ITALIAN MINISTRY OF ENVIRONMENT AND ENERGY SECURITY

Italy

Eighth National Communication

under the United Nations Framework Convention on Climate Change








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Summary

Foreword

I am pleased to present the Italian Eighth National Communication under the United Nations Framework Convention on Climate Change that includes data and information on the compliance of Italy's objective under the second Kyoto Period (2013-2020).

The year 2020 was an important year of verification because it closed the second commitment period of the Kyoto Protocol and its Doha amendment, and the data, as presented in this communication, clearly show that Italy has reached its Doha commitments.

Policies and measures in all sectors described in the Communication are in fact consistent with the commitments taken under the Kyoto Protocol and its amendment, the European Climate and Energy Package for the period 2013-2020, the EU NDC, the European 2030 Climate and Energy Framework and Clean energy for all Europeans package for the period 2021-2030.

It is important to mention that Italy is continuing to adopt policies and measures with a post-2020 horizon. In this context one of the most important tools is represented by the "Recovery and Resilience Plan" (NRRP) adopted on July 2021. This Plan includes both important measures to tackle climate change aimed at an inclusive, climate resilient and a net-zero emissions future and purse sustainable, virtuous economic growth . It envisages investments and a consistent reform package for repairing the economic and social damage caused by the pandemic crisis, contributing to addressing the structural weaknesses of the Italian economy, and leading the country along a path of ecological, environmental and just transition.

In October 2022, the Italian Ministry of Environment and Energy Security, in collaboration with ISPRA, has published the National Adaptation Platform to foster the exchange of information between the Central Administration, Local Authorities and all stakeholders on the issue of climate change adaptation. The Platform, in particular, aims to facilitate access to and sharing of data and information on observed and future climate changes impacts and vulnerabilities of regions, natural systems, socio-economic sectors, institutional levels working on the issue, adaptation strategies and plans at different administrative levels and possible adaptation actions.

Furthermore, 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.

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 2017-2020 increased substantially compared to the levels of previous years, while improving the quality and transparency of our reporting.

In terms of bilateral cooperation, the geographic range of MASE's cooperation was doubled between 2017 and 2019. As many new bilateral Memoranda of Understanding (MoUs) were signed with developing countries and the number of MoUs in force reached 52.

Most significantly, in 2021 the Italian Climate Fund has been established with the purpose to finance interventions in favour of mitigation and adaptation action in countries that are recipients of official development assistance identified by the Development Assistance Committee of the Organization for Economic Cooperation and Development (OECD-DAC). The Fund is endowed

with 840 million euros per year for each of the years 2022 to 2026, and aims at mobilizing 1.4 billion per year for 5 years in climate finance to developing countries. Therefore, the Italian Climate Fund will be a significant national public instrument for contributing to the achievement of Italy's commitments on climate finance in favour of developing countries

Italy remains fully committed to the long term temperature goal set out by 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.

Alessandro Modiano

Director General for European and International activities

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 of Environment and Energy Security (MASE) is 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. Besides, since 2011, the MASE, in consultation with other relevant ministries, is responsible for preparing a report on the status of implementation of GHG emission reduction commitments and emission trends and projections. The report is annexed to the Economic and Financial Document (DEF), approved annually by the Government.

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. Furthermore, with the Decree Law 22/2021, at the Presidency of the Council of Ministers, the Inter-Ministerial Committee for Ecological Transition (CITE) has been established. The CITE has the task of approving the Plan for the Ecological Transition, to coordinate policies on the reduction of climate-changing gas emissions, sustainable mobility, hydrogeological instability and soil consumption, water resources and related infrastructures, air quality and circular economy. The Plan for the Ecological Transition (Pte) has been approved with CITE Resolution No. 1 of 8 March 2022.

Demographic and social trends of countries are generally considered among the main driving forces for the emissions trends. During the years 1991-2014 the national population increased, according to the national surveys, due to the migratory movements. From 2014 it steadily decreased and at first of January 2022 it was 58,983 million. The decrease of births, started about thirty years ago, together with the most recent contraction in the migration balance are the main causes of the demographic trend. In the two pandemic years (2020 and 2021), the population decline was mainly due to the strongly negative natural balance: in 2021 births will felt below 400,000, the lowest since the unification of Italy, while deaths were dramatically high during the pandemic period. The aging trend of population has been increasing over the years because of a low birth rate and a continuous growth of the elders. In 2021, the median age of the Italian population was 47.6 years, the highest amongst the Member States. As of 1st January 2022, there were 188 people aged 65 and over for every 100 people under 15 and the population is expected to age further in the years to come, peaking at 306 in 2059. The fertility rate (number of children per woman) at first January 2022 was 1.25, in slight recovery compared to the 2021 but down compared to 2011 when it was 1.42. The family size has been decreasing and the number of households living in dwellings equipped with air-conditioning systems increased considerably in the last 2 decades, from 10.7% in 2001 to 48.6% in 2021. The share of families living in dwellings with a washing machine and a dishwasher also increased. These factors contribute to the consumptions and emissions. As of 31 December 2019, 50.7 per cent of the resident population made daily journeys to their place of study or work, it was 48.6 per cent in 2011. The pandemic caused a drastic drop in all types of travel due to the containment measures taken including the use of smart working. In March-April 2020, with the Covid pandemic restrictions in place, 19.8 % of staff in companies with at least 3 employees were working remotely, compared to 3.7 % in January of that year. In 2021, with the pandemic came back under control, smart working continued to be widely used and remained at more than double the level in early 2020. Therefore, it looks like a structural change destined to last.

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. As far as temperature is concerned, year 2021 was the fourteenth Italian warmest year since 1961, summer was the sixth hottest while the spring was the coldest since 2005. Heat waves occurred in Italy during the summer months. Concerning the precipitations, the 2021 ranks 24th least rainy year in the entire series since 1961 with winter the rainy season than the norm while the other seasons were drier on average.

Italy was the world's eighth world largest economy and the fourth largest economy among the EU countries

in 2021. A global financial and economic crisis hit advanced economies thus resulting into severe recession in many countries including Italy from 2007-2009. Between 2010 and 2012, Italy has moved into recession again, and in the following years the national economy has been showing a moderate recovery until 2017. In the year 2020 due to the Covid pandemic and the implementation of severe measures of social containment and restriction of production activities, Italian GDP felt by 9%. The fall in GDP was mainly driven by the collapse in domestic demand, particularly consumption. In 2021, with pandemic under control, a recovery of GDP was recorded (+6.7% over 2020). Between mid-2020 and the beginning of 2022, the Italian economy fully recovered from the fall in GDP due to the COVID-but during the first half of 2022 with the worsening of the international picture, growth weakened greatly in our country just as in the European Union. The driving sector of the national economy is still the service sector (72.9 % of GVA in 2021); the industry-related activities accounted for 22.8% of GVA in 1995, it remained in the range of 18.8-19.9% from 2010 to 2021; agriculture accounted for 2.0% of GVA in 2021 while construction was 5.12%. The imports of goods and services showed an increasing trend from 1996 to 2007, and then a fluctuating trend was recorded. In 2018 and 2019 imports of goods and services increased while in 2020, due to the economic crisis, there was a 12% decrease compared to 2019, followed by a growth (+ 14.7%) in 2021. From 1995 to 2007 the exports of goods and services increased by 50.6%. In 2020 exports decreased by 13.5% compared to 2019 and in 2021 a recovery in exports (+13.4% compared to the 2020) occurred, but the market had not returned to pre-pandemic levels. The balance exports - imports was always positive over the years 1995-2021 except for the period from 2003-2006 and from 2009-2011.

In 2020 the unemployment rate in Italy was 9.3%, higher that EU27 value (7.2%) and in 2021 while EU27 registered a decreased, with the rate equals to 7.0%, in Italy it was 9.5%, higher than the previous year.

Italian energy asset is essentially dependent by import. The energy dependence of Italy from abroad is high compared with the EU27 average (73.5% in 2020 in Italy; 57.5% in 2015 in EU) although the dependence for Italy has been decreasing since 2000. Compared with others European countries, Italy's energy primary consumption is characterized by a major share of natural gas, a lower coal share, a structural electricity imports, and the absence of nuclear power. The share of renewable energy (which increased from 4.4% in 1990 to 20.7% in 2020) in Italy's energy supply mix is higher than the EU27 average. In 2020 the final energy consumption in the end users was about 103.1 Mtoe, the lowest value since 1990, due to the measures, such as economy lockdown, implemented to stop the diffusion of SARS-CoV-2 pandemic. In 2020, 45.8% of the energy end-uses total consumption was related to the civil sector (households, commercial and public services), 28.1% to the transports sector and 23.2% to the industrial sector. Concerning the power sector, 41.7% of the production was provided by renewable resources in 2020. The weight of renewable resources has kept growing in the latest years.

As for passenger transportation, among the EU countries Italy has the second highest motorisation rate (670 cars per 1,000 inhabitants in 2020). Mobility demand and, particularly, road transportation shares have increased in the period from 1990. The number of vehicles for road transportation has kept growing steadily over the last three decades (1990-2020), and the circulating passenger car fleet has been gradually aging. The energy demand in the transportation sector has increased in the period 1990-2019 by 7.1%, in the last year the decrease, basically due to the pandemic, was about -18.4%, with a resulting decrease from 1990 to 2020 equal to -12.6%. Transport sector keeps depending almost completely on oil (+291.8%, of from 1990 to 2020 diesel vehicles), LPG vehicles increased by 189.4% and CNG vehicles increased by 315.9%. 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 three decades (2020 emissions level is lower than in 1990).

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 population have occurred since 1982. The total agricultural area, the utilized agricultural area and the number of agricultural holdings has 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 from 1990, changes in the land use have resulted in the increase of the area included under the forest land category (26%), settlements (41%) and wetlands (15%), and a reduction of the cropland area (17%) and grassland area (10%). Italian land surface belonging to "Forest" category was about 7,590 kha of our national land surface in 1990 and 9,578 kha in 2020, equivalent to 32% of our national land surface. 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. In 2020, forested areas affected by fires amount to approximately 45% of the total land surface burned by fire in the same year.

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 29-30 Mt since 2019. Changes in lifestyle 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 and Covid-19 pandemic has contributed too. In 2020, approximately 28.9 Mt of municipal waste were produced, corresponding to 488.6 kg/year per person (EU27 average per capita MSW production was about 502 kg/year in 2019). The production of special waste by manufacturing industries had been increasing since 1990; it accounted for about 33 Mt in 2000, 39.4 Mt in 2010 and it decreased to 26.6 Mt in 2020. Separate collection has been increasing since 1996. In Italy, the number of landfills has been decreasing since 1999: a reduction of 659 landfill installations was registered in 2020. 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 production of special waste has been increasing since 1990, reaching 146.9 Mt in 2020; 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.

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 26.7% between 1990 and 2020, varying from 520 to 381 CO_2 equivalent million tons (Mt).

The most important greenhouse gas, CO_2, which accounts for 79.3% of total emissions in CO_2 equivalent, shows a decrease by 31.2% between 1990 and 2020. In the energy sector, in particular, CO_2 emissions in 2020 are 29.6% lower than in 1990.

CH_4 and N_2O emissions are equal to 11.2% and 5.1% of the total CO_2 equivalent greenhouse gas emissions, respectively. CH_4 emissions have decreased by 13.4% from 1990 to 2020, while N_2O has decreased by 28.4%.

As for other greenhouse gases, HFCs account for 4.2% of total emissions, PFCs and SF_6 are equal to 0.2% and 0.1% of total emissions, respectively; the weight of NF_3 is about 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 2020, of 78.4%. Emissions from this sector have decreased by 29.7% from 1990 to 2020; in particular, an upward trend is noted from 1990 to 2004 (+14.5%) in total greenhouse gas emissions in CO_2 equivalent excluding LULUCF, whereas a reduction by 38.7% between 2005 and 2020 is observed. From 2005, 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 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 8.1% of total national GHG emissions, excluding LULUCF. Total emission levels, in CO_2 equivalent, reduced by 23.2% from 1990 to 2020.

The decrease is prevalently to be attributed to the drop of emissions in the mineral and chemical industries, explaining 68.2% and 13.3%, respectively, of the sectoral total. Emissions from mineral production

decreased by 52.8%, mostly for the reduction of cement production whereas the reduction in chemical industries (-81.9%) 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 8.6% to total greenhouse gases, excluding the LULUCF sector. Emissions mostly refer to methane and nitrous oxide levels, which account for 59.0% and 39.5% of total emissions of the sector, respectively. The decrease observed from 1990 to 2020 (-11.4%) is due to the decrease of CH_4 emissions from enteric fermentation (-13.0%) and N_2O from agricultural soils (-3.9%), which account for 41.4% and 33.1% 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 4.9% of total national greenhouse gas emissions, excluding LULUCF. Emissions show an increase of 7.7% from 1990 to 2020 mainly driven by the emissions from solid waste disposal which increased by 16.8% and account for 76.6% 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 that 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 of Environment and Energy Security 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 2018" (ISPRA, 2018), publicly available at http://emissioni.sina.isprambiente.it/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://emissioni.sina.isprambiente.it/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 and its amendment (Doha amendment);
- the European Climate and Energy Package for the period 2013-2020;
- the EU NDC, the European 2030 Climate and Energy Framework and Clean energy for all Europeans package for the period 2021-2030.

