 (Kattsov et al. 2012). A focused effort on improving the representation of permafrost and high latitude land surface, including wetlands, in climate models, with specific emphasis on their role in the global carbon cycle has been requested. Permafrost, defined as subsurface earth materials that remains at or below 0°C continuously for two or more years, is widespread in the Arctic, subArctic. There is a need for improved and less expensive, remote sensing based tool and method to asses permafrost stability risk, and to monitor existing infrastructure integrity such us roads, rail beds, pipelines, and buildings. Studies regards the use of shortrevisit sensor, as COSMOSkyMed, to increase the temporal resolution of deformation time series. They are addressed to better capture permafrost seasonal dynamics and to separate seasonal from longterm subsidence trends. In addition, studies are conducted to carry out a comparative analysis to assess the suitability and complementarity of Cband and Xband.

Land surface changes resulting in modification of terrain are a further issue. Permafrost related terrain changes, including geohazards in lowlands and mountain areas, are surface subsidence, landslides (including active layer detachment slides, rock slides), thermoerosion as well as coastal erosion. Implications for infrastructure, specifically related to exploitation of natural resources as well as indigenous societies need to be addressed in this context. Indigenous residents are affected as ecosystems and the hydrological systems are continuously modified by surface and subsurface disturbances, which have an impact on resources traditionally available for humans.

In October 2017, following the requirements of the scientific community working in the PSTG framework, ASI activated an additional acquisition plan for permafrost monitoring as Italian contribute to this international working group.

About 60 sites over the polar region are systematically acquired with the following acquisition geometry:

- Stripmap mode (35 m resolution, 40 km swath;
- HH polarization, ASC/DESC direction, Right LooK Side;
- High Incidence Angle > 45°
- Time resolution in winter period: from 1 to 3 times a orbital cycle (16 days) depending on the extension of the area of interest,
- Time resolution in summer period: once every 2 orbital cycles (32 d).

In addition to the systematic observations, different studies and projects carried out through the use of COSMOSkyMed data are ongoing or have been activated in the framework of agreements or projects activated with ASI by several public Authorities and Institutions (ministers, territorial authorities, research centers, Universities, etc.). Some of these projects are directly managed by ASI, other are activated in the framework of the Announcement of Opportunities issued by ASI, as the Joint CALL ASI CSA (Italian Space Agency – Canadian Space Agency) issued in September 2013, or the last two Open Calls published on the ASI web site in February 2015.

The significant investment in spacebased infrastructure made by Nations and Countries all over the world has not yet been fully exploited. Realizing the full benefits requires a solid base of political support, laws and regulations, institutional responsibility, and trained people. Of course, the international cooperation represents a promising strategy to enhance the combined and complementary use of space technologies for societal benefits. In this context, COSMOSkyMed represents a useful and strategic national asset, considering that it has been designed to face international partnerships and integration of the system itself into a multimission framework of cooperating multisensor systems.

The CEOS (Commettee on Earth Observations Satellite), which coordinates civil spacebased EO programmes involving more than 30 agencies being collectively responsible for the operation of more than 100 current EO satellite missions, identified four main challenges for Climate Change:

- ❖ effective institutional arrangements
- ❖ ensuring continuity of future observations
- ❖ adopting and reporting «climate indicators»
- ❖ ensuring accuracy of climate observations

Ensuring continuity of future spacebased observations is one of the key element in understanding and monitoring of climate change effects on a global scale.

8.4 Support to developing countries

8.4.1 Funding opportunities for free and open data exchange

Italy contributes to free and open data exchange through its participation to the Intergovernmental Oceanographic Commission (IOC) of UNESCO. Since 1961, the country is involved in IOC's program "International Oceanographic Data and Information Exchange" (IODE) that aims at enhancing the free and open international exchange of data among member 146 countries. Moreover Italy contribute to the Copernicus free provision of remote sensed and in situ data (e.g. CMEMS). Italy participate to the Global Ocean Observing System through the coordination of MONGOOS (Mediterranean Oceanography Network

for GOOS) and the participation to EUROGOOS which share the objective of promoting the free and open data access to the marine observations. Italy has contributed to Seadatanet and currently to Seadatacloud which coordinated the exchange of historical delayed mode observations. Italy contributes to several EMODNET initiatives which represent the EU framework for data collection handling and free and open data delivery.

8.4.2 Establishing and maintain observing systems, and related data and monitoring systems

ISACCNR manages, since March 2006, three permanent automatic meteorological stations: Pyramid, Kala Patthar and South Col (Nepal, http://evk2.isac.cnr.it/realtime.html) in Khumbu Valley, Mount Everest National Park, at an altitude respectively of 5050 m asl, 5585 m asl and 7986 m asl. In the last site above mentioned the *insitu* highest meteorological observations in the world take place. Monitoring activities are carried out in close cooperation with Nepal Hidrology and Meteorology Department (DHM), Regional Representative Office of WMO.

Many Italian Institutions, Universities and Agencies are active participants in international EU funded projects on climate change related topics and in National projects funded by means of bilateral agreements, with a special emphasis on research capacity building in developing countries such as:

- *CLIMRUN* (Climate Local Information in the Mediterranean region Responding to User Needs, www.climrun.eu);
- *CliMiP* (Climate change Mitigation and Poverty reduction) http://www.feem.it/getpage.aspx?id=5257&sez=research&padre=18&sub=70&idsub=86&pj=Ongoing);
- *IMPACT2C* (Quantifying projected impacts under 2°C warming, http://www.hzg.de/mw/impact2c);
- *EUPORIAS* (European Provision Of Regional Impacts Assessments on Seasonal and Decadal Timescales, http://www.euporias.eu);
- *ClimAfrica* (Climate change predictions in SubSaharan Africa: impacts and adaptations, http://www.climafrica.net);
- *METEOMET* (Metrology for Meteorology, http://www.meteomet.org);
- *SHARE* (Station at High Altitude for Research on the Environment, http://www.evk2cnr.org/cms/it/ricerca/programmi_integrati/share);
- *SPICE* (WMO Solid Precipitation Intercomparison Experiment 20122014, http://www.wmo.int/pages/prog/www/IMOP/intercomparisons/SPICE/SPICE.html);
- *SUSKAT* (A SUStainable atmosphere for the KAThmandu Valley; http://www.iasspotsdam.de/regionalfocussustainableatmospherekathmanduvalley);
- Activities of the GEO (Group on Earth Observations) Ecosystems SBA (http://www.earthobservations.org/index.shtml);
- Education programmes implemented by means of several training workshops on 'modelling of regional climate, extreme events, air quality and human health' (http://www.ictp.it/homepage.aspx);
- *Evaluation of the carbon sink potential of an ecosystem of the oasis in Algeria, Rainfall, fire, elephant, and tree interactions in Southern African savannas and desertification* (Italy – South Africa Bilateral Agreement);

- *Landfill emissions reduction by waste stabilisation processes: an effective way of managing renewable energy sources* (Italy – South Africa Bilateral Agreement)*;*
- *Monitoring system for CO_2 captured in a used deposit of hydrocarbons* (Italy – Algeria Bilateral Agreement);
- *Optimization of water use by native plants in arid lands facing climate change and desertification* (Italy – Pakistan Bilateral Agreement).

9 EDUCATION, TRAINING AND PUBLIC AWARENESS[204]

9.1 Education and Public awareness

Italy has made progress in improving its education and training system over the last few years. Being aware that education aims at recovering the relation with the environment, this progress reflected also on environmental education, education to sustainability and on climate change and adaptation.

On 3 September 2014 the Italian government published 'La Buona Scuola', a set of guidelines for a comprehensive reform of the school education system. The plan was subject to a public consultation from 15 September to 15 November 2014. On 13 March 2015, the Italian government presented the reform as a draft law, which was approved by parliament on 9 July 2015 (Law 107/2015). With this reform the Italian government has put at the core of its mission the education of young people.

Following this school reform in order to integrate and advance it, new "**Guidelines for Environmental Education and Sustainable Development** (Linee Guida per l'Educazione Ambientale e lo Sviluppo Sostenibile) were issued by the Ministry of Environment, Land and Sea in collaboration with the Ministry for Education, University and Research in 2015. As already mentioned in the 6NC, Guidelines for Environmental Education and Sustainable Development were developed by MATTM and MIUR for the first time in 2009 with the aim of providing innovative approaches for the development of curricula and the management of educational and didactic activities.

The new guidelines contain guidance material for teachers, covering a number of thematic issues (biodiversity, food, climate change, transport, water, cities..). A further step carried out with this new guidelines is to articulate overriding environmental topics in differentiated educational paths for each grade/level of school.

In the awareness that education aims to recover the relation with the environment and with the natural and sociocultural resources and biodiversity of the territory, in November 2016 the Italian Ministry of the Environment, Land and Sea and the Ministry of Education University and Research signed a new Programme of commitments: the "**Rome Charter**".

This Act on education and training is broken down in 12 points, from biodiversity and mobility, from digital communication to climate change. The Rome Charter is mainly addressing students, as well as teachers and trainers, and is also aimed at supporting the implementation of the renewed Italian National Strategy on Sustainable Development as well as the 2030 Agenda Objectives.

In the framework of the Europe Strategy 2020 particular attention has been made to train adequate competences correlated to the new jobs in the environmental field.

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Schools are at the top for the dissemination and awareness raising initiatives on important issues such as energy saving, sustainable consumption, CO2 emissions and climate change; in other words, schools are the training ground of new generations to whom we will leave our Planet.
The collaboration of Regional and Provincial Administrations and Regional Environmental Agencies (ARPAs), as well as Municipalities and other stakeholders, such as NGOs, Parks and Universities is essential for the promotion and implementation of innovative methods for teaching and learning and raising awareness on climate change in Italy. It was on a local scale, according to the different territorial contexts and characteristics, that a strong effort has been made to educate, train and raise awareness in order to increase resilience. The new Guidelines for Environmental Education and Sustainable Development, beyond formal strategic aspects intend to be a connection tool with the territories where we live, to stimulate and encourage operational activities for the sustainable development.

The initiatives on education and public awareness have been divided in two separate sections below.

Education

Italy benefits from a long and valuable tradition of initiatives and programmes on Environmental Education (EE) and Education for Sustainable Development (ESD) at regional and local level, focusing especially on nonformal education. Climate change is becoming increasingly a central theme of these educational programmes and activities.
For several years, regional programmes/networks have been based on an institutional framework of collaboration between the State (Ministry for the Environment) and the Regions, the so called **National Programme for Environmental Education, Information and Training (IN.F.E.A)**. Under the INFEA system, the regional EE/ESD programmes/networks have been supported and facilitated by the Ministry for the Environment, in the framework of a single national scheme.
The INFEA was structured as an open and dynamic integration of systems on regional scale, where the regional administrations play a role of listening, proposal and coordination by fostering a constant dialogue with the actors involved in the field of the environmental education.
The INFEA Programme has contributed, with financial support, to spread throughout Italy, structures and tools to assist and strengthen the role of Regions (e.g. CEAs Centres for Environmental Education) and to direct the actions towards the set up of a National System of Education, training and environmental information.
Among these regional and local activities, there is still a significant variety of good and excellent practises on ESD, especially in some advanced Regions, where climate change is tackled as the main issue or the challenging context that affect other issues.
The “Rome Charter” on environmental education and education for sustainable development, signed by the Ministry for the Environment and the Ministry for Education in 2016 calls for the revitalisation of this national platform, mainly aiming at valorising and sharing good educational practices.

It’s worth to mention the Italian National Commission for UNESCO, which coordinates and collect the implementation, at local level and by local actors (mainly schools, NGOs, local administrations, private sector), of the UNESCO programmes on Education for Sustainable Development. In particular, every year the “National Week of Education for Sustainable Development” develops a large number of initiatives to raise awareness and education throughout the country. Climate change was the theme of

the UNESCO ESD Week both in 2016 (Climate change and Cities) and 2017 (Climate change and migrations).
Within this framework, the National System for Environmental Protection (SNPA), composed by ISPRA and the Regional and Provincial Environmental Agencies, plays an important role, promoting and implementing educational programs, projects and initiatives on various environmental issues.
The Network of Focal Points of Education for Sustainability, recently instituted and coordinated by the Regional Environmental Protection Agency of Emilia Romagna (ARPAE), is working to prepare the Program of Activities for the coming years.

At National level, following the Law 107/2015[205] "La Buona Scuola", the **new Guidelines for Environmental Education and Sustainable Development (**Linee Guida per l'Educazione Ambientale e lo Sviluppo Sostenibile) were issued by the Ministry of Environment, Land and Sea and the Ministry for Education, University and Research in 2015. They contain guidance material for teachers, covering a number of thematic issues (biodiversity, food, climate change, transport, water, cities..), and differentiated for each grade/level of school.

The goal of these Guidelines is to provide students with holistic knowledge rather than specific technical skills: in this regard, they represent the starting point to build on new educational profiles in an integrated manner with the local territory. The Guidelines are structured in 8 educational profiles:
1. "Protection of water and sea" (Preschool Education, Primary Education)
2. "Protection of biodiversity: Flora and Fauna" (Preschool Education, Primary Education)
3. "Sustainable nutrition" (Preschool Education, Primary Education, Lower and Upper Secondary Education)
4. "Waste management" (Preschool Education, Primary Education, Lower Secondary Education)
5. "Protection of biodiversity: ecosystemic services" (Lower and Upper Secondary Education)
6. "Green economy: green jobs & green talent" (Upper Secondary Education)
7. "Sustainable city: pollution, soil sealing and waste" (Upper Secondary Education)
8. "Climate change adaptation: hydrogeological instability" (Upper Secondary Education)

On the basis of the Guidelines, and following an agreement signed in 2016 by the Ministries for Environment and Education, teachers' training activities on EE/ESD (Education for Sustainable Development) have been shaped and are in course of being launched, covering the whole national territory. This teachers' training program falls under the "National Operational Program" on School Education 20142020, funded by the EU.

20 million euro have been dedicated to this activity.

The National Charter on ESD, the "Rome Charter" , signed in November 2016 by the two Ministers (Environment and Education), aims to integrate and advance the Guidelines. For each topic (mobility, biodiversity, sustainable development, climate change, water, health), the Charter identifies Education principles and specific actions to be implemented in order to introduce ESD in school education and/or to

[205] LEGGE 13 luglio 2015, n. 107 Riforma del sistema nazionale di istruzione e formazione e delega per il riordino delle disposizioni legislative vigenti. http://www.gazzettaufficiale.it/eli/id/2015/07/15/15G00122/sg

advance ESD policy. The Charter has been elaborated during the national Conference on ESD (Nov. 2016) with the active contribution of more than a hundred of ESD experts, from various actors (civil society, private sector, institutions, academia).