On the 12th December 2015, UNFCCC Decision 1/CP.21 adopted the Paris 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). 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 2030 EU Climate and Energy Framework, defined in October 2014. In this framework, the European Union set the following binding targets to be reached by 2030:

- at least 40% reduction in GHG emissions compared to 1990 (compared to 2005 levels, -43%, for EU ETS sectors and -30% for ESD sectors);
- at least 27% of energy consumption from renewable sources;
- at least 27% of energy efficiency improvements[1].

In December 2019, the European Council endorsed the objective of making the EU climate-neutral by 2050, in line with the Paris Agreement. The long-term strategy has been submitted to the UNFCCC in March 2020. On this basis, in December 2020 the European Consilium updated the NDC by increasing its climate ambition, endorsed a binding EU target for a net domestic reduction of at least 55% in greenhouse gas emissions by 2030 compared to 1990. To reach that target the European Commission proposed a comprehensive and interconnected set of new directives and regulations, known as the "fit for 55%" package.

In November 2022, the Council and the European Parliament reached a provisional political agreement on stronger emission reduction targets for member states under the Effort Sharing Regulation. The provisional deal endorses an EU-level GHG reduction target of 40% compared to 2005, by 2030, for the sectors not covered by the EU-ETS. For Italy, the proposal increases the national reduction target to 43.7%.

The other policies in the "fit for 55%" package are still under discussion. Since the formal adoption is still pending, the Policies and Measures presented in this Chapter as well as the projections presented in Chapter 5 do not include the effect of the "fit for 55%" package.

The potential emissions reduction has been assessed up to 2030 at sectoral level. The policies and measures hereinafter described are divided into two types:

- Measures implemented by 31st December 2019;
- Measures planned.

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

The measures envisaged as planned are consistent with the ones reported in the National Energy and Climate plan. The impact assessment have not been calculated for policies and measures individually, but at sectoral level because of interaction between the mitigation actions. Some planned measures have been reported in more than one sector, anyway the effect assessed in terms of greenhouse gas emissions reduction is the one expected in the specific sector to avoid double counting. For each sector a table of mitigation actions is reported.

The total GHG reduction for the planned measures can be estimated as 62,900 kt CO_2eq at 2030.

1.4 Projections and Effects of Policies and Measures

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 and 33% by 2030. Targets up to 2020 have been achieved, while according to the WM scenario there is a sizeable distance from targets set to for the period 2021-2030. On November 8, 2022, the Council and the European Parliament reached an interim political agreement on stricter emission reduction targets for Member States under the Effort Sharing regulation. Pending formal adoption, the provisional agreement endorses an EU-wide GHG emission reduction target of 40% by 2030 compared to 2005 levels. For Italy, the target corresponds to a 43.7% reduction, to be achieved through a progressive annual reduction set by year-specific maximum allowances from 2021 to 2030. The new allowances have not been defined yet.

The scenario presented in this NC was elaborated in 2021 and projections include all PaMs implemented or adopted up to the end of 2019.

The projection data are reported by sector and by gas, with an explanation of trends. The effect on 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 2030, estimated according to Eurostat methodology, is expected to be about 138.7 Mtoe in 2030 with an average yearly decrease rate of -0.8% since 2015. After the further fall in 2020 and the rebound effect in 2025 the projected gross inland consumption shows constant decrease to 124.6 Mtoe up to 2050.

Sector by sector analysis for the period 2020 – 2050 shows that:

- a small emissions reduction in energy industries is projected (-2%) mainly due to power production; in this subcategory, 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 trend observed in the projected years is the result of increasing production offset by further increasing thermoelectric efficiency, renewable share, and fuel shift toward low carbon fuels as natural gas;
- the projected emissions from transport will decrease by 22% as results of implemented measures, notwithstanding the increasing transport demand;
- emissions from residential and commercial show a relevant decrease (-21.8%) 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 2005–2020 (-50.4% for energy emissions and 34.2% for industrial processes); 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, after 2020 industrial emissions show a decreasing trend with increasing GVA;
- emissions from waste sector show the highest rate of reduction among sectors (-48.7% in 2040 compared to 2020) mainly due to the decrease of waste disposal in landfills.

In order to test the robustness of the assumptions and to assess the variation in the results obtained as the input parameters changed, a sensitivity analysis was carried out for both the WM and WAM scenarios. To test the behavior of the system under different assumptions of economic development, therefore, it was chosen to produce alternative scenarios characterized by annual GDP growth rates with excess and shortfall of 0.5% per year compared to the projection used for WM and WAM scenarios. It was also deemed useful

to investigate the effects produced by different trends in the price of CO_2 emission allowances on the European ETS market through sensitivity analysis concerning this parameter, in addition to sensitivity to GDP.

Finally, an historical review of projections from different National Communications is reported.

1.5 Vulnerability assessment, climate change impacts and adaptation measures

Italy is located in an area identified as particularly vulnerable to climate change: as a matter of fact, the Mediterranean region is considered to be a hotspot of climate change impacts. 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.

Since 2015 the Ministry of the Environment has been working on the implementation of the National Adaptation Strategy (NAS) through the development of a National Adaptation Plan (NAP). The NAP is aimed at supporting national, regional and local institutions in the definition of adaptation measures, in relation to the critical issues that most characterize them and promoting a general coherence at national level. The NAP provide institutional guidance to national and local authorities, for the integration of adaptation measures within policy processes and spatial planning.

The Ministry of Environment and Energy Security (MASE), that is the institution in charge of climate policy, is currently working on revising draft NAP and preparing of environmental report in which the likely significant effects on the environement of implementing the Plan, and reasonable alternatives considering the objectives and the geographical scope of the Plan, are identified, described and evaluated. Moreover the Ministry started activities aimed at spreading informations at regional and local level and strengthening technical and administrative capacity. In June 2020, guidelines for Italian Regions and Municipalities were produced. At present, the activity is concerned with supporting regional and local governments in using the contents of the above-mentioned documents for the establishment of their adaptation strategies, plans and measures, in line with national planning.

In October 2022, the Ministry of Environment and Energy Security, in collaboration with ISPRA, has published the National Adaptation Platform, which intends to foster the exchange of information between the Central Administration, Local Authorities and all stakeholders on the issue of climate change adaptation. At the moment it represents the main information tool in Italy on this topic. The general purpose is to inform, raise awareness and make data and operational tools available to all citizens, to promote and support Local Authorities in decision-making and planning processes on the subject of adaptation to climate change, as well as to provide the information contained in the National Plan for Adaptation to Climate Change.

In June 2021, a funding Programme for urban adaptation was launched. This Programme is aimed at increasing the resilience of cities to the risks of climate change, in particular to heat waves, extreme rainfall and drought phenomena allocating around 80 million euro for the implementation of mainly green and blue actions, but also, to a lesser extent, grey actions.

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 and will continue to do so. Our public climate finance in the period 2017-2020 increased substantially compared to the levels of previous years (2013-2016), while improving the quality and transparency of our reporting.

Total climate finance for the period 2017-2020 amounts to more than 2 billion euro (2.108.831.654 euro, corresponding to 2.406.698.114 USD). This represents more than double (a 107% increase) the support provided and mobilized for climate action in non-Annex I countries from the 1.16 billion USD provided in the period 2013-2016.

In the provision of public financial resources, Italy aims to strike a fair balance between support to mitigation and adaptation activities in non-Annex I countries over time. The adaptation component in 2017-2020 stays stable at 53% of the total public climate specific support with respect to the previous reporting period 2013-2016 (considering cross-cutting activities equally allocated between the two objectives).

Italy classifies a significant share of its support provided to non-Annex I countries as cross-cutting: on average, the 74% of international climate finance is categorized as cross-cutting between 2017 and 2020. Italy considers as cross-cutting every activity addressing both mitigation and adaptation, as well as those activities in which mitigation and adaptation components are mainstreamed into projects in a range of sectors, especially agriculture.

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.

In terms of bilateral cooperation, the geographic range of MASE's cooperation was doubled between 2017 and 2019. 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), the Capacity Building Initiative for Transparency (CBIT) 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 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.

In December 2020 CIPE approved another PNR that covers the period 2021-2027. The 2021-2027 PNR is divided into system priorities, major areas of research and innovation and related areas of intervention, national plans and missions. The six major areas of research and innovation (and related areas of intervention) mirror the six clusters of Horizon Europe and take into consideration the areas of the National Smart Specialization Strategy as well.

Other programmes contribute to finance climate change research projects: the National Research

Programme in Antarctica (PNRA – Programma Nazionale di Ricerca in Antartide), the Arctic Research Program (PRA – Programma di Ricerche in Artico) 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.

Compared to the previous period a new element that has affected the policy framework on research in Italy is the approval of the National Resilence and Recovery Plan (PNRR). The PNRR is a package of investments and reforms that is part of Next Generation EU (NGEU), the instrument established at European level to respond to the pandemic crisis and transform the economies of the member states in view of the future challenges including the ecological transition. The Italian Plan envisages investments for 191.5 billion euros, financed through the Recovery and Resilience Facility (RRF).

In the field of climate prediction and simulation, through CMCC Foundation, Italy developed a new Earth System Model (CMCCESM) for seasonal–to–decadal (S2D) forecasting. CMCC has the responsibility of the CMES medium range operational ocean predictions for the Mediterranean and Black Sea regional basins. An outcome of this activity is the annual Ocean State Report where the ocean climate indicators are developed and monitored at high resolution from the global ocean to the European Seas. Moreover it is involved in a large number of international projects and activities concerning model development, design of new strategies and tools for evaluating global highresolution simulations at a process level.

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 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 ETC-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

Italy benefits from a long and valuable tradition of initiatives and programmes on Environmental Education for Sustainability (EES) and Education for Sustainable Development (ESD) at regional and local level. The

Italian Environmental and Sustainability Education context is very much varied and complex and includes a lot of public and private actors, mostly engaged in non-formal and formal education.

The most representative actors are central Institutions, in particular the Italian Ministry of Environment and Energy Security (MASE) and the Ministry of University and Research (MUR); Regions and Autonomous Provinces; National System for Environmental Protection (SNPA), composed by the Italian Institute for Environmental Protection and Research (ISPRA) and the Regional Environmental Agencies (ARPA/APPA); Regional Environmental Education Centres (CEA), deriving from the Information and Education National System (INFEA); Associations, Foundations, NGOs; Protected Areas, Parks, Museums; Schools and Universities.

With Law of 30 December 2018, no.145, the Italian legislator intervened, reshaping the minimum training hours provided for the various study fields and sanctioning the mandatory access to the high school exam as a fundamental part of the study plan, making greater leverage on the objective that these training courses contribute to develop the transversal skills (ref. Recommendation of the Council of the European Parliament of 22 May 2018) most requested in the world of work (so-called soft skills) and, finally, by changing their name to Pathways for transversal skills and guidance.

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.

Several communication campaigns aimed at spreading environmental education and information at large and disseminating European environmental policies were organized at national level by MASE.

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.

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 Ministry of Foreign Affairs and International Cooperation (MAECI) and MASE 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 MASE 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 of the Environment appointed its national focal points on Action for Climate Empowerment (ACE) activities.

At national level, the Italian Ministry of Environment organized several communication campaigns aimed at raising awareness spreading environmental education and information at large and disseminating European environmental policies.

The year 2021 represented a very important moment for the global action to address climate emergency with the international community called to review the climate targets. In 2021 Italy as co-organizer of COP

26, has hosted in Milan a ministerial preparatory event (28 September- 2 October 2021) together with an international and remarkable event dedicated to young people Youth4Climate.

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 MASE on its website.

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[2]

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 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 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. In 2021, with Decree Law 22/2021, converted with amendments into Law 55/2021 the competences and structures of certain ministries were reorganised and renamed Ministry of Ecological Transition (MITE). The MITE inherits the competences of the former Ministry of the Environment and is enriched with new competences that are closely linked to the ecological transition process, mainly related to the energy sector, Thus, its functions concern the sustainable development, the protection of biodiversity, ecosystems and the marine-coastal heritage, the safeguarding of land and water, policies to combat climate change and global warming, energy efficiency and the circular economy, integrated waste cycle management, the remediation of Sites of National Interest, the environmental assessment of strategic works, combating air-acoustic-electromagnetic pollution and the risks arising from chemical products and genetically modified organisms. In relation to the energy sector, MITE was assigned the competences for energy and mining policy, previously assigned to the Ministry of Economic Development.

Furthermore, Art. 4 of the Decree Law 22/2021 establishes, at the Presidency of the Council of Ministers, the Inter-Ministerial Committee for Ecological Transition (CITE) with the task of ensuring the coordination of national policies for ecological transition and related programming. The Committee is chaired by the President of the Council of Ministers or, in his stead, by the Minister for Ecological Transition; it is composed of the Minister for the South and Territorial Cohesion, the Ministers for Ecological Transition, Economy and Finance, Economic Development, Infrastructure and Sustainable Mobility, for Labour and Social Policy and Agriculture, Food and Forestry.

The CITE has the task of approving the Plan for the Ecological Transition, in order to coordinate policies on the reduction of climate-changing gas emissions, sustainable mobility, hydrogeological instability and soil consumption, water resources and related infrastructures, air quality and circular economy. the Plan for the Ecological Transition (Pte) has been approved with CITE Resolution No. 1 of 8 March 2022.

From October 2022, with the new Italian Governement, the Ministry has been renamed Ministry of

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

Environment and Energy Security (MASE).

Besides, since 2011, the MASE, in consultation with other relevant ministries, is responsible for preparing a report on the status of implementation of GHG emission reduction commitments and emission trends and projections. The report is annexed to the Economic and Financial Document (DEF), approved annually by the Government.

The MASE 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 MASE 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[3] (CIPE) – a collective governmental body chaired by the President of the Council of Ministers[4]. The MASE 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 held concerning the national plan. To date, the PNACC (national climate change adaptation plan) has not been approved yet.

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 MASE 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 30 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 59.948 million in 2011 (15th national survey) (ISTAT)[5]. Since 2018 the National survey on Population and Housing has been taking place yearly and no longer every ten years.

The resident population has been steadily decreasing since 2014 and at first of January 2022, according to first provisional data, it was 58,983 million, -2.3% compared to 2014.

The widening gap between births and deaths – started about thirty years ago together with the most recent contraction in the migration balance are the main causes of the demographic trend.

The SARS-CoV-2 pandemic of the last two years has contributed to this demographic dynamic already in a recession since 2014. Between 1 January 2020 and 1 January 2021, the Italian population decreased by 405 thousand units (corresponding to −0.7% of its population) and in absolute terms, it was the highest decrease observed in the European Union that registered a drop of 278 thousand people.

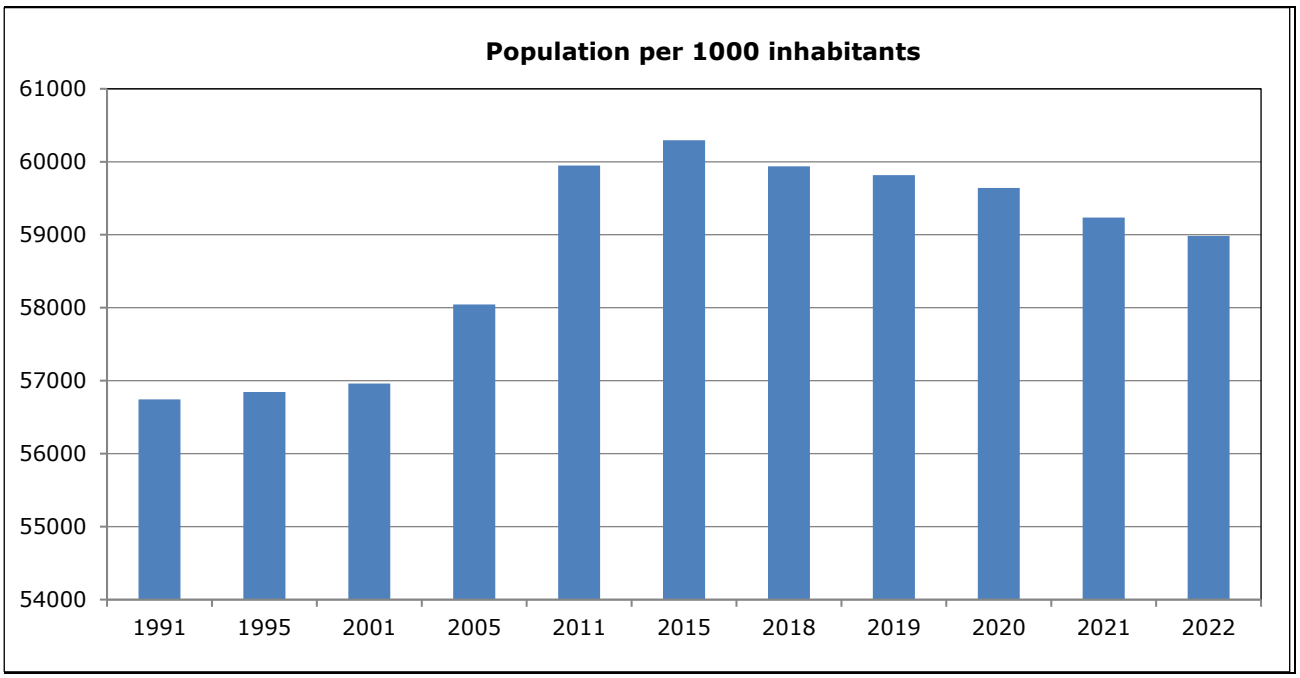
Between 1 January 2021 and 1 January 2022, a drop by 0.4% (corresponding to −253 thousand units) was registered with the pandemic still present, albeit with less pronounced impacts than in 2020. In the two pandemic years (2020 and 2021), the population decline was mainly due to the strongly negative natural balance: in 2021 births will felt below 400,000, the lowest since the unification of Italy; deaths were dramatically high during the pandemic period and remained at high levels compared to the pre-covid.

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

[4] CIPE's resolution n. 17/2013 was adopted to enable Italy to contribute to 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.

[5] http://demo.istat.it/, ISTAT

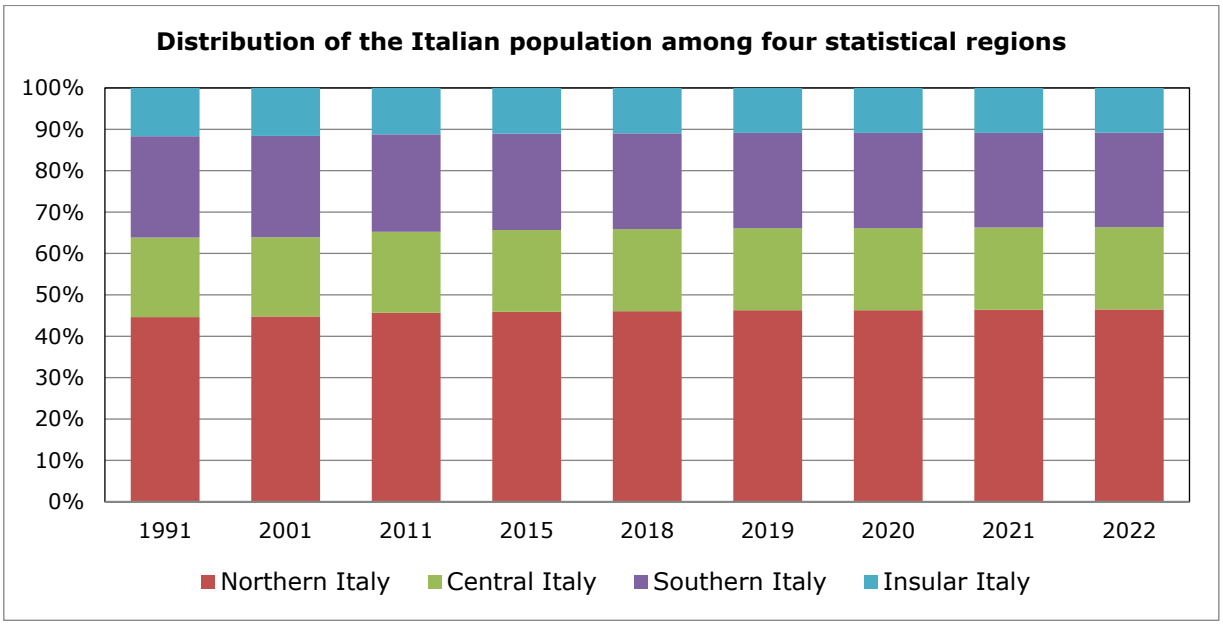
Figure 2.1 - The population (1000 inhabs) of Italy along the last two decades



Source: ISTAT (the Italian National Institute of Statistics)

At first January 2022, about 46.5 % of the resident population lives in northern Italy, about 19.9% of the population lives in central Italy, about 22.8% of the population lives in southern Italy and the remaining 10.8% lives in the islands (Figure 2.2). Based on the official statistics, increases in the resident population from 1991 to 2020 have occurred above all in northern and central Italy with +8.2% and +7.7% respectively, while a decrease has occurred in resident population of southern (- 3.3%) and insular Italy (- 3.5%). 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



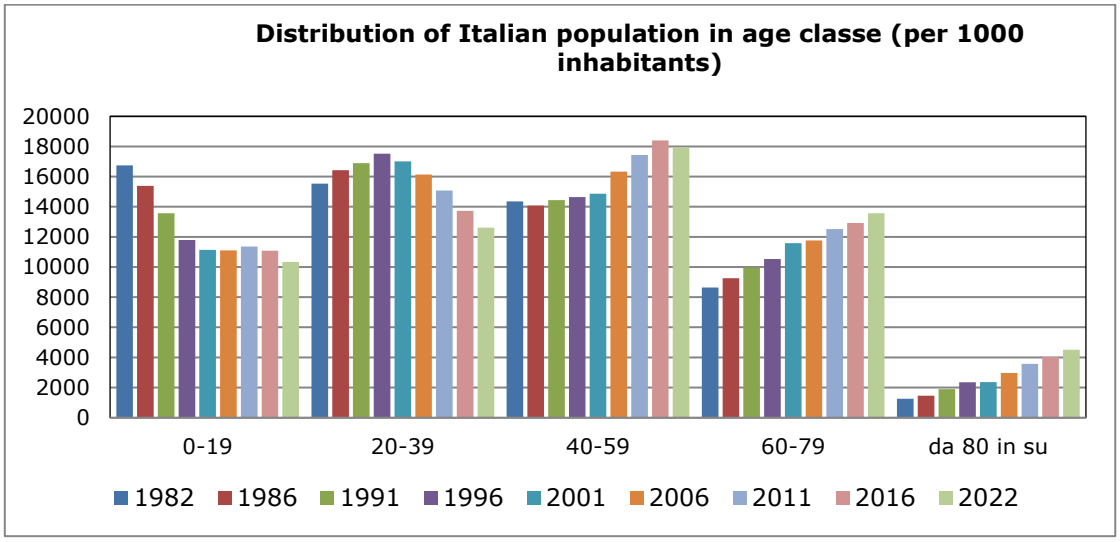
Source: ISTAT, the Italian National Institute of Statistics

The aging trend of population has been increasing due to a low birth rate and a continuous growth of the elders: on 1st January 2021, the median age of the Italian population was 47.6 years, the highest amongst the Member States[6] (44.1 years was the median age in the EU27[7]).

As of 1st January 2022, there were 188 people aged 65 and over for every 100 people under 15 (aging index), while in 2020 the aging index was equal to 131.7 (Figure 2.4). According to the most recent estimates, the population is expected to age further in the years to come, peaking at 306 on 1 January 2059.

The extremely elderly people, people aged 80 and older, are 7.6% of the population in 2022 and they were 5.9% in 2011, 4.1% in 2002 and 2.2% in 1982; they represent a considerable and growing portion of the Italian population (Figure 2.3). In 1982 the youngest people (aged 19 and lower) represented the 29.6% of the Italian population while in 2022 they represent the 17.5%. At European level the population is also aging and share of those aged 80+ almost doubled between 2001 and 2021. In 2021 Italy registered the highest share of persons aged 65 and over in the total population among the Member States, and the lowest share of children aged below 14 (13%) together with Portugal and Malta.

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

Concerning the fertility rate (number of children per woman) at first January 2022, it was 1.25, in slight recovery compared to the previous year (1.24). The fertility rate of 2021 is the same as 2001 but, as reported in the *"2022 Istat Annual Report[8]"* these values indicate different situations: the 2001 the fertility rate indicated a recovery in fertility after the all-time low of 1.19 children per woman recorded in 1995, while now it indicates a negative trend. This trend is mainly due to the reduction of children born in households with both parents of Italian; citizenship children of foreign couples increased until 2012 and after 2012 they also started to decrease steadily until, in 2020 and 2021, the number of foreign births dropped below 60,000, with a return to the levels of fifteen years ago, when, however, foreign residents were half the current number[8]. In detail, in the sharp drop in foreign births in 2021 (five times the drop of Italian births), the pandemic played a significant role. It affected the most vulnerable segments of the population, that include the foreign population, and resulted in the containment of incoming flows in 2020,

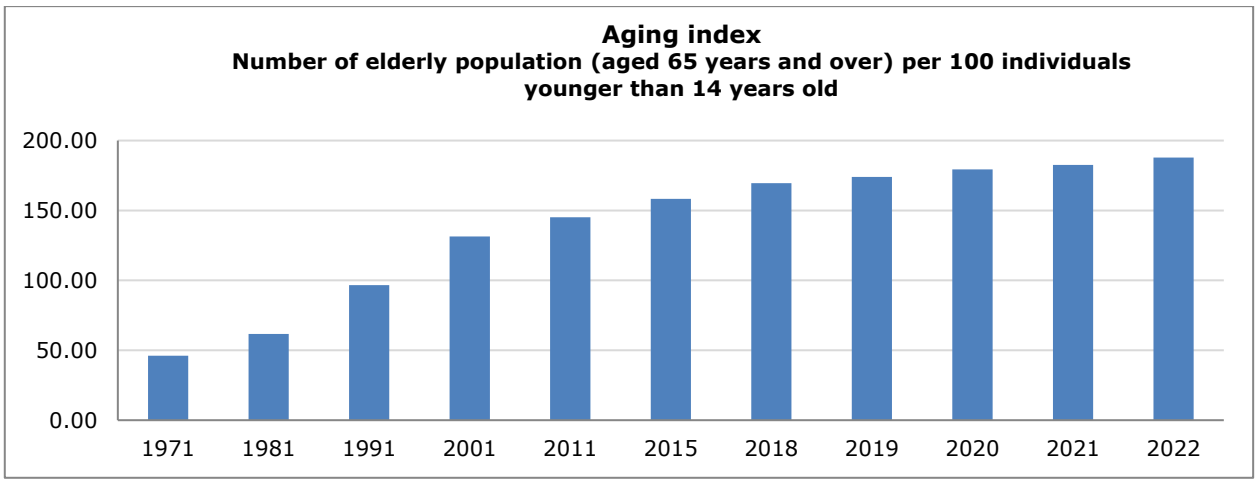
[6] ISTAT, http://dati.istat.it/
[7] EUROSTAT, http://ec.europa.eu/eurostat/statistics-explained/index.php/Population_structure_and_ageing
[8] ISTAT, 2022. Rapporto annuale 2022. La situazione del Paese. ISBN 978-88-458-2080-9 (https://www.istat.it/en/archivio/271806)

with impacts on family reunifications. The migratory movements in 2021 were higher than in 2020 with +2.7% of the foreign migration rate (+156,000 units compared to 2020) but the international migration movements remain below average 2015-2019.