In the framework of the above mentioned National Operational Programme on School Education ("PON Scuola" 20142020), funded by the EU trough the European Structural Funds, a call has been launched by the Ministry for Education in 2017, aiming at granting financial contribution to projects presented by schools (also in partnership with NGOs or other local actors) on "global citizenship education".

120 million euros are invested for this initiative, covering the whole national territory.

The projects must aim at developing students' competencies in one or more of the following thematic areas:

1. Food and local land resources;

2. Wellbeing, correct lifestyles and sport;

3. Environmental Education;

4. Economic citizenship ;

5. Civic engagement and respect for diversities.

Climate change is a central issue in most of the five above mentioned areas.
The European days of environmental education , promoted by the WEEC (World Environmental Education Congress) Network, were held in Bergamo on 25 and 26 September 2014 at the end of which it took finally start a process of building a "European concertation" and a European network for environmental education. To educate citizens aware of their rights, it is also useful to remember the three pillars of the Aahrus Convention, as a necessary tool for the protection of the right to live in an environment adequate for their health and wellbeing: ensure that citizens have access to environmental information; encourage the participation of citizens in decisionmaking that may affect the environment; extending the conditions of access to justice.

During Milan EXPO 2015 the vision and values of the school environment, from nursery schools to universities, were fundamental in spreading the Event's contents and guaranteeing its legacy. For this reason, teachers and students were invited to study Expo's Theme in depth through specific training and educational paths launched in the classroom over the past years, and especially through educational visits and school trips to the Site. Thanks to the latter, students had the possibility to enhance their experience through ad hoc itineraries and global discussions about food with their peers, also from other nations.

More than 170 Italian Universities joined the project "Le Università in Expo" and over one million students visited Milan EXPO 2015.

The new National Strategy on Sustainable Development, approved by the Council of the Ministries in October 2017 and proposed by the Minister for the Environment in order to align the Italian policies to the Sustainable Development Goals of the UN Agenda 2030, includes some objectives in the field of environmental education and education for sustainable development, with special attention to climate change. The strategy refers to the need to shape interdisciplinary and participatory educational

programmes on SD, to reinforce the training of teachers and to orient school management toward sustainability practices.

EDUCATION: List of initiatives and projects carried out since 2014

Organisation / Promoter /	Name of the activity	Short Description	Indicators / Number
Rai Radio2 (Italian Public Broadcasting Service)	**M'illumino di meno** **"I am enlightened less"** Energy Saving Day campaign (2014/2015/2016/2017 Editions) Caterpillar Edition 2017: Let's switch off the lights to switch on the stars" #MilluminoDiMeno http://caterpillar.blog.rai.it/milluminodimeno/# https://www.facebook.com/caterpillar.radio2 https://twitter.com/caterpillarrai	As part of the yearly energy saving campaign "M'illumino di meno" Rai Radio2 has organized the largest radio campaign dedicated to the reduction of energy consumption to raise awareness on energy consumption through Caterpillar. It's the most important energy efficiency awareness campaign ever launched by a national public radio. The 16th of February 2005 is the day when the Kyoto Protocol came into force; that day Caterpillar, a popular current radio show on Italian Public Broadcasting Service, has announced the First National Day of Energy Saving. Every year the campaign has been launched with growing success. The day's philosophy is to convince more people as possible to back saving, the biggest energy deposit available in a free way and in a short time. At its thirteen edition the campaign involves a great variety of Subjects: thousands of listeners, hundreds of associations and the most important institutional actors Italian and foreigners. The initiative is under the high patronage of the President of the Republic, the European Parliament, the Senate of the Republic , the Chamber of Deputies, the Ministry of the Environment, Land and Sea, the Ministry of Education University and Research, the Ministry of infrastructures and Transport as well as the participation of hundreds of municipalities. http://caterpillar.blog.rai.it/files/2009/09/millumin oenglish.pdf	451 thoughts on "M'illumino di Meno" 13100 Tweets 2613 Following 44000 Followers 4131 I like
Rai News Italian State Broadcaster	**"Mercalli Pills"** **Lessons of Sustainability** **A blog active**	An innovative voice of environmental communication. Luca Mercalli is a climatologist and he chairs the Italian Meteorological Society. He founded and directs Ximumx the Nimbus meteorology magazine, he is the author of 1993 scientific publications and over 85 dissemination articles appear mainly on the newspaper. He deals with research on climate and alpine glaciers, he teaches sustainability in schools and universiities in Italy, Switzerland and France.	Videos on rai news page have got more than 2,4 Thousand visualizations
Italian Ministry for the Environment, Land and Sea	**"Environmental Classroom 2.0"** Milan, EXPO 2015	The goal of this experimental project was to go beyond solitary learning, by constructing an instructive game context where individuals interact with a group, as well as to consolidate the use of 2.0 technology, new languages and digital supports in schools, including interactive whiteboards and tablets, not for substituting books with digital devices but in order to encourage learners to connect with each other.	
University of Bologna	**Climate Days** Bologna 21 April, 2017	On April 21st, 2017 professors from the University of Bologna met with highschool students to provide them with information around climate change as well as the tools to deal with this challenge. Among the related topics, were solar	

	https://site.unibo.it/termoref/it/agenda/giornataclima	and electric mobility, urban and innovative solutions, green technologies etc.	
Italian Ministry for the Environment, Land and Sea	**Environmental Education Festival** Rome April 2017	On the occasion of the celebrations around the Earth Day, 2 days were dedicated to follow up on the Estates General on Environmental Education and 140 students gathered to write an appeal to Environment Ministers from major world countries to ask for real policies both in the field of environmental protection and education	140 students
Italian Ministry for the Environment, Land and Sea	**Schoolwork alternation project** Ongoing	A pilot project involving two schools of Rome municipality were students choosing an environmental theme will work, with the experts involved and the teachers, to the definition of a Shared project of short, medium and long term actions that the school can put in action to pursue a "sustainable school" model.	2 schools
Ministry for the Environment, Land and Sea SIOI Mater	**Scholarships** – 2016/2018	The Italian Ministry for the Environment, Land and Sea funded 8 scholarships for a mater degree on Sustainable development, geopolicy of resources and arctic studies" to the Italian Society for International organization (SIOI)	8 scholarships
Ministry for the Environment, Land and Sea "Rondine" association	**Scholarships** – 2016/2017	The Italian Ministry for the Environment, Land and Sea funded a Master degree on Climate Change and 4 scholarships to students from Developing Countries	4 scholarships
ISPRA (Italian Institute for Environmental Protection and Research)	**VADDI (italian acronym of "Vallo A Dire ai DInosauri" "Tell it to dinosaurs!")** Game simulation kit on climate change http://www.isprambiente.gov.it/it/formeducambiente/educazioneambientale/progettiedinitiative1/kitva.d.di/index	The educational kit "Tell it to the dinosaurs', aimed at students aged between 13 and 18 years, was launched in 2011. The simulation game aims at stimulating the active participation of the players, with a problemsolving approach. The communication campaign to promote and spread the game has continued also in the years 2014 – 2017, through presentations in public events, as well as training workshops for environmental educators and teachers, including one in Trento Province (2015), and through the environmental education pages on ISPRA website:	N. 20 environmental educators of Trento Province trained (2015) N. 30 boxes delivered to Trento Province (2015) N. 15 requests of information received via email (2014 – 2017)
ISPRA (Italian Institute for the Protection of the Environment)	**"Adaptation to climate change" (Environmental education initiative for schools)** School year: 2017 2018	The initiative "Adaptation to climate change" ("Let's adapt but not too much to climate changes") addresses the issue of climate change by the impacts and adaptation point of view. The aim is to provide some key concepts about the problem of climate change, their impacts on natural resources, and to suggest, through a playful activity, some behaviours to save resources and reduce risks. The target of the initiative are primary and middle school students. The initiative is part of the Environmental Education Initiatives' Plan of ISPRA addressed to schools for the year 2017 – 18.	
Centro Epson Meteo	**Progetto Scuole** Italy http://www.meteo.expert/news/nasceprogettoscuolecentroepsonmeteo/	The Project is dedicated to students of all ages, from preschool education to upper secondary education, and it aims at explaining young students the basics of meteorology and the importance of weather forecasts to predict atmospheric events that may impact people's life.	
EuroMediterranean Center on Climate Change Foundation LINKS	**Che mare farà – Mare, Istruzioni per l'uso: Bollettino Multimediale** 20142015 Regione Puglia Living Labs	The project aims to incentivize the users' training process, through the provision of innovative forecasting systems. The project envisages the creation of a technology platform for the provision of weather forecast services for the Mediterranean	

Management & Technology SpA	Smart Pulia 2020 Apulian ICT Living Lab http://livinglabs.regione.puglia.it/	Sea and specifically for the Puglia Coasts. The services, from forecasting systems, to daily and weekly bulletins, and warning signals, will be delivered in multidirectional and multichannel mode, including television and web format, multimedia material (video and animation) and documentary material. The project has been presented at the European Space Expo (Milano September 27 / 28, 2015) a touring exhibition showcasing the flagship European Space programmes: Copernicus, Galileo and EGNOS, and their benefits and applications. Within the Eu Space Expo several short courses for students (from elementary to high school levels) have been given, presenting and interacting with the students on sea conditions, forecasting tools, sea bulletins and dictionary of the sea.	
Arpa Piemonte (Dip.to Sistemi Previsionali; Museum A come Ambiente (Torino); University of Torino (Dip.to Scienze della Vita e Biologia dei Sistemi)	**Exhibition : "C3 Alps"** C3 Alps (EU Project Capitalising Climate Change Knowledge for Adaptation in the Alpine Space 2014	It is an itinerary and multimedia Exhibition across VerbanoCusioOssola Parks addressed to schools and citizens on the topic of adaptation to climate changes of alpine biodiversity. The project started in 2012 and ended in 2014. The exhibition consists in a guided path through proactive interaction between flora and fauna of the alpine natural habitat and phenomena related to climate changes. Adult visitors can deal with a series of guided phenological surveys on local flora and fauna while children are involved in recreational activities aimed at building awareness . In particular ARPA Piemonte has organized the activity " Searching for the "Biotresure"	
Arpa Piemonte; Scientific Lyceum Gobetti of Turin	**School path on climate changes and hydrogeological risk** School Year 2016 2017	This project has involved highschool students : it consisted of a classroom debate with interventions and sharing of ideas, one day at ARPA Piemonte premises and a field lesson. The key topics addressed were permafrost, nivology and landslide monitoring.	
Valle d'Aosta Region Centre de Recherches sur les Ecosystemes d'Altitude, (CREAFR), Parco Nazionale del Gran Paradiso (PNGPIT), Parco Naturale del Mont Avic (PNMAIT) et Parc National des Ecrins (PNEFR).	**"ePHENO" Project** 20132015 www.phenoalp.eu/index.php/it/edupheno www.phenoalp.eu/index.php/it/epheno	Environmental Education activity addressed to children, in the framework of the european project ePheno (20132015). The main objectives are to improve understanding of phenological variations caused by climate changes in the Alps and to involve new territorial actors, both in the observation of phenomena and in awareness raising.	
Fondazione Montagna Sicura (FMS) – University of Savoye – Municipality of Valtournenche – ARPA Valle	"**PrévRiskHauteMontagne" Project** 20162017 http://www.fondazionemontagnasicura.org/fr/projetsencours/prevriskhautemontagne	The project aims at educating and raising awareness among local people and tourists about the high mountain characteristics and related risks, also with reference to the impacts of global warming on glaciers and permafrost.	The web page has got : 8992 "I like" 30 information and communication experts

d'Aosta – ARPA Piemonte			
Regional Environmental Agency of Valle d'Aosta (ARPA Valle d'Aosta)	**"From the environment to the Territory: environmental analyses and innovative research** (Arpa VdA experience)" 20162017	It is a collaboration among High school Institutes to promote the project "Climate changes and effects on mountain territory " . This project aims at making children think about climate change in its broadest sense. https://prezi.com/jjrnnd5bgvzr/stagescuoleclimatechange/	Thematic hashtag #climatechange 213 tweets
Provincial Environmental Agency of Trento (APPA Trento)	**Learning paths in the schools** on: AIRclimate, energy, alternative energy sources and energy saving. Anni scolastici 2014/2015, 2015/2016, 2016/2017 http://www.appa.provincia.tn.it/educazioneambientale/guidascuola/ Results and material are available on the following website: http://www.educazioneambientale.tn.it/	APPA carries out freely in Trentino schools of all levels in different environmental education activities and collected in the catalogue " At school of environment and at school of lifestyles" addressing several topics such as air pollution , climate changes and renewable energies. Type of activities: educational paths (classroom meetings and exits); environmental sustainability pills (single class meeting); interactive exhibitions : "A window on climate , "Energy transformer" Game show: "Ecoquiz: On mission for the planet "	**School Year 2014/2015** School Activities EDUCATIONAL PATHS about 90 classrooms for 1800 students GUIDED VISITS TO EXHIBITION : about 30 classrooms **School Year 2015/2016** School Activities: about 150 classrooms for 2800 students) GUIDED VISITS TO EXHIBITION: about 15 classrooms **School Year 2016/2017** School Activities EDUCATIONAL PATHS and PILLS: about 160 classrooms for 3200 students GUIDED VISITS TO EXHIBITIONS: about 24 classrooms (about 450 students) ECOQUIZ: 300 students III e IV classroom – High School 2° degree
Regional Environmental Agency of Veneto (Arpav), IN.F.E.A. Centre of the Province of Treviso, IN.F.E.A Regional network	**Project "Let's tell us stories… Collection of stories on the environment** " 2014; 201718 http://www.arpa.veneto.it/serviziambientali/educazioneperlasostenibilita/educazioneambientale/diffusionedi201craccontiamocilefavole…raccoltadifavolesull2019ambiente201d2014	The project involves nursery and primary schools of the regional territory with the aim of involving children in the environmental topics described in the publication "Let's tell us stories…" through the development and implementation of several interactive educational activites (readings, games miseenscene, exits). Among the topics addressed, air and meteorology. http://www.arpa.veneto.it/serviziambientali/educazioneperlasostenibilita/educazioneambientale/raccontiamocilefavole	Year 2014: 21 schools 57 teachers 720 children involved 4000 DVD produced. Year 2017 – 18: 7 provinces 32 schools 32 laboratories 192 hours of activity 800 pupils involved
Arpav, IN.F.E.A	**Cineforum Environment**	Realization of four cineforum in the provinces of Vicenza, Treviso, Padova and Rovigo with open	