Another aspect affected by the SARS-CoV-2 pandemic was the number of marriages celebrated, as a result of containment measures. In 2020 only 97,000 marriages were celebrated, compared to 184,000 in 2019. 2021 showed signs of recovery with 179,000 celebrations (3 per thousand inhabitants). As in Italy at least two thirds of births occur within the conjugal nucleus, repercussions on births in the coming years as well is possible.

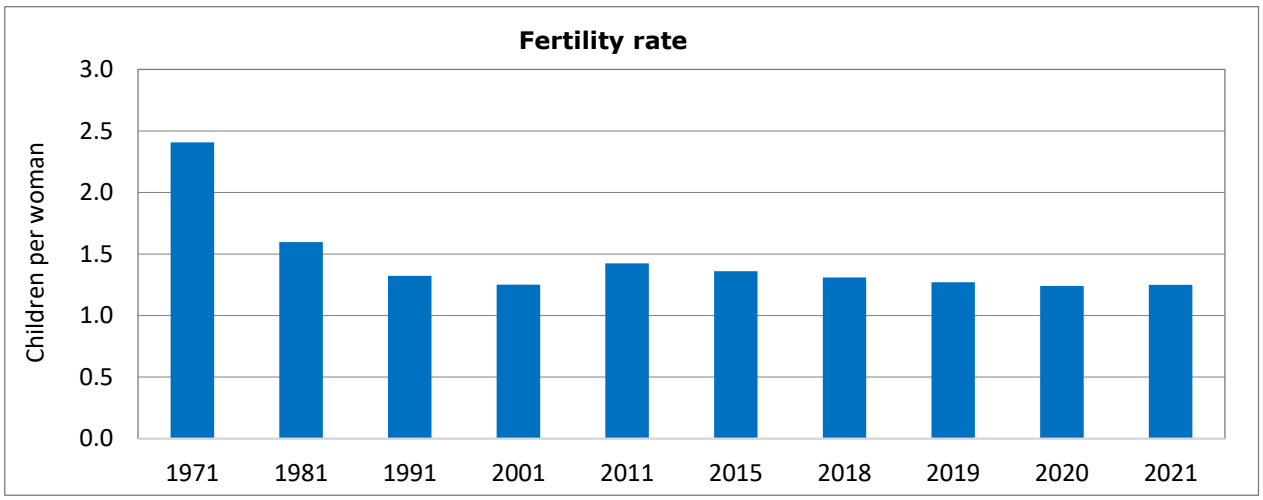
A low birth rate reduces the younger age groups and produces aging from the "foundation" of the population pyramid, an increasing age index (Figure 2.4, and 2.5) describes the aging "at the top" of the population pyramid. The two factors combined point out that the proportion of population of working 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.

Figure 2.4 - Ageing index in Italy along the last decade



Source: ISTAT, the Italian National Institute of Statistics

Figure 2.5 – Fertility rate (children per woman) in Italy along the last decades



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

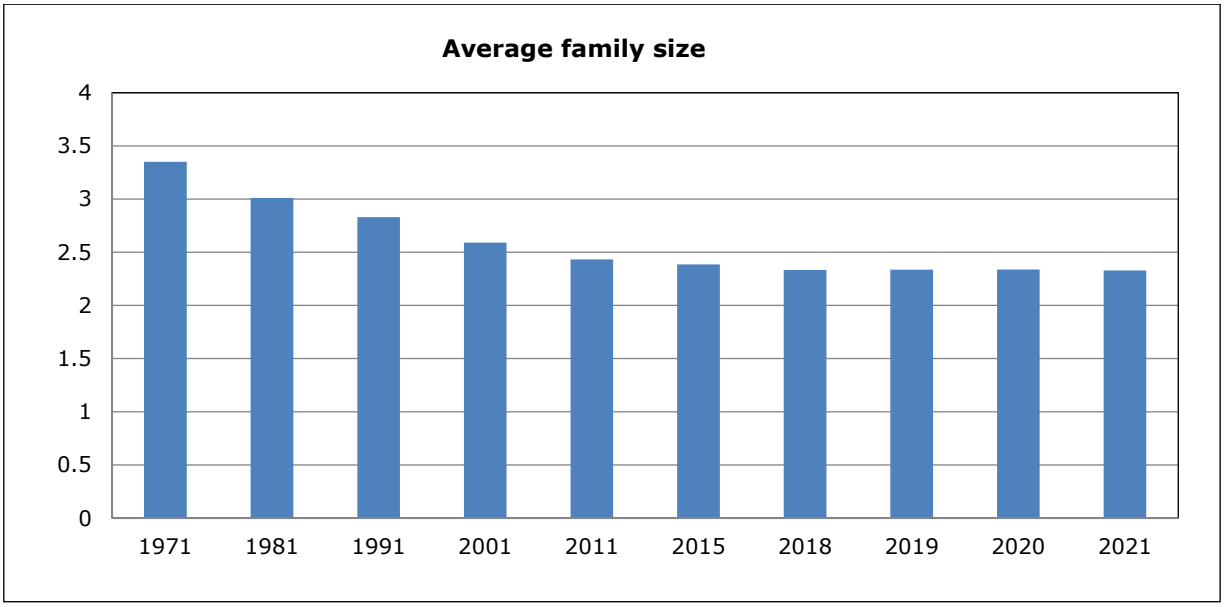
larger acquisition and use of durable goods as household appliances, cars, etc., previously shared among a greater number of people.

According to the results of annual surveys concerning Italian families, the number of households living in dwellings equipped with air-conditioning systems increased considerably in the last 2 decades, from 10.7% in 2001 to 48.6% in 2021 (it was 33% in 2011). The share of families living in dwellings with a washing machine and a dishwasher also increased. The families with washing machine accounted the 96.5% of the total in 2001 and 98% in 2021 while the share of households living in homes equipped with dishwashers increased from 33.1% to 54.9%. Households with a car were 78% in 2001 and 81% in 2021 while the family share with more than 1 car slightly increased from 33.4% to 34.6%.

As regards the building stock, according to the National Institute of Statistics, in Italy there were about 19.7 million occupied dwellings in 1991 and this number has been steadily increasing over the years. 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.

In Italy, according to the National Institute of Statistics, there are 25.3 million families in 2021 with an average size of 2.3 people per family. The number of households is expected to increase by about one million in 2041 (+3.8%) while the average size is expected to decrease to reach the value 2.1 in 2041[8]. In 1971 the average family size was 3.4.

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, as of 31 December 2019, 50.7 per cent of the resident population (30,214,401 people) made daily journeys to their place of study or work; it was 48.6 per cent in 2011. The highest percentage were registered in the regions of the North while all the regions of the south of Italy registered percentages below the national average value (50.7%).

The pandemic caused a drastic drop in all types of travel for the adopted containment measures including travel restrictions and incentives for the use of smart working. In January 2020, about 3.7 per cent of the staff of enterprises with at least three employees were working remotely. In the two months March-April 2020, with the restrictions of Covid pandemic in force, the overall incidence among the analysed companies suddenly rose to 19.8 per cent; thereafter, in 2021 when pandemic came back under control, smart working continued to be widely used and it remained at more than double its level in the early 2020. Therefore, it is plausible to think that this is a structural change destinated to last[8].

In 2020, 69.5% of students and 88.3% of employees used a means of transport to reach the place of study or work. Specifically, the 34.9% of students as passengers and 70.7% of employed as drivers used the car. Students moved more frequently on foot (30.5%) or with public transport (30.9%), than the employed (11.7% e 9.6% respectively).

In 2005, the percentage of students and employees that used a means of transport to reach the place of study or work was 73.0% and 88.2% respectively. The 34.2% of students as passengers and 70.5% of employees as drivers used car to go to the place of study and work; students that moved on foot were 26.5%, more than the employed (11.1%). Public transport was used by 35.1% of student and 10.2% of employed (see table 2.1)

Table 2.1: Travel to work and study by type of transport used (%)

Travel to work and study by type of transport used (%)	2005	2010	2015	2016	2017	2018	2019	2020
Children and students who travel to school or university on foot	26.5	26.0	25.5	26.6	27.9	27.6	27.5	30.5
Children and students who travel to school or university using a car as passenger	34.2	36.8	39.2	37.3	37.0	38.4	36.9	34.9
Children and students who travel to school or university by some means of transport	73.0	73.6	74.1	72.8	71.5	71.8	72.5	69.5
Children and students who travel to school or university by public transport	35.1	33.3	32.8	32.7	32.8	32.6	32.4	30.9
Persons aged 15 and over employed who go to place of work on foot	11.1	10.7	11.8	11.4	12.0	12.4	12.0	11.7
Persons aged 15 and over employed who travel to place of work driving a car	70.5	70.8	68.9	68.9	69.2	69.2	69.7	70.7
Persons aged 15 and over employed who travel to place of work by some means of transport	88.2	88.7	87.3	87.9	86.8	86.4	88.0	88.3
Persons aged 15 and over employed who travel to place of work by public transport	10.2	10.8	10.9	11.2	11.2	12.2	10.1	9.6

Source: ISTAT, the Italian National Institute of Statistics

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 there are the following protected areas[9]:

- 25 National Parks,
- 32 Marine Protected Areas,
- 147 State Natural Reserves,
- 146 Regional Natural Parks,
- 1 Interregional Park,
- 419 Regional Natural Reserves,
- 694 Other 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;

[9] www.parks.it

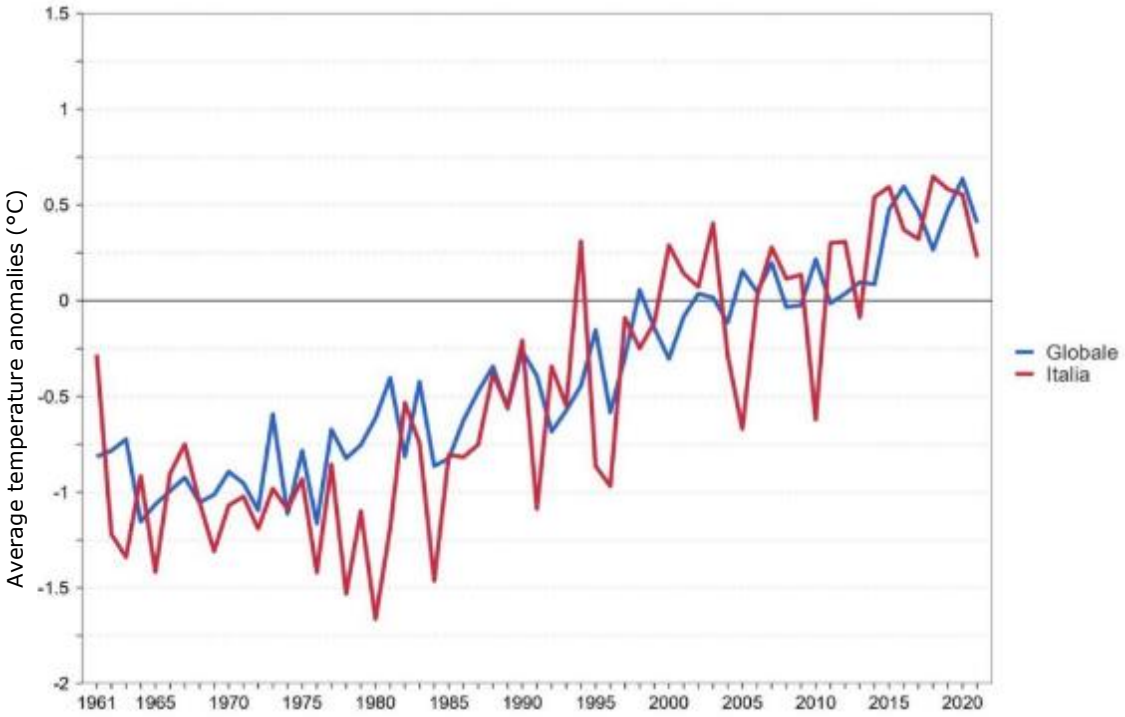
- Po valley climate, with low temperatures in the winter, high in the summer, moist in spring and autumn.

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 Italian Institute for Environmental Protection and Research (ISPRA)[10] .

While at the global scale year 2021 resulted the sixth warmest years, in Italy it was the fourteenth among the warmest years, with a mean temperature anomaly of 0.23°C with respect to the 1991-2020 (Fig. 2.7).