Centres. Province of Padova, Belluno, Vicenza Treviso, INFEA Regional Network	2014 http://www.arpa.veneto.it/serviziambientali/educazioneperlasostenibilita/educazioneambientale/cineforumambiente/cineforumambiente	showings and documentaries, at schools in the morning and at cinemas in the evening for citizens with the participation of guests and experts of environmental communication about climate change, energy saving, food waste, landscape protection , urban gardens, waste, legality and water resources.	
Arpav, Regional School Office of Veneto Region – MIUR, Veneto Region Regional Group "Health in every Policy"	**Competition QUALe idEA!** School Year 2017/2018	This competition aims at promoting the realization of environmental education projects in the schools at all levels on environmental hot topics in accordance with ARPAV Guidelines " School and Environmental Education: planning according to quality". The best projects will be awarded with prizes aimed at activities or purchase of school material dedicated to environmental education and will be published on ARPAV website and Regional School Office of Veneto Region website. For School Year 2017 – 18, the following topics are proposed: 1. Circular Economy: reuse and recovery 2. Climate Change: I reduce CO2 and my ecological footprint 3. Take care: I adopt an environment , a school , a square a garden	Underway. Data not yet available
Arpav, Aqua srl di Taglio di Po (RO) Belluno Municipality Verona Municipality, Venezia Municipality, Padova Municipality La Fenice Foundation of Padova Venice National History Museum	**Ideas of sustainability 2016** http://www.arpa.veneto.it/serviziambientali/educazioneperlasostenibilita/educazioneambientale/ideedisostenibilita	Laboratories and meetings to promote the environmental culture and the sharing of ecological behavior which make the difference and reduce the impacts of daily actions on the environment. The activities involved children and focused on climate change, air, water, soil, waste, electromagnetic fields and noise.	4 provinces 34 days 149 laboratories 1350 children (312 years old)
EOS Service ARPACAL – Hospitality Training Institutes of Calabria Region	**European Week for waste Reduction** Competition "We do not throw away nothing…we cook everything " Year 2014 http://www.arpacal.it/index.php/arpacal/attivita/gruppoeos/iniziativeeos	A competition of ideas, addressed to students attending Calabria Region Hospitality Training Institutes . The theme of the competition is the realization of receipts with the use of food waste with the aim of encouraging students to identify strategies to reduce waste strengthen the relation between territory and environmental culture and reduce waste production and the release of emissions in the atmosphere.	
Environmental Protection Agency of Calabria (EOS Service ARPACAL) – ARARE Association (Education and Agrarian Training Network)	**"ARARE"Project** Anno 2014	The project aims at the realization of an integrated territorial model among Agrarian Institutes of the province of Reggio Calabria from the implementation of shared objectives related to the study of the impacts of production and commercialization systems on the environment and on climate	
EOS Service ARPACAL –	**"Europe Celebration" European Year of Green**	Educational Interactive Laboratories carried out by the Personnel of the Agency at "Ecolandia"	

Recreational – TechnologicalEnvironmental Park "Ecolandia" RC	**Economy** Year 2014	Environmental Park on environmental topics, renewable sources and reuse of electric vehicles for sustainable mobility.	
EOS Service ARPACAL – I.I.S.T. "Ettore Maiorana" di Roccella Jonica RC	**Educational Meeting Training / Information" Environmental protection "** Year 2015	Theoretical/Practical activity at the Laboratory of the Agency. Focus on the topic" how to spend from the waste of resources , from the culture of use and throw product consumption to the civilization of reuse and recycle , to the conservation of raw materials , especially no renewable ones , to the waste reduction". The importance of recycle to reduce the impact on environment and climate.	
Arpa Sicily (Regional Environmental protection Agency)	**Meeting: "The role of urban trees in reducing greenhouse gas effect "** 2015	Trapani territorial structure of ARPA Sicily has organized a meeting with the students of the Nautical Technical Institute on the theme of urban trees and the relation with greenhouse gas effect reduction. During the event the main contents of "Paris World Conference" on combating climate changes have been discussed.	
Arpa Sicily (Regional Environmental protection Agency), School Institutions	**Exhibition on Environmental Sustainability** 2015	Itinerary Exhibition across the Sicilian territory to reach the Schools: 14 panels divided by 7 sections, the themes proposed starting points to analyze and study the main themes on the main values of sustainability with the aim of raising awareness, among the collectivity on the theme of sustainable development (water, waste, renewable energies, climate changes) and to contribute to build active and informed of communities to the environmental issues.	
Rete Clima® Network (Information and action for sustainability and the fight against climate change)	**Environmental training on climate.** 2014 ongoing http://www.reteclima.it/educazioneeformazioneambientaleclimatica/ https://www.reteclima.it/portfolio/outletbarberinomugellocarbonneutral/	Rete Clima ® is a nonprofit organization, founded in 2011 as a technical network for the promotion of sustainability through educational and training paths with particular awareness to the climate change issue at the local scale. It provides a concrete support to Enterprises and Public Administrations towards an improvement of their ecoefficiency performance . It develops a series of projects concerning carbon assessment, carbon management, carbon neutrality in partnership with them providing support to activities and actions. In 2015 Rete Clima ® in cooperation with McArthurGlen Barberino Designer Outlet (FI) developed a project for the annual carbon neutral exercise of the Designer Outlet, with the aim of evaluating and managing the carbon footprint , that is CO2 and greenhouse gas emission related to their commercial activities with the aim to combat climate changes. After the first phase of quantification of the annual carbon footprint (2016) several actions of energy efficiency, have been implemented with the aim of reducing energy consumptions and therefore related CO2 emissions .The action of environmental responsibility has concluded at the beginning of 2017 with the complete carbon offset of the retailer, until Barberino Design Outlet carbon neutrality. The carbon offset has been operated through support to an international carbon offset project (according to project criteria expressed by UNFCCC) for the installment of a series of wind farms in Tamil Nadu in India. The project participated to technological transfer versus Developing Countries and participated to combat climate change.	In one year a series of energy efficiency actions have caused for the retailer the **carbon Neutrality**
Italian Climate	**"Progetto Scuola"**	Italian Climate Network's School Project is mainly	1,400 students across 9 regions.

Network Onlus	**("School Project")** 2013 – ongoing http://www.italiaclima.org/attivita/conlescuole/	offered to secondary schools (students aged 14 – 19) and it is focused on the climate change issue, although an analysis of the context it fits in is also provided. The Project highlights the strong relations that connect the climate to sustainable development, energy, economics, international relations, health, agriculture and so on. A basic presentation on climate science, consequences and solutions is offered, with the chance of adding one or more thematic curses among "climate and energy", "climate negotiations", "climate and human rights", "climate and health", "climate and waste management". In 20162017, the Project reached over 1,400 students across 9 regions.	
World Environmental Education Congress (WEEC)	**The European days of environmental education** Bergamo 25 26 September 2014 www.europe.environmentaleducation.org http://www.assiseseedd.org/journeeeuropeenne)	They took place in Bergamo on the 25th and 26th of September 2014, the PanEuropean days of environmental education and sustainability. The first edition was held in Lyon (France) on the 4th March 2013. Participation was free and opened to all public and private actors that work for formal education, nonformal and informal learning. The days were preceded, on the 24th, by a national Italian meeting in conclusion of the first phase of construction of an Italian network for environmental education.	
Istituto Oikos	**SAME World Youth 4 Environmental Justice** 20162017 http://youth4ej.sameworld.eu/	The Observatory against Environmental Injustice, collects, monitors, and disseminates cases of environmental injustice and environmental migrants' issues through social networks. The Observatory is an integral part of the S.A.M.E. WORLD project (Sustainability / Awareness / Mobilization / Environment in the global education for EYD 2015). It aims at increasing knowledge, raising awareness and mobilizing action regarding the issues of Environmental Injustice and Environmental Migration by collecting and monitoring relevant cases and material to be disseminated on the web, via the use of forums and social networks. The Observatory is designed to be used mainly by secondary school pupils, university students, and young people in general who are welcome to post, share, and comment on informational material about social injustice and/or environmental migrants' issues.	
Istituto Oikos	**Un Clima che si può cambiare** 20162017 http://www.istitutooikos.org/cosafacciamo/risorsenaturali/78/unclimachesipuocambiare	The campaign has underlined the strict connection between climate and food security. On the one hand, global warming can halve agriculture production in many countries by the end of this century; on the other hand, agriculture plays a relevant role in GHG emissions. To respond to this challenge, a number of actions must be implemented on both sides. The project was active in Italy, Brazil and Tanzania. Italian students were virtually connected with their foreign counterparts to learn their circumstances and conditions.	The project was active in 3 Countries: Italy, Brazil and Tanzania
ICCG International Center of Climate Governance	**Intiatives with schools** Ongoing http://www.iccgov.org/categoriesevents/perlescuole/	The International Center of Climate Governance offers lessons and visits for schools interested in deepening their knowledge on climate change and how the activity research on the topic is conducted.	

Public awareness

At national level, the Ministry for the Environment, Land and Sea organised several communication campaigns aimed at spreading environmental education and information at large and disseminating European environmental policies.
On an annual base the Ministry of the Environment has adhered to the "European Mobility Week, the EU campaign which has become over the years an international event that aims to encourage people to use alternative means of transport to private cars. Its *focal theme* for 2017 "Clean, shared and intelligent mobility", with the slogan 'Sharing gets you further', invites local politicians and the public to experience the benefits of shared mobility[206].

With specific reference to Climate Change, and in view of the UN COP21 in Paris, in December 2015, the central Government held, in Spring 2015, the States General on Climate Change.

The event was hosted at the New Hall of the Palace of the parliamentary groups in Rome and the Government presented an overview of the risks, actions and opportunities related to climate change, and invited the "Italian system" to put climate change at the heart of national policy.

A unique event of extraordinary importance at national and local level from educational, cultural and scientific viewpoints, was the Global event **Expo Milano 2015** hosted by the city of Milan from 1 May to 31 October 2015 involving all of Italy's institutions. During the six months of the Exposition, the Theme chosen, "**Feeding the Planet, Energy for Life**", was analysed through indepth talks on food and the sustainable use of resources, on the right to healthy, safe and sufficient food for the whole planet, and on the search for and sharing of production and consumption models that are more respectful to the environment and social equality.

The innovative aspects of **Expo Milano 2015** were many: the pervading Theme "Feeding the Planet, Energy for Life," the engagement with Visitors, the involvement of Countries in thematic Clusters, the contribution of Enterprises and Civil Society, as well as many initiatives for schools and research environments aimed at analysing the Theme indepth. In addition, Expo Milano 2015 paid close attention to the sustainability of the Event, communicating in a transparent way and to all Stakeholders the commitments undertaken and the results achieved in organising the Universal Exposition from social, economic and environmental viewpoints. The involvement and active participation of all players and of the whole world community contributed to ensure the kind of knowledgesharing which has always been a feature of Universal Expositions ever since they began, and which made Expo Milano 2015 a place where experience meets understanding.

EXPO 2015 experience was illustrated at the 4th Dialogue on Action for Climate Empowerment held at the United Nations Climate Change Conference in Bonn, Germany on 18 and 19 May 2016. The Dialogue is an annual forum for Parties and stakeholders to share their experiences, exchange ideas, good practices and lessons learned regarding the implementation of Article 6 of the Convention, which relates to climate change education and public awareness.

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[206] https://ec.europa.eu/info/events/cities-events/european-mobility-week-2017-2017-sep-16_it
http://www.minambiente.it/pagina/campagne-ed-iniziative

In order to stimulate the debate on ESD (Education for Sustainable Development) among students and mobilise youth, an event, called "**States General of Youth on Environment**" has been organised in Rome, in the framework of the Earth Day celebrations (2122 April 2017). More than one hundred of highschool students gathered in Villa Borghese (Major Park of Rome), in order to elaborate a youth Declaration on EE/ESD. The declaration was presented to the World Political Leaders during the G7 Environment, to be held in Bologna in June 2017, as well as in other highlevel international events.

Recognizing that communication for sustainable development undoubtedly have a key role to play in raising awareness and in building coalitions that amplify advocacy efforts among policymakers, the private sector and local communities, the Ministry for the Environment, Land and Sea of the Government of Italy supported the establishment the Communication for Climate Change MultiDonor Trust Fund (CCC MDTF) at the World Bank in January 2009. In 2014, the CCC MDTF was honored to announce the addition of a new donor to the Trust Fund program: the Federal Ministry for Economic Cooperation and Development (BMZ) of Germany, and since then, with more than 400 partners from civil society, media networks, international organizations, academic institutions, youth groups and private sector representatives, the Communication Program **Connect4Climate** grew as the flagship global partnership program.

The main objectives fulfilled by Connect 4 Climate are not only to raise awareness about climate change and its impacts at various levels: public at large, private sector, and policy and decisionmakers, but also to promote commitment among the public, private sector and policymakers to take action and build coalitions for further advocacy efforts.

Connect 4 Climate increased its reach and impact over the past years. Many successful activities were completed under each of the three components of the MDTF: Support to Operations, Research and Capacity Building and Advocacy and Fund Leveraging.

From having launched with a photo and video competition targeting African youth in 2011, to running global youth competitions, to building a knowledge network of more than 400 partners, to supporting World Bank operations across the African continent, to organizing highprofile and mass public outreach events that reached a potential audience of 4.4 billion during the UNFCCC COP21 in 2015, to presenting a successful and innovative video competition at the UNFCCC COP22 in 2016 in Marrakech, C4C has grown to be an influential program advocating for climate action to end poverty and promoting climate solutions through diverse and creative means to help promote shared prosperity.

C4C complements the World Bank Group (WBG) Strategy to achieve its twin goals to end extreme poverty and promote shared prosperity by researching on the theory and practice of climate change communication, as well as designing and delivering capacity building activities and building effective and strategic partnerships with the private sector, civil society and foundations focused on climate change, and more.

In June 2017, to raise awareness among the civil society, IMELS organized, in collaboration with "Connect4Climate", "All4theGreen" , a set of initiatives aimed at various types of public and organized in collaboration with civic, cultural, university, environmentalist, consortiums and associations, and dozens of companies that have decided to support the appeal for an economy that highlights efficiency saving and reusing resources.

A "container" of 70 events open to the utmost participation of the public in preparing, introducing and "sensitizing" the G7 Environment 2017, the intergovernmental meeting between the most industrialized countries of the Earth that took place in Bologna on June 11 and 12, 2017. National institutions and local authorities, universities, associations companies have been involved in the organization of this dense program of initiatives focusing on environmental protection, climate change and the circular economy.

In October 2017 the Italian Ministry for the Environment has organised the International Summit "Water and Climate – Meeting of the Great Rivers of the World". Awareness raising initiatives on the impact of climate change on water have been organised in various squares of Rome during the three days of the Summit .

Besides these National initiatives, that have involved many Italian cities, also Municipalities, Regional and Provincial Administrations and Regional Environmental Agencies (ARPAs) have realized important initiatives aimed at raising the awareness of citizens (young or adults) to climate change issues through specific Communication Campaigns.