Figure 2.7 - Time series of the mean temperature anomalies (land-only) at global scale and in Italy, compared with normal climatic values 1991-2020



Source: Gli indicatori del clima in Italia nel 2021, XVII Ed.", ISPRA – Stato dell'Ambiente N. 98/2022

This positive anomaly was mainly due to the summer, which with an anomaly of +1.02°C was the sixth hottest since 1961. Compared to all the other season, the spring instead recorded a negative anomaly (-0.96°C) and was the coldest since 2005[10].

In general, the year 2021 was on average a less warm year than previous years, with monthly anomalies of opposite sign over the course of the year. However, the data show an increasing trend in temperature: since 2000, the anomalies with respect to the climatological base 1991-2020 have always been positive except for 4years (2004, 2005, 2010 and 2013). The year 2021 was the eighth consecutive year with a positive anomaly with respect to the norm. Heat waves occurred in Italy during the summer months, the most intense of which occurred in the second week of August, when Syracuse recorded 48.8 °C.

Regarding the temperature extremes indices, the number of days with frost and the index of 'warm periods'

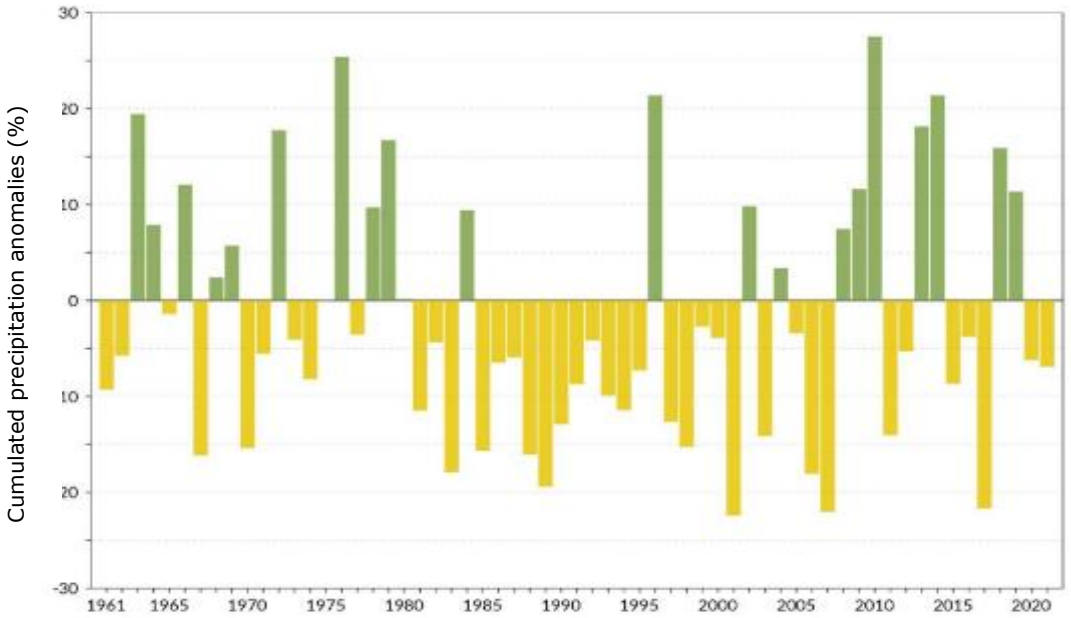
[10] "Gli indicatori del clima in Italia nel 2021, XVII Ed.", ISPRA – Stato dell'Ambiente N. 98/2022

(WSDI) registered values close to the climatological average 1991-2020

Concerning the temperature of the Italian seas, in 2021 the average annual anomaly reached a value of +0.46°C 2021 compared to the period 1991-2020. It is the fifth in the series after 2015, 2018, 2012 and 2020. Besides, the monthly mean sea temperature anomaly was characterised by positive anomalies throughout the year (except for December), with a pick in June (+1.58°C).

In the Figure 2.8 precipitation trends in Italy in recent decades is shown. In detail, the figure reports the series of anomalies of annual cumulative precipitation in the period 1961-2021, compared to the climatological value 1991-2020. Mean cumulated precipitations in 2021 have been about 7% lower than the average, so that 2021 ranks 24th least rainy year in the entire series since 1961. Winter was wetter than the norm, with an average anomaly of +66%, while the other seasons were drier on average. The relatively driest season was summer (-27%), which ranks as the seventh wettest, followed by spring (-25%), which ranks sixth driest since 1961. The negative anomaly was stronger in the Apulia Region and in the large part of the North (with anomalies of up to -70%); positive precipitation anomalies were recorded mainly over Lazio, Campania, Calabria and Sicily. Strong negative anomalies occurred in the spring and summer months and in the month October, as well as in December in the North[10].

Figure 2.8 - Time series of mean annual cumulated precipitation anomalies over Italy, compared to the normal value 1991-2020



Source: Gli indicatori del clima in Italia nel 2021, XVII Ed.", ISPRA – Stato dell'Ambiente N. 98/2022

No statistically significant trends emerge from the analysis of cumulative annual and seasonal precipitation over the period 1961-2020.

Concerning the extreme precipitation events occurred in 2021, the peak value of daily precipitation was registered in the Liguria region with 882.8 mm in the month of October. Also in October, daily precipitation between 200-350 mm was recorded between central Liguria and the extreme southern border of Piedmont.

The 'Consecutive Dry Days' (CDD) drought index[11], recorded the highest values on southern Sicily (up to 139 consecutive dry days), followed by the central Tyrrhenian coast (up to 100 days) and western and northern Sardinia. The highest numbers of dry days over the year were recorded in eastern Liguria and

[11] Drought index: the maximum number of dry days consecutive in the year.

Emilia Romagna, (the peak was of 326 dry days). The lowest values (up to about 207 dry days) was recorded in the consecutive central-eastern Alps and Pre-Alps and on the Apennine ridge.

Regarding to the medium and long-term trends of the indices that represent frequency, intensity and extreme precipitation values, there are no clear signs of changes.

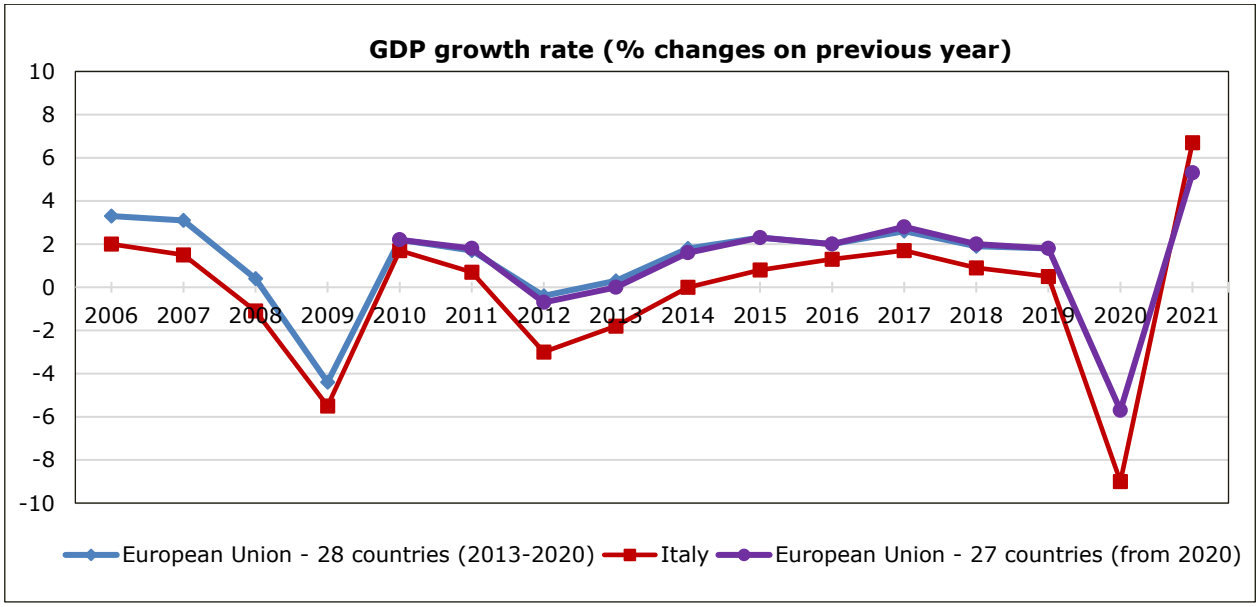
2.2.4 Economic profile and industry

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, in 2021 Italy is the world's eighth largest economy and the fourth largest economy in 2021 among the EU countries (about 12% of the EU27 GDP at current prices and chain linked volumes 2015) behind Germany, UK and France. The GDP was 1,678,489.9 million € in 2021 (chain linked volumes, 2015) against 1,499,354.9 million € in 1995.

Around the mid-2000s, a global financial and economic crisis hit the advanced economies thus resulting into severe recession in the EU, Japan and the United States. In 2009 Italy's GDP fell by 5.3% compare the previous year and by the end of that year, a general recovery in the economies appeared and the GDP raised by 1.7% in 2010.

Between 2010 and 2012 Italy, like many advanced economies, moved into recession again then the national economy has been showing a moderate recovery until 2017. In the year 2020 due to the Covid pandemic, with the implementation of severe measures of social containment and restriction of production activities, Italian GDP felt by 9%, compared to a fall in EU-27 GDP of 5.7%. The fall in GDP was mainly driven by the collapse in domestic demand, particularly consumption. In 2021 the GDP grew by 6.7% over 2020 while the EU GDP increased by 5.3%. The economic recovery of 2021 was more pronounced in the areas most affected by the 2020 crisis: the North-West area where the GDP registered +7.7% compared to the previous year and the North-East area with +7% of GDP. The increase in GDP was less pronounced than average in the Centre (+6%) and in the South (+5.8%) (Figure 2.9).

Figure 2.9 - GDP growth rate (% changes on previous year) of EU28, EU27 and Italy from 2006 to 2021.



Source: EUROSTAT

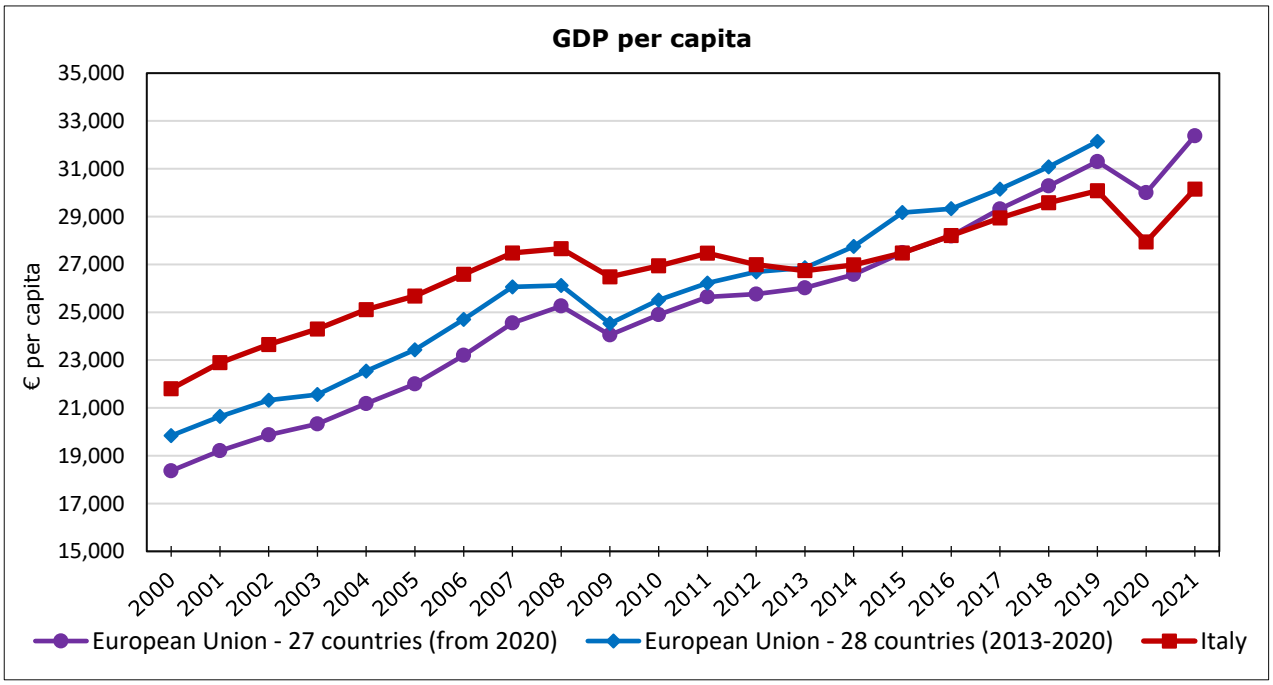
As reported in the Istat Annual Report[8] between mid-2020 and the beginning of 2022, the Italian economy fully recovered from the exceptional fall in GDP associated with the COVID-19 pandemic. In the first half of 2022 with the worsening of the international picture, growth weakened greatly in our country just as in the European Union.

Concerning the Italian GDP per capita, in 2021 it was 30,150 € per capita, about 6.7% below the average

EU27 value (32,389 € per capita) and about 8% higher than the value of the previous year (27,940 € per capita), which was strongly affected by the Covid pandemic. (Figure 2.10).

GDP per capita data show an overall increasing trend over the period 2000 2021.

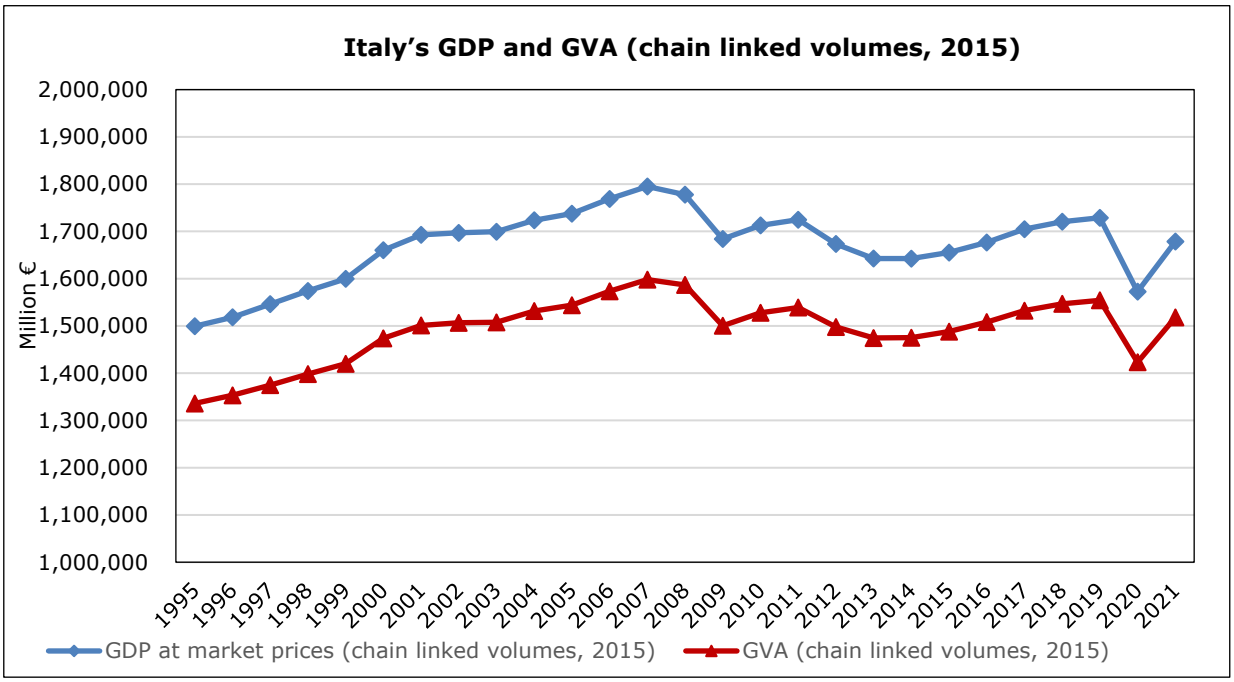
Figure 2.10 - GDP per capita (Italy and EU27) time series



Source: ISTAT, the Italian National Institute of Statistics

In the following figure, the time series of GDP and GVA (Gross value added) from 1995 to 2021 are reported. Italy's Gross value-added increased between 1995 (1,336,013 M€) and 2007 (1,598,029 M€), then it started to decrease and in 2009 it was about by 6% lower than in 2007. A slight recovery was registered in the following two years, then value added started to decrease again until 2014. From 2014 to 2019 the GVA steadily increased and in 2019 it was 1,554,315 M€. The pandemic led to a drastic decline in 2020 (-8.4 % compared to the previous year) with a recovery in 2021 when it was 1,518,078 M€ but remained at a lower level than in 2019 (Figure 2.11).

Figure 2.11 - Italy's GDP and GVA along the last decades (chain linked volumes, 2015)



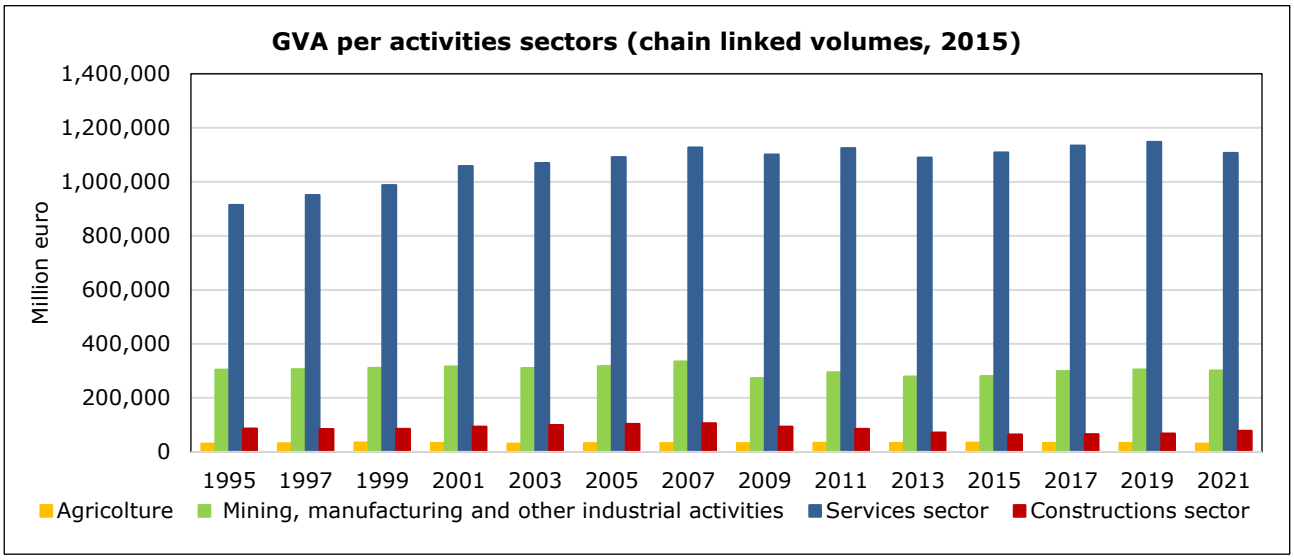
Source: EUROSTAT

The driving sector of the national economy is the service sector, which accounted for 68.4% of GVA in 1995, later increased up to 73.4% in 2009 and to 74.5% in 2014 and 2015. Since 2015 the share of service sector started to decrease and in 2018 it was 73.8% of GVA. In 2020 increased up to 74.2%, then in 2021 it felt to 72.9 %.

Industry-related activities accounted for 22.8% of GVA in 1995, then decreased up to 18.2% in 2009. In the following years, from 2010 to 2021, the industry share remained in the range of 18.8-19.9%. The minimum was recorded in 2014, the maximum in 2021. Agriculture accounted for 2.3 of GVA in 1995 while in 2021 it accounted for 2.0%. The construction sector accounted for 6.5% of GVA in 1995, decreased to 6.0% in 1998, 1999, 2000, later increased up to 6% of GVA in 2005 and 2006. From 2007 it started to decrease again up to 4.3% in the years from 2015-2018. In the last three years an increase was registered and in 2021 the share of construction was 5.12% of GVA.

In the following figure (Figure 2.12), the trend of GVA for activities sectors in millions of Euros is reported. A negative trend for the industry sector occurred from 2008 with e negative peak in 2009 (-18.5% compared to 2007), followed by an increased by 6.5% in 2010 respect 2009. The Covid pandemic caused a drastic fall of the industry sector GVA with -11.3% in 2020 compared to 2019 and a recovery in 2021. Compared 2020, in 2021 value added in volume increased by 11.5% in industry, by 21.6% in construction and by 4.7% in services compared to 2020, while it decreased by 1.3% in agriculture.

Figure 2.12 – GVA per activities sectors (M€ - chain linked volumes, 2015)



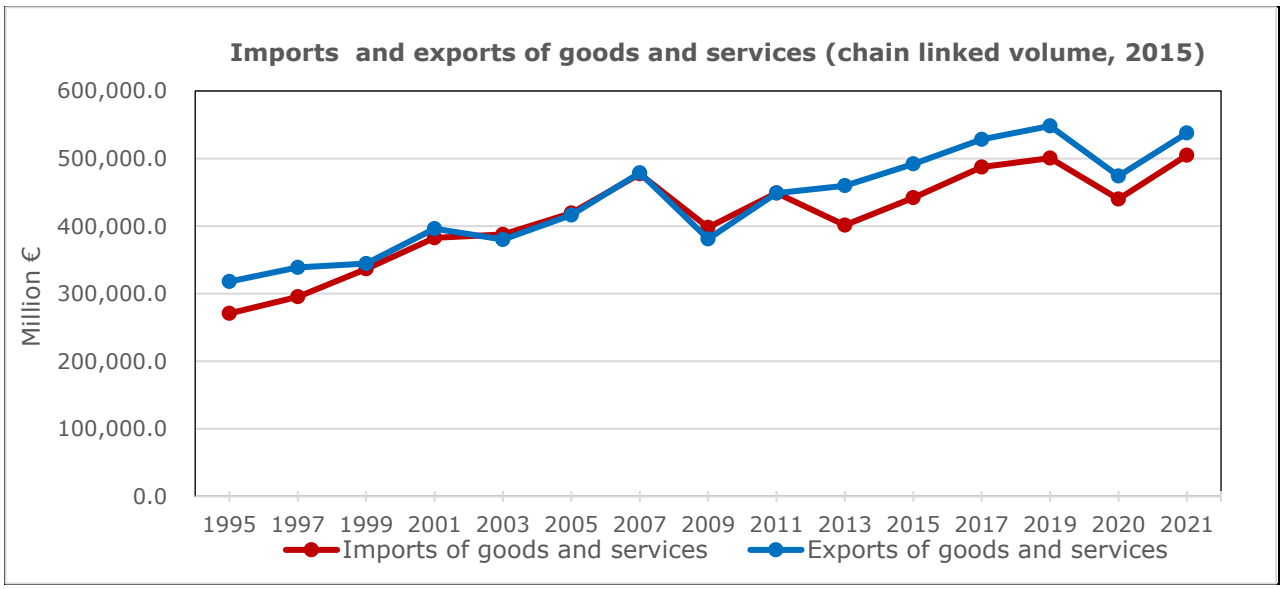
Source: ISTAT

The imports of goods and services showed an increasing trend from 1996 to 2007 (477,283 M€ - Chained linked, 2015), then a fluctuating trend due to the fluctuation of the domestic demand. Since 2013, imports of goods and services had been increasing and in 2018 they amounted to 504,113 M€, down to 439,947 million of Euro in 2020 due to the economic crisis (-12.1 % compared to 2019). In 2021, the GDP growth was accompanied by a 14.7 % volume increase in imports of goods and service (504,780 M€).

From 1995 to 2007 the exports of goods and services increased by 50.6% reaching the value of 478,762 million of euro; in 2009 there was a significant fall in exports (-17.8%) compared to the previous year when it was 463,589.4 M€. From 2009 exports trend was crescent but in 2020 exports decreased by 13.5% compared to 2019. In 2021, with Covid pandemic under control a recovery in exports (+13.4% compared to the 2020) occurred but the market had not returned to pre-pandemic levels. (Figure 2.13).

The balance exports -imports was always positive over the years 1995-2021 except for the period from 2003-2006 and from 2009-2011. The higher negative peak was registered in 2009 and 2010 with -16,990 and -20,601 million of euro respectively.

Figure 2.13 - Italy's Imports and exports of goods and services (M€ - chain linked volumes, 2015)

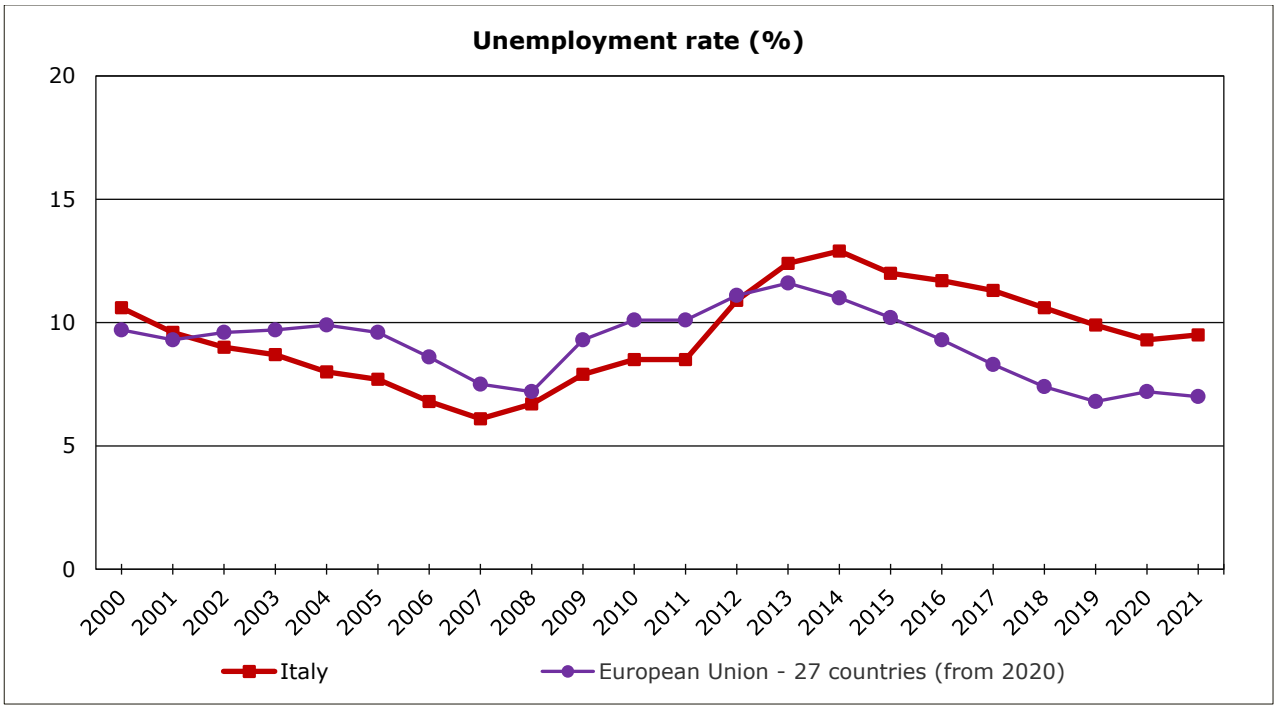


Source: ISTAT

In 2021, Italian imports and exports were mainly from/to the European Union (68.4% for imports and 67.5% for export) and Asia (19.7% for import and 13.3% for export). In terms of value, the main imported goods in 2021 were: chemical products (6.8%), auto vehicles (5.6%), crude oil and precious base metals and other non-ferrous metals and fuels nuclear (5.4%), pharmaceuticals (5.3%). In the same year the main exported goods were medicines and pharmaceutical products (5.9%), "other general purpose machines"[12] (5.2%), general purpose machines (4.8%) auto vehicles (4.1%).[13].