PUBLIC AWARENESS: List of some initiatives carried out since 2014

Organisation / Promoter	Name of the activity	Short Description	Indicators / Numbers
Ministry of the Environment and Protection of Land and Sea and by Expo 2015 S.p.A.	**"Towards a Sustainable Expo" Programme** Milan EXPO 2015	Created by the Ministry of the Environment and Protection of Land and Sea and by Expo 2015 S.p.A., together with all the Participants in the Universal Exposition of Milan, this programme aimed to stimulate and encourage closer attention to sustainability and enhancing voluntary initiatives capable of making the Exposition of Milan a more sustainable Event. Expo Milano 2015 strongly encouraged the commitment to limit the environmental impact caused by its own participation, highlighting the most relevant solutions (best practices, innovative technologies, original ideas and projects) and disseminating them, also as a legacy for the future. The Participants at "Towards a Sustainable Expo", (called "Players"), present their solutions regarding four categories: • sustainable architecture with reference to the projects for the Pavilions and Exhibition areas; • sustainability of the food offered by the refreshment or catering services; • application of green procurement criteria for furniture, packaging and merchandising; other initiatives or particular projects on environmental and sustainability themes.	
Ministry of the Environment and Protection of Land and Sea and RSE	**"Smartainability"** Milan EXPO 2015	Through the project, RSE – (Ricerca Sistema Energetico of the GSE Group), assessed the level of sustainability (in terms of environmental, economic, energy and social benefits) of the innovative technologies implemented by the Partners on the Exhibition Site compared to conventional	

		ones. Savings estimated and presented to the public in order to raise awareness on sustainability challenges were: 90 thousand MWh of primary energy from fossil sources, 21,000 t of CO2, 36 t of nitrogen oxide, 62 t of sulphur dioxide, more than 5,000 kg of particulate, of which more than 4,000 kg was fine; €6 million of minor costs for materials and maintenance.	
Ministry of the Environment and Protection of Land and Sea Kyoto Club	**Campaign "Sostenibilmente"** 2017	A series of webinar were organized by the Kyoto Club and funded by the Ministry for the Environment, Land and Sea, in order to disseminate and sensitize the civil society on the goals of the Paris Agreement	
Ministry of the Environment and Protection of Land and Sea and UNFCCC secretariat	**"The EXPO 2015 experience"** **1819 May** **4th ACE Dialogue in Bonn**	Ms. Fiona May, permanent representative at the Italian National Olympic Committee, spoke about raising public awareness on climate change at the World Expo Milano 2015	
Università delle Tre Età (Unitre Susa); Arpa Piemonte	**Meeting – Workshop on climate changes** 2017	A meeting on climate change and most relevant aspects at local and regional level addressed to citizens (march 2017).	
Municipality of Bolzano	**KlimaenergyAward 2015 (Seventh edition)** 26 Marzo 2015 , Bolzano Fair http://www.klimaenergyaward.it/142/	Klimaenergy Award is a competition that rewards the most virtuous Italian public entities in the energy field. It consists of a review of good environmental practices planned and implemented by the Italian municipalities and provinces to contribute to the improvement of Italy's ranking with respect to the objectives to be achieved by 2020 in terms of energy efficiency, renewable energy production and pollution abatement. Promoted by Bolzano Fair and Bolzano Savings Bank Foundation, the award builds on tangible results and on replicability of projects in other public administrations.The winners of the seventh edition of Klimaenergy Award are: Tavagnacco (less than 10,000 inhabitants) Forlì (inhabitants between 20.000 and 150,000) and Bologna (more than 150,000).	28 Municipalities have participated (*From 19 in 2010 to 28 in 2015*)
Autonomous Province of Trento Department for Civil Protection Risk Prevention Service Trentino Climate Observatory 1. Edmund Mach Foundation 2. Provincial Agency for the protection of the environment (APPA) 3. University of Trento 4. Museum	**Trentino Observatory on climate**	The Trentino Observatory on climate has been established by the provincial junta in 2010 and carries out the technical and scientific coordination of Trentino territory commitment on research and monitoring activities of climate variables, and scientific dissemination activities, information and education campaigns. http://www.climatrentino.it/	

tridentino of natural sciences 5. Bruno Kessler Foundation 6. Trentino glaciology committee			
Natural Park Adamello Brenta Autonomous Province of Trento	**Climatesaving menus** 2010, ongoing http://www.pnab.it/vivereilparco/dovemangiare.html	An information campaign to raise awareness on the climate impact of food, carried out by the Natural Park of Adamello Brenta, in collaboration with the EcoInstitute of Bolzano and with a number of restaurants located in the municipalities within the Park. Climatesaving menus have been designed taking into account sustainability criteria and revealing the climate impact in kilograms of CO_2 emissions of each dish.	
ARPA EmiliaRomagna Regional Environmental Agency of EmiliaRomagna	**UHI Project (Urban Heat Island)** "Development and application of mitigation and adaptation strategies and measures for counteracting the global Urban Heat Islands phenomenon". 20122014 http://www.euuhi.eu/	UHI Project aims at developing mitigation, risk prevention and management strategies concerning the urban heat island (UHI) phenomenon. The UHI is a microclimatic phenomenon that occurs in the metropolitan areas. It consists in a significant increasing of the temperature in the urban area respect to the surrounding periurban and rural neighbourhoods. In particular, the project intends to provide a deeper knowledge on the manmade risk of the UHI and its interactions with global climate change and set up suitable strategies for the mitigation of and the adaptation to UHI. For these purposes a communication campaign was realized by UHI Project is developed in 8 of the most relevant metropolitan areas in Central Europe, in Italy are the metropolitan cluster of Bologna – Modena and the urban corridor of Venice – Padua.	
Connect 4 Climate and the Ministry of the Environment and Protection of Land and Sea	**"All4theGreen"** Bologna 512 June 2017 https://connect4climate.com/initiative/millionsconnectedall4thegreenweeksupportingambitiousg7environmentoutcome	The All4TheGreen week in Bologna featured more than 80 events under the auspice of the Italian G7 Presidency that connected the G7 Environment Meetings to a global audience from June 5 to 12. Coordinated by the Connect4Climate program of the World Bank Group, a coalition of businesses, NGOs, academia and local and regional authorities called for greater awareness of climate and environmental issues, declaring that they are all in support of the green transition to a lowcarbon, resilient, and sustainable future.	
EuroMediterranean Center on Climate Change Foundation	**Smart Agriculture in a Climate Changing World** EXPO 2015 Padiglione della Società Civile Cascina Triulza, Milano – 07 September 2015 http://cascina.fondazionetriulza.org/en/initiative/smartagricultureinaclimatechangingworld/5535/	The event organized by CMCC was part of EXPO 2015 and offered a view about interlinks between food and climate change. Agriculture, food security, food production, and even food culture: all these sectors interact with the climate system, all of them contribute in some way to the changing climate and each of them is affected by climate change impacts. While the scientific community plays a crucial role in increasing knowledge related to climate change, it is a multidimensional topic which requires the collaboration of	

		several and different skills: policy makers, economists, experts in landuse, agriculture, water management, food, ecosystems, energy and sustainability. The event highlighted in which way climate change is interacting with agriculture and food related sectors and cultures, giving some clue on future scenarios for the forthcoming years and on the Planet we are going to leave to the youngest generations.	
Arpav, University of Padova, Botanical garden	**Pills of sustainability** 2014 http://www.arpa.veneto.it/serviziambientali/educazioneperlasostenibilita/fileeallegati/ortobotanico2014/Programma%20ARPAV_La%20Scienza%20in%20Orto.pdf	Some focus on environmental education by ARPAV experts on climate change, waste , metereology, within the Project " "The science in the garden" organized by the Unibersity of Padova at the botanical garden. The main objective is to promote a dialogue with families and citizens to let them play an active role with the institutions in order to safeguard the environment.	14 focus (7 on waste and 7 on meteorology and climate change) 200 citizens involved
Arpav, Aqua srl di Taglio di Po (RO) Municipalities of Belluno, Verona, Venezia, Padova La Fenice Foundation of Padova Venice National History Museum	**Ideas of sustainability** 2016 http://www.arpa.veneto.it/serviziambientali/educazioneperlasostenibilita/educazioneambientale/ideedisostenibilita	Meetings to promote the environmental culture and the sharing of ecological behavior which make the difference and reduce the impacts of daily actions on the environment. The meetings have been addressed to families and citizens on the following topics: climate change, air, water, soil, waste, electromagnetic fields and noise.	4 provinces 34 days 450 adults
University of Genova Faculty of Architecture	**International Forum MED.NET RESILI(G)ENCE** 2538 October 2016 – Faculty of Architecture)	Within the Forum aimed at developing a new strategic and perspective approach to urban landscape, ARPAL made an intervention on Ligurian and climate change also focused on climate resilience urban environment .	Conference Public: 500600 people
Doria Natural History Museum of Genova ARPAL Regional Environmental Agency of Liguria	**Tuesday Pro Nature at Doria Museum** Meteo climatic events on Mediterranean area looked through photography 28 march and 12 December 2017	"METEOCLIMATIC EVENTS WITHIN 2016 AND 2017", looked also through photography: a conversation with the showing of digital images on a big screen. Through a series of photographs have been represented different meteorological situations characterized by extreme events, hot weather persistence and drought, in the context of a Mediterranean climate extremisation linked to an almost annual change of air circulation which have recently interested most of Italian territory, Liguria included.	Conference Public : 4060 people

Arpa Sicilia (Regional Agency for the Protection of the Environment)	**M'illumino di meno** **"I am enlightened less"** 2014 / 2017 http://www.arpa.sicilia.it/news/11899/	Dissemination and promotion of M'illumino di meno Campaign. Arpa Sicilia as In.F.E.A. Regional Laboratory, participated to this initiative by organizing a dissemination event for citizens, schools and institutions During 2017 edition in addition to switch off public lightening they proposed also gestures of sharing against waste of resources in all fields: food waste , mobility, communication…) for the benefit of "sociality	
Arpa Sicily (Regional Agency for the Protection of the Environment)	World Environment Day "**Seven billion dreams. One Planet. Let's consume with moderation".** 2015 http://www.arpa.sicilia.it/educazione/6520/	On the occasion of the World Environment Day 2015" , ARPA Sicily has organized an awareness raising event at "Uditore a Palermo" urban Park to disseminate environmental sustainability values among users of the Park also: an exhibition area with an information booth of ARPA and its moving laboratory on air quality. The event has been disseminated through In.F.E.A Network and local organizations. Several schools participated also to the event.	
Arpa Sicily (Regional Agency for the Protection of the Environment)	**Action Plan for Sustainable Energy (PAES)**	Information and Training activities addressed to citizens for the adoption of sustainable behaviors for the reduction of energy consumptions and CO2 emissions.	
Kyoto Club	**Kyoto Club Web Portal** http://www.kyotoclub.org/	Kyoto Club is a nonprofit organization which promotes awarenessraising initiatives, information and training to foster energy efficiency, renewable energy sources and sustainable mobility. Its members are all engaged in reaching the greenhouse gases reduction targets set by Kyoto Protocol.	
Kyoto Club	**"Sustainably" Project**	"Sustainably" is the Kyoto Club new project with the support of the Italian Ministry of the Environment, Land and Sea aimed at the dissemination of the Paris Agreement, of the National Strategy for Sustainable Development, of the results of Cop Conferences and of the latest EU decisions with regard to adaptation and mitigation of climate change effects, energy and energyefficiency, efficient resource management, bioeconomy and circular economy . The project activates students and Local Authorities against climate change, contributing to awareness raising on this subject.	
Kyoto Club	**Workshop"Organic Agriculture as a response to climate change"** 20 September 2016	The workshop focused on organic agriculture as a mitigation tool for climate change. Scenarios , outlooks and commitments for each european country following Paris Agreement (COP 21) https://www.kyotoclub.org/documentazione/video/2016set20/lagricolturabiologicacomerispostaalcambiamentoclimatico/docId=5782	
Kyoto Club	**Report "105 best practices of energy – efficiency in Italy"**	Book: In 2016 Kyoto Club has published 105 best practices of energyefficiency in Italy. The book presents more than one hundred of concrete examples to replicate varying from industry to public administrations to	105 best practices of energy – efficiency in Italy"

		tertiary, communication and didactics. These best practices are replicable	
Kyoto Club	**"10.000 Trees for Pantelleria"** Civic Crowdfunding campaign for improving the environment https://www.kyotoclub.org/chisiamo/iniziative	10.000 Trees for Pantelleria" is an extraordinary fundraising campaign launched in cooperation with the Municipality of Pantelleria, the University of Palermo and Marevivo Association to contribute to the reconstruction of part of the forest heritage of the Island of Pantelleria partially destroyed from a fire in May 2016. This crowdfunding campaign which counts 131 supporters has collected € 35.030 on € 300.000 (12% of the total amount).	The Civic Crowdfunding campaign has got 131 supporters

9.2 Public access to information

Starting from the assumption that new technologies have substantially changed the way information is disseminated public access to information has necessarily changed too and transformed. In the last few years thanks to this rapid transformation new channels and methodologies have ensured citizens an always more rapid access to information.

As a consequence several innovative and practical initiatives have been implemented at national and local level to improve citizen information on climate change issues. New web tools have been developed like observatories, platforms, webinars and social web pages together with usual newsletters, electronic information systems, web sites, information desks, conferences and workshops, most of them organized and promoted by Italian Ministry of Environment and ISPRA.

A recent example of punctual and integrated access to environmental information at national level is the Newsletter "**AmbienteInforma**". This is the informative product of the New National System for Environmental Protection (SNPA), established by Law 132/16 constituted by 19 Regional and 2 Province's Environmental Protection Agencies and coordinated by ISPRA. The first edition of "AmbienteInforma Newsletter was issued on May 2016. On a weekly base environmental information is provided to citizens at local and national level even focusing specifically on climate change issues.

List of some initiatives carried out since 2014

Organisation / Promoter /	Name of the activity	Short Description	Indicators / Numbers
SNPA	Newsletter **AmbienteInforma** 1st issue : May 2016 http://ambienteinformasnpa.it/ilcambiamentoclimaticonelsnpa/	Weekly Bulletin collecting all the information of SNPA, edited by a Working Group on Communication composed by representatives of ISPRA and all the 21 ARPA and APPA. The Working Group is coordinated by ARPA Tuscany. The edition n. 41 of March 2017 includes a Focus on Climate changes and its environmental risks and a video on impacts, adaptation and vulnerability of climate changes prepared for the Italian Focal Point of Ipcc.	From May 2016 until Sept. 2017: 69.000 visitors 209.000 visits About 80.000 recipients The edition n. 41 had 22.000 visitors and 5.200 visits
ISPRA	**ISPRA web site** Ongoing and past events and news http://www.isprambiente.gov.it/it	The Communication Unit of ISPRA manage the web site of the Institute in which numbers of events, conferences, with ISPRA experts participating, and news were spread on climate change and related activities and which publication can be downloaded.	No. of News: 60 No. of Events: 10 No. of Publications: 33
ISPRA	**Environmental Data Yearbook** **Edition 2013** **20142015** **Edition 2016** **Edition 2017** (in publication) http://www.isprambiente.gov.it/en/publications/stateoftheenvironment/environmentaldatayearbook2016edition?set_language=en	The Environmental Data Yearbook is the most extensive and complete collection of official environmental statistics published in Italy, prepared by ISPRA through a consolidated collaboration with the regional environmental agencies and provincial agencies, now SNPA System, the National System of Environmental Agencies, that combines direct knowledge of the territory and local environmental issues with national policies for prevention and environmental protection so that has become an institutional and technicalscientific reference point for the whole Country. The Report includes a chapter on "The perception of European and Italian citizens on the environment, climate change, waste management and resource". Each year ISPRA organizes a public event for the presentation of the new edition of Databook.	No. of downloads: more than 1300 No. of participants to the Conferences: around 900 participants to the 3 events
ISPRA	**Report on Urban Environment Quality** **2017 edition** **2016 edition** **2015 edition** **2014 edition** http://www.isprambiente.gov.it/en/ispraevents/xiiireportonurbanenvironmentquality2017edition1?set_language=en	The report is published by the National System for Environmental Protection SNPA, and it has become over the years a reference for professionals and for users, thanks also to analyzes and assessments provided by the SNPA experts on the numerous data presented, which help the reader to understand the phenomena. The 2017 edition of the report provides the updates for all the 119 (116 Italian provincial capitals plus the 3 cities most populated) of a set of core indicators for the analysis of the urban environmental quality and urban quality of life in the Italian cities. **The 2014 edition includes a focus on "Cities and the Challenge of climate change"** The report is issued each year and it has	Participants (2 conferences): 375 Downloads: 5671 at 30/09/2017 (edition 2015)

		came to the 13th edition. ISPRA organizes a public event for the presentation of the new edition. Since 2007 the Report is completed with a Focus on a specific topic, and for 2017 will face the Sustainable Urban mobility.	
ISPRA Sapienza University of Rome	**The major urban challenges: climate change and environmental quality,** **Congress in** Rome, March 31, 2015 http://www.isprambiente.gov.it/en/archive/ispraevents/year2015/march/themajorurbanchallengesclimatechangeandenvironmentalquality?set_language=en	Based on the work done by the National System for Environmental Protection (ISPRA / ARPA / APPA) the 2014 Report on Urban Environment Quality 2014 and the Focus dedicated to climate change ISPRA and Sapienza University of Rome / DICEA organize a congress addressing the ability to assess the environmental quality of the Italian cities in relation to broad environmental mitigation and adaptation to climate change.	Participants: 225 (Researchers and the professionals operating in the field, public administrations and environmental associations)
ISPRA	**Coastal Erosion and climate change: adaption strategies, management and environment al sustainability,** Workshop in Rome, 3 November 2015 http://www.isprambiente.gov.it/en/archive/ispraevents/year2015/november/coastalerosionandclimatechangeadaptationstrategiesm?set_language=en	The Workshop aimed to spread and share national and international scientifictechnical results of the Project INTERCOAST, POR FESR 20072013 Lazio relating to "Policies of Adaptation and Sustainable Protection of Coastal Zone considering to erosion and changes Climate", Objective Competitiveness and Employment Axis II Interregional Cooperation, in partnership with Generalitat of Valencia with Agency FEPORTS	

ARPA Emilia Romagna Regional Environmental Agency of EmiliaRomagna	**BLUE AP Project** Bologna Local Urban Environment Adaptation Plan for a Resilient City. http://www.blueap.eu/site/ 20122015	BLUE AP is a LIFE+ project for the implementation of an Adaptation Plan to Climate Change for the Municipality of Bologna, providing for some concrete local measures to test, in order to make the city more resilient and able to meet the climate change challenges. The BLUE AP planning and testing actions developed in the city of Bologna will lead to the creation of guidelines useful for the definition of similar adaptation plans, that can be adopted by other mediumsize Italian cities. Bologna will be the pilotcity that, first in Italy, will face climate changes with the appropriate and creative tools. The City of Bologna, as a joint effort with the project partners (ARPA EmiliaRomagna, Kyoto Club and Ambiente Italia), will implement a Local Adaptation Plan that will make the city more resilient and prepared to handle the consequences of climate change. This also occurs through the creation of a Local Climate Profile and the involvement of stakeholders and citizens on the territory. The web site and platform is still ongoing and acting as ain information portal on initiatives carried out in the city of Bologna related to resilient cities and climate change.	
University of Ferrara Centre for Research on Territorial Resilience, MultiHazard Risk Assessment and Mitigation (TeRRA) IUAV University of Venice	**Resilience an Agenda for the Government for climate change adaptation,** Ferrara, 1920 February 2016 http://www.alternativasostenibile.it/articolo/resilienteunagendadigovernoperladattamentoalcambiamentoclimatico.html	The research center TeRRA of the University of Ferrara, in collaboration with the Department of Design and Planning of University IUAV of Venice, organized a symposium on the territorial resilience and the adaptation of cities to climate change, a round table among some of the most important Italian experts in various disciplines and institutions with a large number of directors and policy makers at different levels of government: national, regional and local.	
Municipality of Assisi UNESCO DESS	**The role of LGMAs in climate actions on adaptation and mitigation: Italian case studies,** Side event during CoP 22 UNFCCC in Marrakech, 15 November 2016 http://www.isprambiente.gov.it/files/notizieispra/notizie2016/COP22_City_of_Assisi_Programme_draft.pdf	In the framework of the UNESCO Week for Education to Sustainable Development (DESS) 2016, the event was organize as side event during CP22 of the UNFCCC in Marrakech and aimed to describe the role of Local Government and Municipal Authorities (LGMAs) in carrying out mitigation and adaptation actions, within the framework of sustainable development (environmental, economic and social) and in line with the Sustainable Development Goals (11. Sustainable Cities and communities; 13. Climate Action).	

Italian Ministry of the Environment, Land and Sea	**The new challenge of the climate and energy policies integration: the Italian perspective** **Side event during CoP 22 UNFCCC in Marrakech** 17 November 2016	The sideevent " The new challenge of the climate and energy policies integration: the Italian perspective" was presented in Marrakech, organized by the Presidency of the Council of Ministers, in which the activities of the Working Group on a low carbon were presented by ISPRA, ENEA and Politecnico of Milano. http://www.isprambiente.gov.it/files/notizieispra/notizie2016/SideEventITALIANPRECIDENCYOFTHECOUNCIL.pdf	
Kyoto Club Italian Ministry of the Environment, Land and Sea Municipality of Rome	**Italy, the climate challenge and the circular economy. After Paris and towards the EU 2030 objectives,** Conference in Rome, 16 February 2016	The Conference was held in Rome on February 16, on the day of the entry into force of the Kyoto Protocol. https://www.kyotoclub.org/prossimieventi/2016feb16/litaliaelasfidadelclimaedelleconomiacircolaredopoparigieversogliobiettiviueal2030/docId=5117	
Fiera delle Utopie Concrete 2016 Alleanza per il Clima Onlus	**Climate change. What adaptation for agriculture?** Workshop in Città di Castello (Perugia), 36 November 2016	One year after EXPO Milano and the Paris Agreement on climate change, the event debated the ecological conversion in Italy in 3 different key actions : agriculture, food and climate. http://www.isprambiente.gov.it/it/archivio/notizieenovitanormative/notizieispra/2016/11/ilclimacambia.qualeadattamentoperlagricoltura	
ICCG International Center for Climate Governance (an initiative of Eni Enrico Mattei Foundation and Giorgio Cini Foundation)	**Building resilience to climate disaster risk: innovation and best practices** Best Climate Practices 2017 Award Webinar	In conjunction with the first week of COP23, ICCG organizes the “ICCG Climate Week”, a series of webinar lectures and dissemination activities on climate change sciences and governance, mostly linked to its observatories’ activities and awards. This webinar, which is dedicated to the Best Climate Practice Award, is the occasion to showcase the most innovative and compelling projects that have participated in the 2017 edition of the contest, and to explore the landscape and challenges of climate resilience and disaster risk reduction strategies. http://www.iccgov.org/event/svilupparelaresilienzalocaleaidisastriclimaticiinnovazionemiglioripratichebestclimatepracticesawardwebinar/	

9.3 Public participation

A strong encouragement to public participation on climate change policies and related measures has been promoted by environmental NGOs and nonprofit organizations. Their commitment proves to be always more relevant in raising public awareness and fostering public participation especially among young

people by promoting simple actions accessible to all, able to give a small contribution to the protection of our planet.

Such actions include the testing of active citizenship practices in order to give young people spaces and tools to express their critical viewpoint and their proposals on key environmental issues and climate change, but also with regard to the cultural, social and economic context in which they live and in which their personality is taking shape.

The initiatives launched by NGOs and Youths are often welcomed and willingly supported and sponsored by Italian Ministry of the Environment, as for the very important initiative " Italian Youth Think Tank on Intergenerational Equity" aimed at drafting a policy proposal for the implementation of the intergenerational equity principle to be included within the global climate change agreement, which was later signed as Paris Agreement. Under the supervision of a scientific committee, a number of young representatives from Italian youth organizations contributed to the final document, named "Italian Youth Declaration on Intergenerational Equity".

New technologies demonstrated to be an important tool to actively involve citizens in themes related to climate change, particularly about "Adaptation". The Smartphone applications the so called "App" for example make citizens actively participate by giving immediate information on localisation of extreme events , meteorological events or environmental phenomena. The development and implementation of this new tool is part of the communication plans of several projects and National campaigns. The citizen science shows to be the new participatory process to increase resilience of citizens to climate change.

Concerning bottomup approaches in Italy there is a significant experience in the field of "River's Contracts", local processes of participatory governance for the protection and sustainable management of river basins (but also lakes and other aquifers), with the active involvement of all relevant private and public actors . Several of these contracts originate from the need to fight the effect of climate change in the basin, mainly in terms of flooding.

A national board of Rivers contract, gathering all the major local experiences is in place since 2008 with the active participation of the Ministry for the Environment. A national observatory is on course of being launched, within the Ministry for the Environment, to monitor and promote these instruments, and to trigger their potential contribution to the implementation of the measures identified at the basin level.

It's worth to mention also two conferences organized last years by the Italian Council of Ministers and the Ministry of the Environment, the States General on Climate Change and on Environmental Education, opened to NGOs and civil society.

The following table provides some examples of actions for promoting and facilitating public participation on climate change policies and related measures.

List of some initiatives carried out since 2014

Organisation / Promoter	Name of the activity	Short Description	Indicators / Numbers
Presidency of the Council of Ministers	**StatesGeneral on Climate Change and Hydrogeological Instability,** Rome, 22 June 2015 http://www.minambiente.it/comunicati/climagallettii	Presidency of the Council of Ministers organized the StatesGeneral on climate change and hydrogeological instability with the aim of receiving the opinions and contributions from various stakeholders as well as to present the strategies adopted by the Italian Government to	

	l22giugnostatigeneralisuicambiamenticlimatici	contribute to climate change mitigation and adaptation in view of COP21.	
Italian Ministry of the Environment, Land and Sea Italian Ministry for Education, University and Research	**StatesGeneral on Environmental Education,** Rome, 2223 November 2016 http://www.minambiente.it/comunicati/educazioneambientale2223novembreglistatigenerali	The second National Conference on Environmental Education was a twoday event with the participation of ministers, national and international institutions, academic, research, NGOs and civil society representatives. On the first day, twelve roundtables were organized to discuss specific topics and drafting recommendations. Conclusive proposals from roundtables were merged into a final document setting a program of commitments in the medium and long term. On the second day, a public conference with the presence of the Minister of Environment and the Minister of Education was convened.	
Ministry of Economic Development Ministry of the Environment, Land and Sea	**Italy's National Energy Strategy** (Sen 2017) Public consultation on the New National Energy Strategy	The National Energy Strategy is the result of a one year wellstructured and shared process which has involved since the preliminary phase, the public entities operating in the energy context, in the transport of electricity and gas as well as relevant experts of the energy sector. After this phase the proposal has been submitted to a public consultation during a period of three months. Results: a wide participation, comments and observations from associations, enterprises, public organisms, citizens and representatives from Universities.	251 complete contributions 838 thematic contributions 40 one to one meetings 5 workshops 9700 visualizations of the dedicated web page of the Ministry of Economic Development
Department of Civil Protection, INGV – National Institute of Geophysics and Volcanology, Anpas National Association of Public Assistance and ReLUIS Laboratories University Network of seismic engineering.	**National Communication Campaign "I don't take risks: are you ready?"** Subcampaigns: I don't take risks Flood I don't take risks Tsunami I don't take risks Earthquake Year 2017 http://iononrischio.protezionecivile.it/en/homepage/	**Io non rischio** (I don't take risks) is a national communication campaign on best practices of civil protection. Italy is a country exposed to many natural risks, and this is a fact, but it is also true that the individual exposition to such risks can be considerably reduced through the knowledge of the problem, the awareness of the possible consequences and the adoption of a few simple expedients. And through knowledge, awareness and best practices being able to say, exactly: "I don't take risks" . It is about training volunteers of civil protection on risk knowledge and communication and then make them go on the streets of their cities and towns to meet citizens and inform them. The voluntary work associations of civil protection are everywhere in Italy. Volunteers live and operate on their own territory, they get to know it and are, in turn known by local institutions and citizens. Every risk is illustrated and communicated to the citizens along with the best practices to reduce the impact on people and things. Participate to the campaign local sections of national organizations, regional associations and local groups.	103 cities where the campaign is carried out 751 organisations participate to the campaign