In the Figure 2.14 the unemployment rate in Italy and in the EU27 over the last fifteen years is reported. The unemployment rate was 10.6% in 2000 and it decreased for the following seven years; after the year 2007, when it was 6.1%, it increased again up to 2014 (12.9%), reaching values much higher than in 2000, as a consequence of the recession of the national economy, but it has been decreasing since then. In 2020 the unemployment rate in Italy was 9.3%, higher that EU27 value (7.2%) and in 2021 while EU27 registered a decreased, with the rate equals to 7.0%, in Italy it was 9.5%, higher than the previous year.

Figure 2.14 - Unemployment rate (%) in Italy and in the EU27



Source: EUROSTAT

2.3 Sector specific information

2.3.1 Energy

Italian energy asset is essentially dependent by import. The energy dependence of Italy from abroad is high compared with the EU27 average (73.5% in 2020 in Italy; 57.5% in 2015 in EU) as shown in the following table 2.2 although the dependence for Italy has been decreasing since 2000.

[12] Furnaces, burners and heating systems, lifting and handling machinery and equipment Office machines and equipment (excluding computers and peripheral units), non-domestic equipment for refrigeration and ventilation ventilation.
[13] *"Osservatorio economico. Statistiche relative all'import/export italiano"*. 2017, Italian Ministry of Economic Development.

Table 2.2 - Total energy dependence (Italy and EU27)

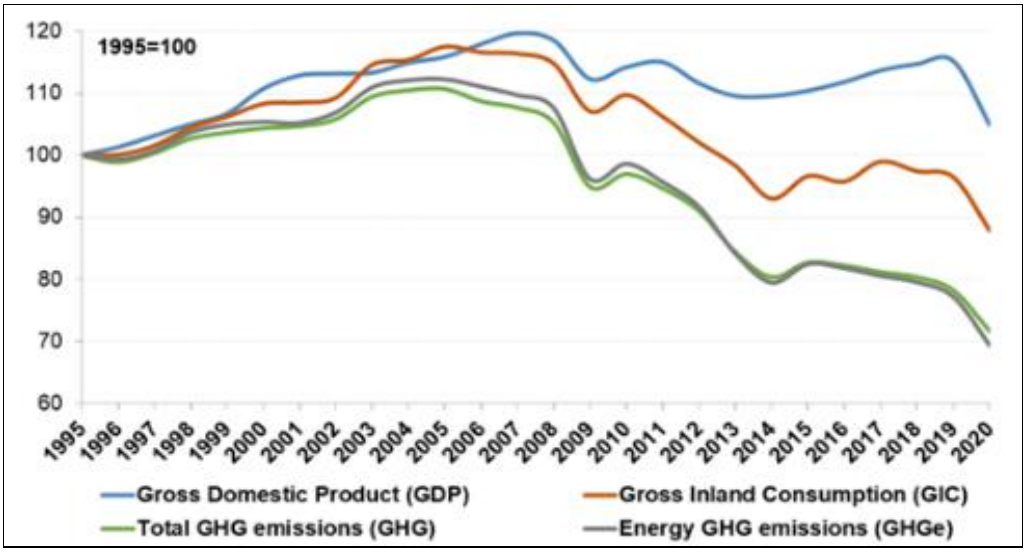
Energy dependence	1990	1995	2000	2005	2010	2015	2020
Italy	84.4	82.0	86.5	83.3	82.6	77.0	73.5
EU27	50.0	52.1	56.3	57.8	55.8	56.1	57.5

Source: EUROSTAT

National gross inland energy consumption shows an increasing trend from 1990 until 2005 when it peaked at 189.4 Mtoe, then there was a reduction accelerated by the effects of the economic crisis with the minimum value of 149.8 Mtoe reached in 2014. Gross domestic consumption in 2020 furtherly decreased as consequence of lockdown to contain SARS-CoV-2 pandemic (-8.9% lower than 2019 level and -4,4% lower than 1990 level).

In order to assess the relationship between energy consumption, economy and GHG emissions the trends of gross inland energy consumption (GIC), gross domestic product and GHG emissions are analysed. GDP and GIC have parallel trends up to 2005. Then the two parameters begin to diverge showing an increasingly decoupling. GHG emissions growth was slower than that of GDP until 2005, highlighting a relative decoupling. After 2005, the divergence between the two parameters becomes increasingly marked by showing absolute decoupling up to 2019, as shown in Figure 2.15.

Figure 2.15 – Indexed trends (1995 = 100) of gross domestic product, gross inland energy consumption, total and energy GHG emissions (GDP; chained link values 2015).



Source: ISTAT, MSE, ISPRA, 2022.

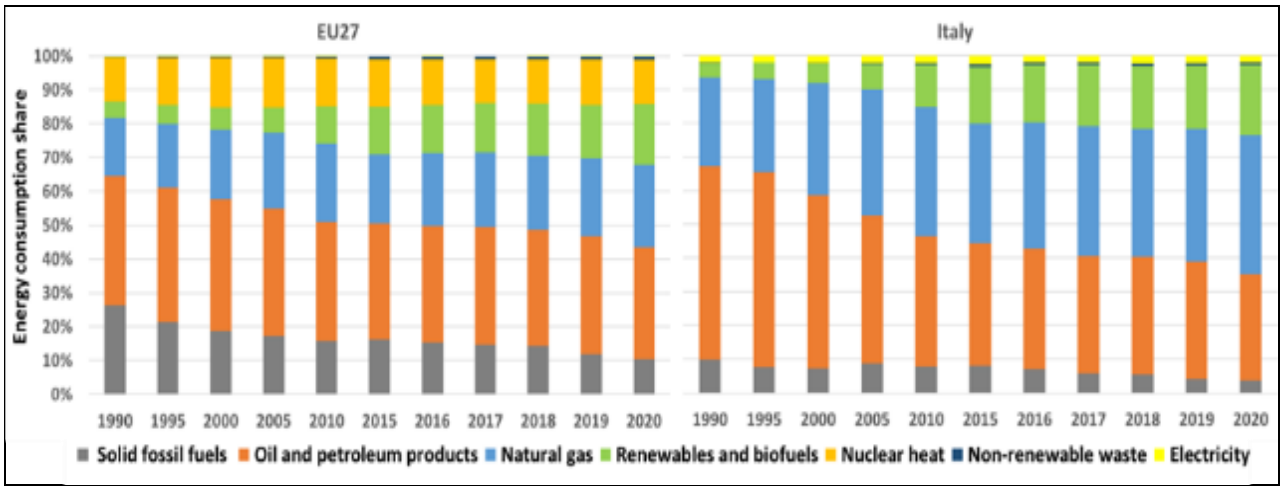
The gross inland consumption of energy per fuel types (see Figure 2.16) is characterized by:

- a reduction of the oil share, which was the most important energy source in the '90s;
- the corresponding increase in the use of the natural gas;
- and the gradually increasing share of energy from renewable sources.

Compared with other European countries, Italy's energy consumption is characterized by a higher share of natural gas, a lower coal share, a structural electricity imports, and the absence of nuclear power. The share of renewable energy (which increased from 4.4% in 1990 to 20.7% in 2020) in Italy's energy supply mix is higher than the EU27 average (17.9% in 2020)[14].

[14] ISPRA 2022, Efficiency and decarbonization indicators for total energy consumption and power sector. Comparison among Italy and the biggest European countries. https://www.isprambiente.gov.it/it/pubblicazioni/rapporti/efficiency-and-

Figure 2.16 - Share in gross inland energy consumption by sources in EU27 and Italy (%).



Source: Eurostat, Ministry of Economic Development

In 2020 the final energy consumption in the end users was about 103.1 Mtoe, the lowest value since 1990 due to the measures, such as economy lockdown, implemented to stop the diffusion of SARS-CoV-2 pandemic. The previous lowest value was reached in 2014, when the impacts of economy crisis started in 2008 was at the highest level. Since 2015 up to 2019 there was a slight recovery of consumption (+3.9% in 2019 wrt 2014). The outbreak of Covid-19 pandemic reduced drastically the energy consumptions in 2020 (-8.9% wrt 2019).

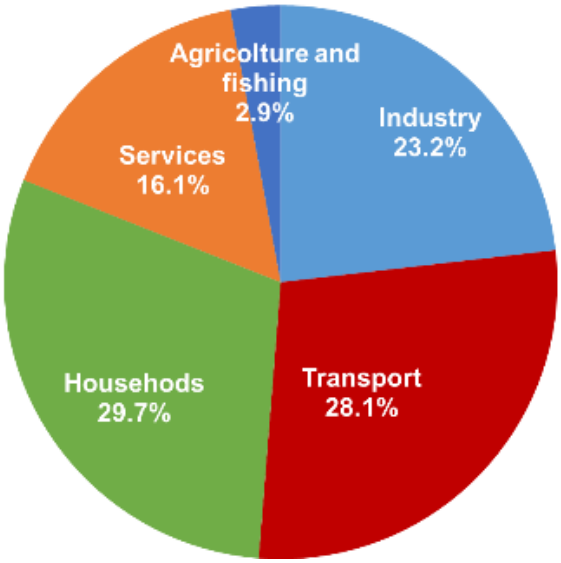
Regardless the singularity for 2020 the latest long-term trends of energy consumptions in end-uses sectors can be pictured as:

- energy consumptions in the industry sector have been decreasing since 2004. The fall in energy consumption recorded in 2009 (-17.3% wrt 2008) was related to the national economy crisis and to the fall of the industrial production. In general, the decreasing trend (-27.1% in 2015 on 1990) is mainly due to the heavy drop of consumptions in the petrochemical and iron & steel sectors. Since2015 the industry consumptions show a quite stable trend;
- stabilization of consumptions in the transport sector, although with wide oscillations, (about 36 Mtoe from 2012 to 2019) after the decreasing trend registered between 2007 and 2012 (-14.1%);
- overall increase in the consumption trend in the civil sector (households and services) up to 2010 and next fluctuations around 49 Mtoe with a slight decreasing trend. The energy consumptions in the services have increased from 1990 up to 2019 (+122.6%), while consumptions in the households after the increase from 1990 to 2010 have been fluctuating around 33 Mtoe since 2010, except for the drop to 29 Mtoe experienced in 2014.

As already reported energy end-uses total consumption in 2020 was of 103.1 Mtoe, of which 45.8% related to the civil sector (households, commercial and public services) and 28.1% to the transports. Industry accounts for 23.2% of total end-uses energy consumption, as shown in the following figure:

decarbonization-indicators-for-total-energy-consumption-and-power-sector-comparison-among-italy-and-the-biggest-european-countries

Figure 2.17 – Share of energy end-use consumptions per sector in 2020



Source: Processing of data from the National Energy Balance.

Concerning the power sector, the average electricity production provided by thermoelectric power plants was around 80.5% from 1990 to 2007, after such year the share has been decreasing up to the lowest value of 63% in 2014 in correspondence with the highest level of renewable share reached by the country (43.1% of electricity production). The weight of renewable resources, after a fall to 35.1% up to 2017, has kept growing in the latest years (41.7% in 2020). The capacity of renewable power plants has been constantly increased with an average rate of 6.9% per year from 2005 to 2020. The unpredictability of precipitation and related hydroelectric production make sense for the variability of renewable electricity production.

The renewable target according to the European Directive 2009/28/EC concerns the share of energy from renewable sources in the gross final energy consumption. Gross final energy consumption is defined in the mentioned Directive on renewable energy sources as energy commodities delivered for energy purposes to final consumers (industry, transport, households, services, agriculture, forestry and fisheries), including the consumption of electricity and heat by the energy branch for electricity and heat production, and including losses of electricity and heat in distribution and transmission. The accounting rules in the Directive prescribe that electricity generated by hydropower and wind has to be normalised for annual variations (hydro 15 years and wind 5 years). The overall share of renewable energy consumption in 2020 for Italy is 20.4%, over the target of 17% to be achieved in 2020.