Municipality of Bologna	**PlayBlueAp,** Created in 2015 http://playblueap.herokuapp.com/	PlayBlueAp is the first Smart online device which aims to actively involve the citizens in themes related to climate change, particularly about the Adaptation Plan of the Municipality of Bologna has arranged as a part of the project LIFE+ (LIFE11 ENV/IT/119) BLUE AP. The APP is intended to be used as a tool to spread the scientific knowledge derived from the Blue AP project, under the supervision of the Municipality of Bologna and to gather the adaptation abilities of the inhabitants. The Bologna residents are called upon to make something concrete for their town through a certain number of suggested activities divided online into the following categories: agriculture, buildings, resilience, green spaces, water, mobility.	
Municipality of Rome	**"Rome Towards COP21"** Rome, October 2015 https://www.comune.roma.it/pcr/it/newsview.page?contentId=NEW954524	Awareness campaign on climate change ahead of COP21. The initiatives aimed at involving students, stakeholder and institutions to promote and discuss local measures to tackle climate change and improve life quality in cities.	
Italian Climate Network in cooperation with WWF Italy	**Italian Think Tank on Intergenerational Equity** 20142015 http://www.italiaclima.org/attivita/equitaintergenerazionaleilthinktank/	The Italian Youth Think Tank on Intergenerational Equity was an initiative aimed at drafting a policy proposal for the implementation of the intergenerational equity principle within the new global climate change agreement. Under the supervision of a scientific committee, a number of young representatives from Italian youth organizations contributed to the final document, named **Italian Youth Declaration on Intergenerational Equity**. The Declaration was finalized ahead of Lima COP20 and submitted to the Italian Minister of the Environment. At COP21 in 2015, also thanks to the support of the Italian Minister of the Environment, the principle of the **Intergenerational Equity** was included into the preamble of the Paris Agreement. **Link to the Declaration.**	Italian Climate Network in cooperation with WWF Italy
RAI Radio 2 "Caterpillar" radio broadcast	**M'illumino di meno "Let's brighten less"** Energy Saving Day campaign 1 week each year, during the month of February http://caterpillar.blog.rai.it/milluminodimeno/ Edition 2017: Let's switch off the lights to switch on the stars"	Energy Saving Day is a national communication campaign dedicated to energy saving policies. This annual campaign was launched for the first time on February 16th, 2005, sponsored by the Ministry of the Environment, Protection of Land and Sea and also supported by the EU. Everybody is asked to reduce to the minimum their own private energy use during the show's airtime from 6:007:30pm. By doing this the maximum visibility in the media and the largest participation by common people are concentrated on Energy Saving Day.	451 thoughts on "M'illumino di Meno" 13100 Tweets 2613 Following 44000 Followers 4131 I like

High Adriatic River Basin Authorities supported by the European Commission, the Italian Ministry of the Environment, Land and Sea, the Italian Civil Protection	**#COWM16: in Venice the citizen Observatory for water risk** International Workshop COWM (Citizen Observatories for Water Management). 7 10 June 2016 Venice	Citizen Science theory applied to water risk to enhance resilience. Resilience is the capacity of reaction and adaptation of people to climate change to save human lives and reduce economic losses. A continuous feedback between the civic network and the operating Centre of the Civil Protection. Experts of hydrogeological management from all over the world met at this meeting to share ideas and to present initiatives aiming at optimizing decisionmaking by authorities in case of catastrophic events. It was showcased an experimental project, an app for smartphone as a useful tool directly in the hands of the citizens for monitoring Po river banks in case of floods. In Italy the pilot city to implement the project was the city of Vicenza who involved more than 130 volunteers who through the use of smartphones cooperated to reduce floods damages. https://ec.europa.eu/futurium/en/content/citizenobservatorieswatermanagementconferencepalazzolabiavenice79june2016	
Italian Climate Network Onlus Legambiente Kyoto Club	**Rome's Climate March** Rome, Via dei Fori Imperiali 21 September 2014 http://www.italiaclima.org/newyorkchiamaroma21settembrevieniinpiazzaconnoi/	Climate march convened in occasion of the UN Climate Summit held in New York in September 2014. The initiative was promoted by Power Shift Italy coordination, Italian Climate Network, Legambiente, Kyoto Club and other organizations. The event registered the attendance of a few thousands of participants as well as the presence of the President of the Chamber of Deputies and of Rome's Deputy Mayor for the Environment.	
WWF Italia with the patronage of the Municipality of Bologna	**Climate change: resilient cities' challenge** **18 November 2017** https://www.wwf.it/news/appuntamenti_wwf/?35160%2FII18novembreaBolognacittaresilienti	The workshop is aimed at addressing the challenge of urban areas. These ones at the center of the challenge that institutions and populations, with the support of the world of research and science, have to face in setting up local action plans and identifying effective and immediate action priorities for adapting to change climate and to tackle a global and national situation characterized by the alternation of extreme drought and floods	
Coalizione Clima	**Marcia per il Clima (Climate March)** Rome, Via dei Fori Imperiali 29 November 2015 http://www.ansa.it/canale_ambiente/notizie/clima/2015/11/25/climadaromaatokyocittadiniinmarciapersummitparigi_fb418a94ee1c43cca21fbeca3e6574d6.html	Climate march and concert organized ahead of the beginning of COP21. The initiative was promoted by the Coalizione Clima, an Italian coalition of over 100 members including NGOs, movements, youth organizations, trade unions and other entities.	Over 10,000 people attended the event
350.org	**"One Earth, One**	People of faith, civil society groups, and	

FOCSIV OurVoices	**Human Family: climate march in Rome"** Rome, St. Peter's Square 28 June, 2015 https://350.org/oneearthonehumanfamilyclimatemarchinrome/	communities impacted by climate change marched together in Rome to express gratitude to Pope Francis for the release of his encyclical on the environment, Laudato Si'.	
Legambiente	"**Get in the way for climate"** Awareness campaign 2015 https://www.legambiente.it/inmarciaperilclima/iniziative	The campaign aims at raising awareness among citizens, national administration, small and medium enterprises towards different sustainable development patterns, taking into account territories and communities .	

9.4 Training

The training offer in Italy is nowadays very diversified and spread throughout the Italian territory from North to South of the peninsula: longdistance training, Graduate Programs, Summer and Winter Schools, PhD programmes, Master Degrees are active in many Italian Universities as Venice, Padua, Milan, Rome, Bologna, Turin, Genoa and Calabria.

The EuroMediterranean Center on Climate Change Foundation inaugurated in 2008 its Graduate Programs, in collaboration with three Italian universities (Ca' Foscari University of Venice, the University of Salento and the University of Sassari) with the objective of promoting and coordinating advanced studies on the impacts of climate change and climate policies. The programs offer advanced courses and research activity, with special focus on themes concerning innovative management strategies, both from a physical and a socioeconomic perspective, for phenomena related to climate and its changes.

In the table below are listed many of the Master Degrees and PhD Programmes organized by Italian Universities as well as some relevant training events promoted in Italy by the Regions, ARPAs or other national institutions.

List of some initiatives carried out since 2014

Organisation / Promoter /	Name of the activity and duration	Short Description	Indicators / Numbers
ICCG International Center of Climate Governance	**Climate Change Governance** Webinars 2017 http://www.iccgov.org/categoriesevents/webinar/	The ICCG webinars on Climate Change aim at promoting longdistance training. They are targeted to the public at large and the world of policy making, in particular from developing countries where these issues are often underaddressed. The lectures are delivered by internationally renowned experts coming from both the academic and policy fields. The main research and policy institutions which work on the governance of the climate change are represented within our experts, e.g.; International Energy Agency, IPCC, European Commission, Fondazione Eni Enrico Mattei, UNEP.	

Organisation / Promoter /	Name of the activity and duration	Short Description	Indicators / Numbers
EuroMediterranean Centre on Climate Change Foundation	**CMCC Graduate Programs, Summer and Winter Schools** 2008ongoing https://www.cmcc.it/school_type/cmccgraduateprograms https://www.cmcc.it/school_type/schools	CMCC Graduate Programs were inaugurated in 2008, in collaboration with three Italian universities: Ca' Foscari University of Venice, the University of Salento and the University of Sassari. The objective is to promote and coordinate advanced studies on the impacts of climate change and climate policies. The three universities contribute to the Graduate Programs through four distinct doctorate programmes: Science and Management of Climate Change (Ca' Foscari University of Venice), Agrometereology and Ecophysiology of Agricultural and Forestry EcoSystems (University of Sassari), Energy Systems and Environment and Climate Change Sciences (University of Salento). The Programs offer advanced courses and research activity, with special focus on themes concerning innovative management strategies, both from a physical and a socioeconomic perspective, for phenomena related to climate and its changes. The synergy with CMCC has allowed the interested universities to expand their training offer, namely in the field of sea science, oceanographic ecology, High Perfomance computing, economics related to the impacts of climate change on the economy, the legal sciences linked to European legislation on mitigation and adaptation of climate change, in the assessment of the social impacts of climate change, migratory effects etc Furthermore, it is also noted the chance for the doctoral students of the University of Salento, to access the CMCC's technological equipment and tools available in Lecce (Supercomputing Center, OceanLab). Finally, in the framework of its doctoral courses, Fondazione CMCC organizes and manages a programme of summer and winter schools also open to students from other international Ph.D. programmes on climate change.	
Centro EuroMediterraneo sui Cambiamenti Climatici (CMCC), CIP – Climate Impacts and Policy Division and International Center for Climate Governance (ICCG)	**Summer School on Adaptation Policies and Practices in the Mediterranean Basin (MedAdapt),** May 2014 Study programme for doctoral and postdoctoral students from all over the world http://www.cmcc.it/it/trainingprograms/cmccicccgsummerschoolonadaptationpoliciesandpracticesinthemediterraneanbasinmedadapt	The aim of the Summer School is to offer an indepth view of the impacts of climate change in the Mediterranean Basin and to pursue a thorough investigation of key adaptation policies and best practices, whether not yet implemented or already implemented across the region. The Summer School programme will combine physical, economic, and sociopolitical aspects of the Mediterranean in an interdisciplinary approach for the purpose of educating the public about the impacts of climate change. Students will also benefit from an overview of the technical instruments that enable a better understanding of the statistical models for impact and adaptation analysis. The Summer School topics will include:	

Organisation / Promoter /	Name of the activity and duration	Short Description	Indicators / Numbers
		climate systems and impacts in the Mediterranean basin, integrated assessment of climate change impacts, and adaptation strategies in the Mediterranean region: case studies, options and best adaptation practices	
Ca' Foscari University of Venice Department of Economics CMCC EuroMediterranean Centre for Climate Change	**The PhD programme in Science and Management of Climate Change** Monthly workshops in English 20162017 http://www.unive.it/nqcontent.cfm?a_id=124319	The Doctoral Programme aims to train experts equipped with wide and indepth scientific and economic education and a proven original research activity related to climate change dynamics and techniques for its assessment and management. The educational activities included in this programme are held in English. The programme may be broken down into two different curricula: one is called Dynamic Climatology" and the other "Impact and Management of Climate Change". They include common educational activities aimed to create a sound scientific and economic background for the general understanding of climate change, together with specific educational activities related to the particular curriculum chosen by the doctoral student.	
University of Padua Centro Studi Qualità Ambiente (CESQA)	**Master in Strategic Environmental Management GAS** 20142017 http://cesqa.eu/	The Master aims to train people who have multipurpose skills, knowledge and expertise in strategic environmental management (EMS), in the field of environmental management systems, in sustainable energy, in the life cycle management and climate change.	
Politecnico di Milano University	**Master Degree in Environmental and Land Planning Engineering** Milan, A.Y. 20162017 http://www.polinternational.polimi.it/educationaloffer/laureamagistraleequivalenttomasterofscienceprogrammes/environmentalandlandplanningengineering/	The Master in Environmental and Land Planning Engineering provides an education focused on the broad range of professional capabilities and expertise required to deal with and address adequate engineering frameworks for the sustainable utilization of natural resources and manmade infrastructures. Among the fields of interest are: planning and design of strategies and infrastructures for land protection and prevention from natural risks damage and related anthropogenic forcing management of complex environmental systems and of information systems for land management and resource planning. Climate change mitigation is specifically dealt by an ad hoc course.	
Roma Tre University	**Master Degree in Environment and Development Economics** Rome, A.Y. 20162017	The Master of Science in Environment and Development Economics is intended for those students with a primary interest in the relationships between environmental issues and development pathways. It provides students with a rigorous training	

Organisation / Promoter /	Name of the activity and duration	Short Description	Indicators / Numbers
	http://dipeco.uniroma3.it/default.asp?contenuto=academicyear20172018	in different disciplines from the economics, social and managerial perspectives. The MSc Programme has four distinguished specializations: Environmental Economics, Development Economics, Sustainable Firms, Global Economic Governance.	
Alma Mater University of Bologna	**Master Degree in Resource Economics and Sustainable Development (RESD)** Rimini, A.Y. 20162017 http://corsi.unibo.it/2cycle/ResourceEconomicsSustainableDevelopment/Pages/default.aspx	The RESD course offers a solid preparation in environmental economics, a critical understanding of the issues involved in sustainable development both from a theoretical and practical perspective and of the complex interactions between economic decisions, market forces, governmental policies and the environment. Among the subjects are climate change, energy economics and policy, food and agricultural economics, environmental innovation.	
University of Turin	**Master Degree in Economics of the Environment, Culture and Territory** Turin, A.Y. 20162017 https://en.unito.it/degree/courses/economicsenvironmentcultureandterritory	The course is aimed at developing specific expertise on global changes, including climate and biodiversity, urban pollution, energy, water, demography, natural resources management etc.	
ISPRA	**Particulate emissions in Italy: evolution of sources and role of biomass** January 29, 2014	Presentation in the workshop on Air Quality Modeling organized by ENEA	
ISPRA	**Climate change and coastline variation.** April 26, 2016	Presentations in the workshop "Climate Change and Coastal Sustainable Development" The use of spontaneous herbaceous vegetation to increase biodiversity in ecosystems and increase the resilience of coastal areas to climate change	
ISPRA	**Mobility Management as a strategy for adapting to climate change,** 2015	Training unit within the ISPRA elearning course "Soft actions and measures for sustainable mobility: mobility management in the public institutions.	41 trainees
ISPRA	**Climate Change and Indoor Air Quality (IAQ),** 2016	Training unit within the ISPRA elearning course "Indoor Air Quality in Schools, Health and Prevention Risks"	63 trainees
Fondazione Montagna Sicura (FMS) – University of Savoye – Municipality of Valtournenche – ARPA Valle d'Aosta – ARPA Piemonte	"**PrévRiskHauteMontagne" Project** 20162017 http://www.fondazionemontagnasicura.org/fr/projetsencours/prevriskhautemontagne	The project aims to educate and raise awareness among local people and tourists about the high mountain characteristics and related risks, also with reference to the impacts of global warming on glaciers and permafrost. Training courses on information and communication methodologies addressed to journalists, experts on glaciers, permafrost, snow and avalanches and alpine guides. The event took place in the Mont Blanc	30 information and communication experts

Organisation / Promoter /	Name of the activity and duration	Short Description	Indicators / Numbers
		area between Chamonix (France) and Courmayeur (AO) with indoor workshops and glacier excursions to reach the high altitude environment.	
Fondazione Montagna Sicura (FMS) – University of Savoye – Municipality of Valtournenche – ARPA Valle d'Aosta – ARPA Piemonte	"**PrévRiskHauteMontagne" Project** June July 2017 http://www.fondazionemontagnasicura.org/fr/projetsencours/prevriskhautemontagne	The project aims to educate and raise awareness among local people and tourists about the high mountain characteristics and related risks, also with reference to the impacts of global warming on glaciers and permafrost. Training days for geologists and engineers dedicated to permafrost and related issues	
UNICEF – University of Genoa – ARPA Liguria	**UNICEF Course "Environment and climate changes"** **Genoa**, April 27th 2016	A lesson to the students of Social Sciences, containing an introduction to the general context and scientific assessments, a focus on the local (Mediterranean and regional) data and evidences, as well as meteorological issues and impacts. Discussion has been stimulated on strategies and behaviors to be adopted by a resilient community.	Number of students: nearly 20.
LUMSA University of Rome	MSDG Annual MSc in Management of Sustainable Development Goals **"Economic Growth, Demography and Climate Change"** **http://www.lumsa.it/corsi_master_primo_livello_msdg** **http://www.lumsa.it/sites/default/files/didattica/master/1718/call_for_application_MSDG.pdf**	The Master "Science in Sustainable Development Goals (MSDG)" by LUMSA is an international master (english language). **"Economic Growth, Demography and Climate Change" is one of the main contents of the master.** It is a high training path of excellence for students coming from all continents aiming at acquiring knowledge and competences in the management of integrated projects on economic sustainability and in management and financial knowledge in line with the new vision of the United Nations Sustainable development Agenda 2030. The main objective of MSDG is to create new professional profiles " the sustainability manager" able to develop, manage and disseminate innovative projects of international relevance on sustainable development, in several sectors and with relevant consequences both in the development production chain of new sustainable products and services and in the management of development programmes based on a new vision of sustainability from one side on Pope Francis' encyclical "Laudato si" and from the other side on the United Nations Sustainable development Agenda 2030 , The master intends to promote a new vision of sustainable development that thanks to an holistic and crosscutting approach intends to support the solution of problems concerning the conservation of the planet in the longterm This new approach oriented to improve quality of life and of the world and to create the good terrain for a sustainable and inclusive growth and a shared prosperity	

Organisation / Promoter /	Name of the activity and duration	Short Description	Indicators / Numbers
Unitrè Susa Arpa Piemonte	**Seminar on Climate Change,** March 2017	Meeting with citizens on climate change and also at regional and local level	
ARPA Veneto	**Climate and Cultivation of Life,** June 17, 2015	Training course for journalists in the agricultural sector	
ARPA Veneto	**Science in Orto,** 1314 December 2014	Training Days for Citizens and Teens at the Botanical Garden of Pavia on Climate and Climate Change in Veneto	
ARPA Veneto	**The climate and the recent evolution of the Marmolada glaciers,** July 8, 2016	Course for geography teachers	
ARPA Veneto	**The Dolomitic deglaciation: how glacier retreat changes the landscape and perceptions of mountains,** June 23,2006	Student lesson under the Boston University Summer Course on Climate Change	
ARPA Veneto	**Winter 201314, extraordinary weather events consequences on the territories,** May 9, 2014	Training course for forest agronomists of Belluno province	
ARPA Veneto	**What's happening to our climate?,** April 7 2017	Seminar for students within the initiative "Schools on the Net"	
ARPA Veneto	**Climate and climatic change,** April 7 2016 9 and 22 March 2017	Seminar for students of the scientific high school and of the University “Tempo libero” in Padua and Pordenone	
ARPA Veneto	**Climate changes and avalanche: effects on the mountainous region of Veneto** May 6, 2016, May 11, 2017	Seminar for students at the University of Padua “TESAF”	
ARPA Veneto	**Climate change: evidence and local and global consequences on cryosphere** March 24, 2017	Seminars addressed to citizens and students within the initiative "Schools on the Net"	
ARPA Veneto	**Weather and climatic conditions and activity planning** February 9, 2016	Seminar for military on mission abroad	
ARPA Veneto	**The effects of climate change:** the evolution of the glaciers of the Dolomites over the last	Seminar for students in the Summer school at Venice University “Cà Foscari”	

Organisation / Promoter /	Name of the activity and duration	Short Description	Indicators / Numbers
	100 years, July 17, 2015		
Emilia Romagna Region ASTER Consortium for Innovation and Technology Transfer in EmiliaRomagna	**ClimateKIC – Italy** (2017) ClimateKIC Italy has 12 national partners: ASTER, AESS, ARPA, CCPB, CMCC, CNRIBIMET, Comune di Bologna, MEEO, PROAMBIENTE, SINERGIS, UNIVERSITÀ DI BOLOGNA Alma Mater Studiorum, URBAN CENTER BOLOGNA.	ClimateKIC is an Initiative of EIT European Institute of Innovation & Technology with the aim to develop knowledge and foster innovation in four areas relevant for climate change. ClimateKIC Italy is based at the National Research Council (CNR) in Bologna. Its aim is to contribute to the definition of new national strategies on climate change.	
CNR ISAC (Institute for Atmospheric and Climate Science) ARPA Calabria Regional Environmental Agency of Calabria	**IAmica** Infrastructure of High Technology for Climate and Environmental Integrated Monitoring 2012 – 2015 http://www.iamica.it/iamica	One of the goals of the project is the organization of the Higher education Course involving technicians of the Multirisk Center of ARPA Calabria and it is based on the strengthening of the network of observation for climateenvironmental monitoring. The objective of the training course is to provide regional and local governments with some tools for the management of environmental issues and train professionals who are able to use the observation network of climate and environmental satellites of international infrastructure.	
EOS Unit (Education Oriented to Sustainability) of ARPA CALABRIA Multirischi Functional Center – Schools – Mediterranean University of Reggio Calabria University of Calabria	**Project: "Resilient cities to combat the waves of climate instability"** November 2016 June 2017 http://www.arpacal.it/index.php/arpacal/attivita/comunicazione/eventieconvegni/938unescosettimanadesseventiarpacalnelprogrammanazionale	The project was realized in the framework of the UNESCO Week for Education to Sustainable Development (DESS) 2016, titled "Earth as a Space Shuttle in the Climate Waves: what can our cities do?" The project involved students that participated during the academic year 2016/2017 to Alternanza ScuolaLavoro (Work related learning) courses at the Arpacal Departments as well as students from the Mediterranean University of Reggio Calabria and the University of Calabria. The activities carried by the project addressed in particular the topic of resilience of the territory as preparedness and response to the phenomenon of climate change. At the Multirischi Functional Center, students were able to know the methodologies and tools used to systematically detect, the magnitudes related to the Earth's climate, on the regional territory. Experts from the Agency's Air Theme carried out a set of initiatives to learn about the methodologies used to carry out climate monitoring and controls .	
ARPA Sicilia, Reg. Sicily Regional Administration, Schools, Associations ad	**Project "Climaticamente"** (funded by MATTM)	In the framework of the project, two training courses have been organized for high Schools teachers, each of 2 days in full immersion, on topics related to climate	

Organisation / Promoter /	Name of the activity and duration	Short Description	Indicators / Numbers
Educational Farms	**2016** http://www.arpa.sicilia.it/educazione/climaticamenteeorientamentoallebuonepratiche/	change and desertification using biodiversity, education, sustainability, forestry, intensive and ecosustainable farming. The courses were carried out in Palermo and in Messina Province. Teaching materials and a video camera were provided to the schools that joined the project. Bilingual flyers on desertification were printed.	
APPA Bolzano Department of Land Development, Environment and Energy, Energy Savings Office	**"Incentives in the energy efficiency and use of renewable energy",** 6 October 2017	The Energy Savings Office collaborated to develop a vocational training addressed to architects and engineers on energy optimization and in particular on energysaving buildings. http://arch.bz.it/it/archacademy/programma/.it	Number of participants: 200
APPA Trento	**"prepAir there is air for you "** **Life Project** April 2017 to September 2020 http://www.appa.provincia.tn.it/Prepair/ http://www.lifeprepair.eu/	The LIFE PREPAIR project has the goal to carry out coordinated and integrated actions to improve air quality in the territory that includes the entire Padana Basin (from the Alpine Arc to the Padana Plain) and Slovenia. The efforts to reduce atmospheric pollutants emissions concern agriculture, biomass wood combustion, energy efficiency and freight and passenger transport. The project includes capacity building actions, also those aimed to design, test and implement training courses to raise awareness and strengthen knowledge of the school system teachers and students on the issues of air quality.	
Lombardy School Office – Arpa Lombardia	**Time and climate** 2016	Training course on the topic of Lombardy Alpine Climatology and Meteorology, addressed to Secondary School Teachers	3 schools involved
Arpa Piemonte Scientific high school	**Didactic path to climate change and hydrogeological risk** January May 2017	Training activities at scientific high school "Gobetti" in Turin: classroom and field training were held on the topics of permafrost, snow science, landslides monitoring	3 classes involved
Rete Clima® Clima Network (Information and action for sustainability and the fight against climate change)	**Environmental education and Environmental training on climate.** 2011 ongoing http://www.reteclima.it/educazioneeformazioneambientaleclimatica/	Climate Network (Rete Clima ®) is a nonprofit organization, founded in 2011 as a technical network for the promotion of sustainability and climate change awareness at the local scale. The network organized a series of training courses for adult (in the Company or for citizenship) including: • motivational activities for the "corporate green behaviour" and the "green team building"; • training on practices and actions for energy saving in the Company; • specific training on working behaviour climate and environmental friendly; • design and delivery of "green days" and environmental events for businesses, municipalities, associations with zero emissions; • information and awareness evenings for citizenship • training on practices and actions for energy efficiency at home, in the Company, in the City.	

Organisation / Promoter /	Name of the activity and duration	Short Description	Indicators / Numbers
Italian Climate Network in cooperation with WWF Italy	**Italian Think Tank on Intergenerational Equity** 20142015 http://www.italiaclima.org/attivita/equitaintergenerazionaleilthinktank/	The Italian Youth Think Tank on Intergenerational Equity was an initiative aimed at drafting a policy proposal for the implementation of the intergenerational equity principle within the new global climate change agreement. Under the supervision of a scientific committee, a number of young representatives from Italian youth organizations contributed to the final document, named "**Italian Youth Declaration on Intergenerational Equity**". The Declaration was finalized ahead of Lima COP20 and submitted to the Italian Minister of the Environment. At COP21 in 2015, also thanks to the support of the Italian Minister of the Environment, the principle of the **Intergenerational Equity** was included into the preamble of the Paris Agreement. **Link to the Declaration.**	
EuroMediterranean Center on Climate Change Foundation	**OTTIMA – Operational oceanography and information technologies for maritime security** Project funded by PON – Programma Operativo Nazionale "Ricerca e Competitività" 20072013 (EU – Fondo europeo di sviluppo regionale / MIUR – Ministero Italiano dell'Università e della Ricerca / MSE – Ministero dello Sviluppo Economico). 20122015 http://www.cmcc.it/ottima/content/benvenutiottima	**OTTIMA** (Operational oceanography and information technologies for maritime security) is a training project that, in range of the technological innovation TESSA project, has the purpose to predispose and supply a training course that allows students to learn competences of the methodologicaloperative aspects of the basic sciences, the operational oceanography, the technology and the engineering applied to oceans and seas. These skills, that are not acquirable through the present training courses available in Italy, are interesting for many industrial sectors (maritime transport, tourism, maritime security, etc.) that are going to have, in the next future, a high development potential. OTTIMA includes two training courses: Objective 1 – Course of "Operational oceanography and security" The students acquire knowledge of the methods, techniques and devices of the operative systems and the fundamental infrastructures for the operational oceanographic and coastal research, the monitoring, the protection and the exploitation of the sea resources and the maritime security. Objective 2 – Course of "Information technologies and security" The students deepen knowledge and acquire competences of the information techniques in the field of the data analysis of marine environments, operational oceanography, both from observable systems and models and of the support systems for the decisions of maritime security, maritime environment protection and sustainable exploitation of its resources.	

9.5 International cooperation

As described in previous chapters, namely in chapter 7 related to Financial resources and transfer of technology, Italy is undertaking continuous efforts to scaleup its international climate finance and the Italian Development Cooperation has undergone an important legislative reform leading to a new institutional framework designed to make it more effective as well as cooperation policies more consistent. Being capacity building and training in general considered by Italy as a priority to enhance institutional capacity in developing countries partners, these activities are mainly already integrated in every bilateral and multilateral cooperation projects and thus described, when relevant, under chapter 7.

With specific reference to international cooperation activities strictly related to Education, Training and Public Awareness there are nevertheless some bilateral projects worth highlighting.

Among those, to support the implementation of Morocco's commitments on Climate Change as expressed in its National Determined Contribution (NDC) published in September 2016 and the National Strategy for Sustainable Development, adopted on 25 June 2017 by the Council of Ministers, the Italian Ministry for the Environment, land and Sea, is collaborating to an integrated program of education on the environment and sustainable development in schools in partnership with the local Ministry of National Education, in order to reinforce the students awareness. Specific objectives of this project include: establishing model schools for sustainable development integrating the concepts and bases of sustainable development; promote environmental education and sustainable development; building capacity in environmental education for environmental club leaders in schools and developing partnerships at national or international level (Mediterranean Basin, for example) to strengthen the exchange of experiences and knowhow in environmental education and sustainable development

In **Asia**, in the framework of the longstanding cooperation between IMELS and the numerous Chinese institutions, is taking shape a new knowledge approach on the base of the previous experience and in the light of the new political and economic role of China within the international community. The signing of a **Joint Declaration on the relaunch of the Sustainable Development and Environmental Partnership** with the Chinese Ministry of Environmental Protection is the result of a strengthened cooperation on a new basis, with the contribution of private investments and greater involvement of companies, in particular in the development and exchange of experiences and best practices in the field of innovative and lowcarbon technologies.

In the timeframe between 2013 and 2016, a wide training program, described below, was strictly related to climate change activities and has been identified in terms of the objectives and programs established in the United Nations Convention on Climate Change; other projects developed under the Sino Italian Cooperation Program for Environmental Protection (SICP) can also be considered useful to create enabling environment for mitigation and adaptation measures, but will not be detailed in this document.

The “Advanced training program on environmental management and sustainable development” was carried out since 2003. IMELS has been promoting an Advanced Training Program on the various issues of environmental management and sustainable development, targeted at technicians, academics, young professionals and decisionmakers in Chinese administrations, universities and enterprises; an important aim of the training program was the capacity building about potential climate change mitigation and adaption actions. Since 2003 more than 150 Italian companies were visited during about 600 study visits. Over 350 public and private institutions were involved, with a total of about 1000 speakers.

Under the agreement on Beijing Clean Air Action Cooperation between IMELS and the People's Government of Beijing Municipality, signed in 2013, an important capacity building project was developed between 2014 and 2015, allocated on SIEC_SUB fund. It is the “Capacity Building for Management and Control of Air Pollution Sources”. The objective of this project was to continue to strengthen the capabilities of Beijing EPB in the management and control of air pollution sources by sharing experience in emissions assessment and authorization procedures, pilot research activity on emission sources, calculation of emissions and pilot case assessment; regulatory and authorization procedures for polluting industries on the basis of European experience.

Organisation / Promoter	Name of the activity	Short Description	Indicators / Numbers
Italian Ministry for the Environment, Land and Sea People's Republic of China	**SinoItalian Cooperation Program for Environmental Protection (SICP) (2011ongoing)**	The cooperation Program between China and Italy, especially dedicated to Climate Change, has been launched on March 2011 with the aims to start a joint program of activities addressing mitigation and adaptation to climate change, transfer and promotion of lowcarbon technologies, studies and researches as scientific support to decisionmaking. The cooperation program includes activities for training and capacity building Program on Climate Change and Sustainable Development. The training aims at providing Chinese participants with theoretical instruments and practical cases on Italian and European experiences in the field of environmental protection and climate change. The Chinese Institutions involved are: Ministry of Science and Technology (MoST), Chinese Academy of Social Sciences (CASS), Ministry for Environmental Protection (MEP), Beijing Metropolitan Environmental Protection Bureau (BMEPB), Shanghai Environmental Protection Bureau (SEPB), Tianjin Science & Technology Commission (TSTC) e la National Development and Reform commission (NDRC), and from 2013 the Ministry for Industry and Information Technology (MIIT).	
Agriconsulting SpA CMCC EuroMediterranean Center on Climate Change Foundation Centre for Advanced Mediterranean Agronomic Studies	**Clima South: support to climate change mitigation and adaptation in the ENPI South region** 20132018 EuropeAid http://www.climasouth.eu/	The project seeks to enhance regional cooperation between the EU and its southern Mediterranean neighbours and among the partner countries themselves (South–South) on climate change mitigation and adaptation, mainly through capacity development and information sharing. The overarching goal is to support the transition of ENP South countries towards low carbon development and climate resilience. Activities include:	

(CIHEAM) of Bari.		• Organisation of regional trainings and meetings on mitigation (e.g. monitoring, reporting and verification (MRV) at national and sector level, including the establishment of national greenhouse gas inventories) and about adaptation (data management, vulnerability assessments, national adaptation strategies and plans); • Fostering EUSouth and SouthSouth peertopeer cooperation by bringing together experts, including academia and civil society, on climate change mitigation and adaptation issues; • Organisation of workshops, trainings and study visits involving the main stakeholders in climate change policy development and implementation; • Creation of a website in Arabic, English and French, as a platform for accessing and sharing information; • Production of targeted climate change material in Arabic, English and French; • Setting up of a flexible expert facility to respond to information and training needs expressed by partner countries' authorities. The project is implemented by Agriconsulting SpA, an Italian Private Consulting Company, as leader of a Consortium of 7 Institutions, five Italian, one Belgian and one Spanish, among which the CMCC and the Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) of Bari.	
CMCC EuroMediterranean Centre on Climate Change Foundation Puglia Region Serbian Hydrometeorological Service	**OrientGate** **A network for the integration of climate knowledge into policy and planning** **SEE (South Eastern Europe Program)** 2012 2014 www.orientgateproject.org	The OrientGate project aimed to implement concerted and coordinated climate adaptation actions across South Eastern Europe (SEE). The partnership comprised 19 financing partners, 11 associates and three observers, covering 13 countries, and the role of the partners can be grouped into three main categories: • National hydrometeorological services, responsible for monitoring climate variability and risk. • Territorial development policy organisations, responsible for translating climate variability and climate risk assessment information into territorial development planning instruments. • Scientific institutions.	

		The core output to be developed by OrientGate is a set of web tools, designed to provide access to data and metadata from climate observations and simulations that will be available through a data platform connected to the European Climate Adaptation Platform. Other project outputs will include six pilot studies of specific climate adaptation exercises developed by the project's three thematic centres (Forest and Agriculture, Drought, Water and Coasts, and Urban Adaptation and Health); capacitybuilding seminars and workshops; and a working partnership among the hydrometeorological services of SEE countries.	
Italian Ministry for the Environment, Land and Sea Variuos Chinese Institutions (China)	**Advanced training program on environmental management and sustainable development** **(China)** From 2003 and ongoing	Since 2003 more than 150 Italian companies were visited during about 600 study visits. Over 350 public and private institutions were involved, with a total of about 1000 speakers. Between 2013 and 2016, over 2,000 participants from all the provinces of China took part in the training program, with a total of 45 courses (in Italy and China).	over 2,000 participants between 2013 and 2016 to training programs 45 courses held in Italy and China
Italian Ministry for the Environment, Land and Sea People's Government of Beijing Municipality (China)	**"Capacity Building for Management and Control of Air Pollution Sources"** **(China)** **2014 2015**	The objective of this project was to continue to strengthen the capabilities of Beijing EPB in the management and control of air pollution sources by sharing experience in emissions assessment and authorization procedures, pilot research activity on emission sources, calculation of emissions and pilot case assessment; regulatory and authorization procedures for polluting industries on the basis of European experience.	
Italian Development Cooperation of the Ministry of Foreign Affairs,	**Climate Change and Mountain Forests The Mountain Partnership and the Global Island Partnership join hands in Latin America and the Pacific"** **(20142017)**	The project builds upon the outcomes of a side event organized in 2012 in Brazil by the Mountain Partnership (MP) at the UN Conference on Sustainable Development (Rio+20) in collaboration with the Global Island Partnership and with the financial support of the Italian Development Cooperation of the Ministry of Foreign Affairs, a core founder and active partner of both alliances. The project aims to promote sustainable management of mountain ecosystems in key tropical mountain regions by supporting the implementation of the Mountain Products Programme (MPP) of the Mountain Partnership Secretariat, as well as FAO's	

		activities aimed at Reducing Emissions from Deforestation and forest Degradation (REDD+). The actions undertaken in the context of REDD+ and MPP programs focus on the development of technical and institutional capacity, support the creation of instruments of forest monitoring and support to local communities regarding sustainable business activities in the agroforestry.	
Italian Development Cooperation of the Ministry of Foreign Affairs (Italian Provinces of Agrigento, Caltanissetta, Ragusa, Siracusa, Trapani in Sicily) Tunisian Regions of Ariana, Beja, Ben Arous,Bizerte, Jendouba and Nabeul)	**ItalyTunisia SeaCrossing Programme CrossBorder Cooperation(CBC)** **European Neighborhood Instrument (ENI)** **20142020**	Under the ENI, support for CBC on the EU's external border continue to draw on funds from both the external and internal headings of the EU budget, for the pursuit of CBC activities serving both sides of the EU's external border. The ItalyTunisia SeaCrossing Programme is part of the ENICBC EU Programme and one of the 3 Thematic Objectives is the OT3 "Environmental protection and adaptation to climate change" within which there are two types of Priority Actions : 1. Joint actions for environmental protection 2. Conservation and sustainable use of natural resources	
Italian Ministry for the Environment, Land and Sea (IMELS) Tunisian Ministry of Energy, Mines and Renewable Energy	**Technical Agreement on Climate Change cooperation,** Starting date : 9 February 2017 Amount of founding: 2 MEURO http://www.minambiente.it/pagina/tunisia	The Work Plan of activities among Parties signed on February 2017 includes: • the promotion of renewable energy and energy efficiency; • the implementation, monitoring and communication of NDC (Nationally Determined Contributions); • integrated coastal zone management; • Sustainable waste management Bilateral activities in Tunisia are supported by MEDREC (the Mediterranean Renewable Energy Center), established in 2004 in Tunis by IMELS.	
Italian Ministry for the Environment, Land and Sea (IMELS) Tunisian Ministry of Energy, Mines and Renewable Energy	**MED DESIRE (MEDiterranean DEvelopment of Support schemes for solar Initiatives and Renewable Energies**) (20132015)	MEDDESIRE main priority is to remove barriers related to the legal, regulatory, economic and organizational framework of distributed solar energy technologies. Cofunded by the European Union through the ENPI CBC MED Programme 20072013 for an amount of 4.192.000 Euro, the project aims at spreading energy efficiency, and in particular, solar energy across the Mediterranean area through the definition of innovative financial schemes and market stimulation tools. The	

		project will facilitate the take up of distributed solar energy and energy efficiency in the target regions, by achieving an effective crossborder cooperation and by raising public awareness on the related benefits for the environment and for sustainable local development. MEDDESIRE is implemented by a consortium of nine partners from five countries (Egypt, Italy, Lebanon, Spain and Tunisia), leaded by Puglia Region – Economic Development Regional Ministry Industrial Research and Innovation Department.	
Italian Ministry for the Environment, Land and Sea	**MEDREC Mediterranean Renewable Energy Centre** Established in 2004	The MEDREC, based in Tunis, was launched in 2004 by the Italian Ministry of Environment and Territory (IMELS) in collaboration with the National Agency of Energy Conservation (ANME) . It involves international and governmental Institutions of Algeria, Egypt, Libya, Morocco, and Tunisia. MEDREC is a regional centre and a donorfunded project within the ANME, through funding from the IMELS. In 2014 the Centre in collaboration with UNEP promoted initiatives of capacity building, training and information as well as programs to support renewable technologies markets: PROSOL Industrial: Solar Water Heating for Industrial Processes: in order to promote the development of solar thermal systems in the industrial sector. In this framework, a workshop was held during the Energy Solutions World Sustainable Energies Forum (Enersol WSEF) gathering the global sustainable energy community in Tunis during which two studies were presented as proposal for a new support scheme for solar thermal technology in industrial sector in Tunisia, and a demonstration project to reduce greenhouse gases emissions, developed with the financial support of IMELS and BENETTON Group.	
EuroMediterranean Center on Climate Change Foundation Italian Ministry of Education University and Research (MIUR) National Council of Researches Dept. Earth system science and environmental technologies	**ERA4CS – European Research Area for Climate Services** **(H2020)** 20162020 http://www.jpiclimate.eu/ERA4CS http://www.jpiclimate.eu/nl/25223454DustClim.html	The ERANET Consortium “European Research Area for Climate Services”, socalled ERA4CS, has been designed to boost the development of efficient Climate Services in Europe, by supporting research for developing better tools, methods and standards on how to produce, transfer, communicate and use reliable climate information to cope with current and future climate variability. ERA4CS will complement other funding programmes and activities	

(CNRDTA) Agence Nationale de la Recherche (ANR) France		on climate services research at European level (such as e.g. H2020, Copernicus and KIC Climate) and at the international level (such as GFCS, Future Earth and Belmont Forum). It will focus its efforts on planning, implementing and monitoring a joint transnational call **between Members States and Associated Countries,** increasing their scope through topup funding from the EC. The ERA4CS Joint Call in 2016 funded the project with CNR DTA as partner: • Dust Storms Assessment for the development of useroriented Climate Services in Northern Africa, Middle East and Europe	
P.A.N.G.E.A. Cooperative Company (IT) In consortium with **ISPRA (IT)** GHGMI —Greenhouse GasManagement Institute Luxembourg (LU) **INEA — National Institute of Agricultural Economics (IT)** LDK Consultants, Engineers and Planners S.A. (GR) and Escarus — Sürdürülebilir Danışmanlık A.Ş. (TR).	**Turkey Ankara: IPA — Technical assistance for support to mechanism for monitoring Turkey's greenhouse gas emissions** **20152017**	The purpose of the project is to provide the essential elements for the establishment of a fully functioning monitoring mechanism of greenhouse gas emissions in **Turkey**, in line with the EU Monitoring Mechanism Decision 280/2004/EC, while taking into account relevant and likely aspects of the expected revision of the Decision. Technical assistance activities was provided on: i) assessment and improvement of the legal and institutional situation and the identification of the steps needed; ii) capacity building aimed at improving the quality of the national inventory reports; iii) improvement of the technical capacity for preparing the elements of the national communications.	

9.6 Monitoring, review and evaluation of the implementation of Article 6 of the Convention

Since COP 20, in Lima, in December 2014, adopted the 'Lima Ministerial Declaration on Education and Awarenessraising', reaffirming the importance of **Article 6 of the UNFCCC** in meeting its ultimate objective and in promoting climate resilient sustainable development, and in 2015 at COP 21 (Paris) governments agreed to cooperate in taking measures, as appropriate, to enhance climate changerelated education, training, public awareness, public participation and public access to information, recognizing the importance of these steps to enhance actions under the Paris Agreement, the Italian **Ministry for the Environment, Land and Sea, appointed its national focal points on Action for Climate Empowerment (ACE)** activities and renewed its efforts to enhance the development and implementation of educational and public awareness programs, as well as to train scientific, technical and managerial personnel, foster access to information, and promote public participation in addressing

climate change and its effects, exchanging good practices and lessons learned, and strengthening national institutions. This wide scope of activities is guided by specific objectives that, together, are seen as crucial for effectively implementing climate adaptation and mitigation actions, and for achieving the ultimate objective of the UNFCCC.

The **ACE national focal points** are active within the climate change negotiation activities and attended all the meetings and seminars organized in the last years on Action for Climate Empowerment by the UNFCCC secretariat.

A permanent section was created on the Italian Ministry for the Environment, Land and Sea's web site, dedicated to environmental education and sustainable development, in order to provide a platform for sharing and disseminating initiatives and best practices. The guidelines on environmental education and the "Chart on Environmental education and sustainable Development" produced in collaboration with the Ministry of Education have also been uploaded to the web site and are available for consultation and download.

To advance enhancing the implementation of the Doha Work program and toward the definition of a national strategy on Action for Climate Empowerment, the collaboration between the Ministry for the Environment, Land and Sea and the Ministry of Education was strengthened in 2016, with the signing of a Memorandum of Understanding on environmental education and sustainable development in schools under the PON (National Operative Plan) School 20142020.

Organisation / Promoter	Name of the activity	Short Description
Italian Ministry for the Environment, Land and Sea	Action for Climate Empowerment (ACE) **Appointment of Italian National Focal Points** 2016	2 national focal points on ACE activities were appointed by the Italian ministry for the Environment; Land and Sea in order to ensure participation to the negotiation process on these matters and identification of areas for possible international cooperation and opportunities for strengthening synergies with other conventions
Italian Ministry for the Environment, Land and Sea	**Web page dedicated to environmental education within the Ministry's official web site** 2016 http://www.minambiente.it/pagina/educazioneambientaleeallosviluppposostenibile	A permanent section was created by the Italian Ministry for the Environment, Land and Sea's web site, dedicated to environmental education and sustainable development, in order to provide a platform for sharing and disseminating initiatives and best practices.
P.A.N.G.E.A. Cooperative Company (IT) In consortium with **ISPRA (IT)** GHGMI (LU) **INEA (IT)** LDK (GR)	**Turkey Ankara: IPA — Technical assistance for support to mechanism for monitoring Turkey's greenhouse gas emissions** **20152017**	The purpose of the project is to provide the essential elements for the establishment of a fully functioning monitoring mechanism of greenhouse gas emissions in **Turkey.** Technical assistance activities provided included also capacity building aimed at improving the quality of the national inventory reports; and the technical capacity for preparing the elements of the national communications.

Escarus (TR).		