For 2030 the European targets for renewables energy reflected the commitments made by the EU under the Paris Agreement: reduction of GHG emissions by at least 40% compared to 1990, achievement of at least 32% of energy consumption from renewables and the achievement of at least 32.5% increase in energy efficiency compared to projections of the expected energy used in 2030. Another target directly related to the electricity system is the achievement of 15% for electrical interconnections in 2030.

To achieve the 2030 targets, the European Union has adopted the EU Regulation 2018/1999 establishing the Governance of the Energy Union with the main objective of planning the policies and measures implemented by the Member States. Within this framework, Italy has prepared and transmitted to the European Commission its National Energy and Climate Plan with a horizon to 2030, whose aim is to implement an energy policy that ensures full environmental, social and economic sustainability for the transition.

With the European Green Deal, the European Commission proposed in September 2020 to raise the 2030 GHG emission reduction target, including carbon removals from forestry activities, to at least 55% compared to 1990. On 14 July 2021 the European Commission presented a proposal for amending the Renewable Energy Directive increasing the current target to at least 40% renewable energy sources in the

EU's overall energy mix by 2030. Relevant actions are required across all sectors in order to achieve the new targets, including increased energy efficiency and renewable energy. Such actions are considered in the Italy's Recovery and Resilience Plan submitted in 2021 to European Commission in compliance with EU's extraordinary recovery effort, Next Generation EU: the plan agreed by EU leaders in July 2020 to overcome the economic and social impact of the pandemic facing the environmental, technological and social challenges of our time.

The Commission started the process of making detailed legislative proposals by July 2021 to implement and achieve the increased ambition that will enable EU to move towards a climate-neutral economy by 2050 – an economy with net-zero GHG emissions.

In reaction to the Russian invasion of Ukraine since 24th February, there is growing support across the European Parliament to increase the EU's 2030 renewable energy target ending the EU's dependence on Russian fossil fuels. Currently, just over 22% of Europe's energy final consumption comes from renewables. From the 40% renewable energy target by 2030 proposed by European Commissions in July 2021, the European Parliament is now set to push for the target to be increased to 45% (see Figure 2.18). On 18 May European Commission has presented the REPowerEU Plan to phase out EU dependency on Russian fossil fuels faster through energy savings, diversification of energy supplies, and accelerated deployment of renewable energy to replace fossil fuels in homes, industry and power generation.

Figure 2.18 – Evolution of renewable energy targets in Europe.

Source: European Commission

2.3.2 Transport

As for transport facilities, the Italian railroad network had in 2020 about 19,863.54 km (66.8% of which electrified), while the Italian road network had at the end of 2020 about 167,911 km, 12.4% more compared to the road extension in 1990.

The extension of the Italian oil pipeline network in 2020 was 3,931 km, with a coefficient of use equal to 45.3%. The extension of the Italian gas pipeline network in 2020 was 32,683 km.

Passengers' transportation in Italy, in 2021, was about 684,282 million of passengers-km (+11.4% compared to 2020 and -24.1% compared to 2015). Road transport is the prevailing mean of passengers' transportation: in 2020 it was 95% and in 2021 it was 93% (considering private transport, collective urban and extraurban transport) of the total passengers-km, while railroad transport accounted for 4% both in 2020 and 2021, water transportation accounted for 0.5% and 0.6%, and air transportation was 0.5% and 2.1% of the total passengers-km in 2020 and 2021 respectively[15]. Since 2005, the picture of passenger

[15] Conto Nazionale delle Infrastrutture e della Mobilità Sostenibili Anni 2020-2021, Ministry of sustainable infrastructures

transportation has not changed significantly. Among the EU countries, Italy has the second highest motorisation rate (670 cars per 1,000 inhabitants in 2020)[16]. There were about 39.7 million private cars circulating in 2020[17].

The goods transported were more than 199 billion tons-km in 2020 (-2.7% compared 2019); in 2021 an increase is then observed of 3.5% (about 206 billion tons-km). The analysis of the related data points out that:

- road transportation of goods is the prevailing means of transportation over the years (about 55% of the total goods transported, in road haulage >50 km, both in 2020 and 2021);
- goods transported by sea have increased since 2005 (about 29% respect to the total both in 2020 and 2021);
- goods transported by railroad have decreased since 2005 (10.4% and 10.8% in 2020 and 2021 respectively).

Italian families' average expenditure for the transport sector was about 15.5% in 2000, while it is about 10.8% and 11.3% in 2020 and 2021 respectively.

Mobility demand and, particularly, road transportation shares have increased since 1990. The number of vehicles for road transportation has kept growing steadily over the last three decades (1990-2020) as shown in the following table 2.3.

Table 2.3 - Road transportation in Italy: trends in fleet[18]

Vehicle category	1990	1995	2000	2005	2010	2015	2020	1990-2020
	number of vehicles							(%)
Passenger Cars	27,417,601	30,316,610	32,212,839	33,945,345	36,446,628	37,103,684	39,722,820	44.9%
Light-duty trucks	1,476,702	1,939,885	2,651,296	3,255,732	3,754,765	3,806,317	4,116,739	178.8%
Heavy vehicles including buses	1,015,269	1,010,969	887,919	1,020,718	992,839	917,735	946,903	-6.7%
Mopeds and Motorcycles	6,606,221	7,375,994	8,791,084	9,147,683	9,420,759	9,542,107	10,041,857	52.0%
Total	***36,515,793***	***40,643,458***	***44,543,138***	***47,369,478***	***50,614,991***	***51,369,843***	***54,828,319***	*50.1%*

During the past years, the reduction of passenger car sales has negatively affected 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 2010, the share of passenger cars in use aged between 10 and 15 years was about 20.7%; since then, this figure has increased up to 22.0% in 2021. The share of passenger cars in use aged between 15 and 20 years was 8.2% in 2010 and it has increased up to 16.6% in 2021[19].

and mobility 2022

[16] Eurostat database, https://ec.europa.eu/eurostat/data/database

[17] ACI, Autoritratto 2020

[18] Table 2.3 and 2.4 report historical data series about the circulating fleet (sources: Ministry of sustainable infrastructures and mobility, ACI, ANCMA, several years) at the basis of the 2022 submission of the National emissions Inventory.
The revision of the data compared to the previous edition is basically due to the incorporation of data on vehicles radiation, and for two-wheelers, the revision of the estimates of the mopeds fleet on the basis of the most recent data provided by the Ministry.

[19] ACI, Annuario statistico 2022

In 2020, the total number of vehicles was 50.1% more than it was in 1990: passenger cars have increased by 44.9%, light-duty trucks have increased by 178.8%; heavy vehicles have decreased of about -6.7% from 1990 to 2020, while mopeds and motorcycles have increased by 52.0%. As for the fuel type, the following table 2.4 describes the distribution of the vehicles (Gasoline, Diesel, Liquefied Petroleum Gas, Compressed Natural Gas, Hybrid).

Table 2.4 - Road transportation in Italy: distribution of vehicles per fuel types

Fuel type	1990	1995	2000	2005	2010	2015	2020	1990-2020
	number of vehicles							(%)
Gasoline*	29,470,744	33,513,060	35,121,546	32,535,291	29,394,069	27,381,262	27,649,565	-6.2%
Diesel	5,715,113	5,697,237	7,851,657	13,536,904	18,415,184	20,222,555	22,390,079	291.8%
LPG	1,081,816	1,165,419	1,281,381	952,954	2,073,900	2,708,844	3,131,292	189.4%
CNG	248,120	267,742	288,554	344,329	709,595	968,742	1,031,873	315.9%
Hybrid**	-	-	-	-	22,243	88,440	625,510	-
total	***36,515,793***	***40,643,458***	***44,543,138***	***47,369,478***	***50,614,991***	***51,369,843***	***54,828,319***	50.1%

*including E85 passenger cars (mixture of 85% bioethanol and 15% gasoline fuel)

**including hybrid gasoline and hybrid diesel vehicles

Over the last three decades, considering the distribution by fuel types, diesel vehicles increased by 291.8%; LPG vehicles increased by 189.4% and CNG vehicles increased by 315.9%.

Road Transport sector energy demand in Italy in the period 1990 - 2019 has increased by about 7.1%; in the last year the decrease, basically due to the pandemic, was about -18.4%, with a resulting decrease from 1990 to 2020 equal to -12.6%. A relative growth over the years has been observed for alternative fuels, but the weight respect to the national total consumed is still not significant, as shown in the following Table 2.5.

Table 2.5 -Road Transport sector energy consumption in Italy per fuel (PJ) referred to 1990-2020

Fuel	1990	1995	2000	2005	2010	2015	2020	1990-2020
	PJ							(%)
Gasoline	568.0	754.9	731.2	589.6	428.9	334.4	250.0	-56.0%
Diesel	652.5	616.9	732.2	958.3	925.2	904.0	732.9	12.3%
LPG	62.6	68.9	65.6	47.5	56.0	76.3	60.0	-4.0%
Natural Gas	8.7	10.2	13.7	15.9	29.1	37.7	32.3	270.5%
Biodiesel*	-	1.7	2.4	7.5	54.9	48.3	52.7	3066.7%
Biogasoline**	-	-	-	-	5.1	1.1	0.8	-83.9%
Electricity**	-	-	-	-	0.2	0.3	0.7	212.1%
Total	***1291.7***	***1452.6***	***1545.0***	***1618.8***	***1499.5***	***1402.1***	***1129.5***	-12.6%

*comparison between 1995-2020

**comparison between 2010-20

Source: Elaboration based on National Energy Balance consumption data

As shown in the previous table, energy consumption in the road transport sector decreased by about 162 PJ in the period 1990-2020. Road transport sector keeps depending almost completely on oil products (92.3% in 2020).

Energy prices and economic recession had an effect in the transport sector. It is observed a strong increase

starting from 1990 until 2007 on one side, due to the increase of vehicle fleet, total mileage and consequently fuel consumptions and on the other side, in the following years a decrease in fuel consumption and CO_2 emissions basically due to the economic crisis and to a lesser extent to the penetration into the market of progressively more efficient vehicles; then, during last year, from 2019 to 2020, there has been a sharp reduction in consumptions, as a result of the pandemic crisis.

As regards the targets for average type-approval emissions for new passenger cars, the EC Regulation 631/2019 set further reduction targets for 2025 and 2030, respect to the previous Regulation EC No 443/2009; finally, the Fit for 55 package sets the proposal of more ambitious CO_2 reduction targets for new passenger cars and vans (-100% in 2035 for cars and vans versus 2021).

Emissions of CO_2 per km from new cars is targeted to decrease over time, Table 2.6 shows the trend in CO_2 emissions from passenger cars along the last three decades.

Table 2.6 - Trend of CO_2 emissions from passenger cars in Italy in the period 1990-2020

Emissions from passenger cars	1990	1995	2000	2005	2010	2015	2020
CO_2 (Mt)	54.9	63.3	69.9	70.2	68.6	68.6	51.5

Source: ISPRA

The EU cars legislation has aimed to improve the fuel economy of cars sold in the European market, these factors linked to energy prices have contributed to move 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, 21.7% of the total agricultural holdings in 2020[20] dealt with livestock farming. Changes in livestock farms have occurred since 1982: the number of livestock farms has decreased by 71.2%. Changes in livestock populations have also occurred: specifically, in 2020 compared to 1982 cattle reduced by 34.1% while poultry increased by 25.3%, the number of pigs decreased slightly (-0.9%).

The total agricultural area, the utilized agricultural area (UAA) and the number of agricultural holdings has been decreasing since 1982 (Table 2.7) according to the Agricultural Census conducted by ISTAT every 10 years; the data related to 2013 and 2016 are the results of the Farm Structure Survey 2013 and 2016, 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 (-63.8% in 2020 compared to 1982) is more significant than the reduction of UAA (-20.8%) thus resulting in the noticeable increase of the average size of Italian agricultural holdings along the same years (+118.9%). In about 40 years, small farms (with UAA less than 1 ha) and large-scale farms (with UAA more than 10 ha) declined by 75% and 35%, respectively. Furthermore, few farms hold the majority of UUA, as small and medium-sized companies have come to large companies over the years: the UAA of small and medium-sized companies fell by 54% from 1982 to 2020, and large-scale farms have increased the average share of UAA from 66.9% to 80.8%. 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.

[20] Considering farms with cattle, pigs or poultry during the 2019-2020 crop year, according to the first results of the 7th General Census of Agriculture, conducted in 2021.

Table 2.7 - Agricultural holdings characteristics in Italy between 1982 and 2020

Agricultural holdings characteristics	1982	1990	2000	2010	2013	2016	2020
Number of agricultural holdings	3,133,118	2,848,136	2,396,274	1,615,590	1,471,185	1,145,705	1,133,023
UAA (ha)	15,832,613	15,025,954	13,181,859	12,856,048	12,425,995	12,598,161	12,535,000
Total agricultural area (ha)	22,397,833	21,628,355	18,766,895	17,081,099	16,678,296	16,525,472	16,474,000
Average size of agricultural holdings (ha)	5.1	5.3	5.5	8.0	8.4	11.0	11.1

Source: ISTAT Agricultural Census for the years 1982 to 2010 and 2020 (preliminary findings); ISTAT Farm Structure Survey (FSS) 2013 and 2016

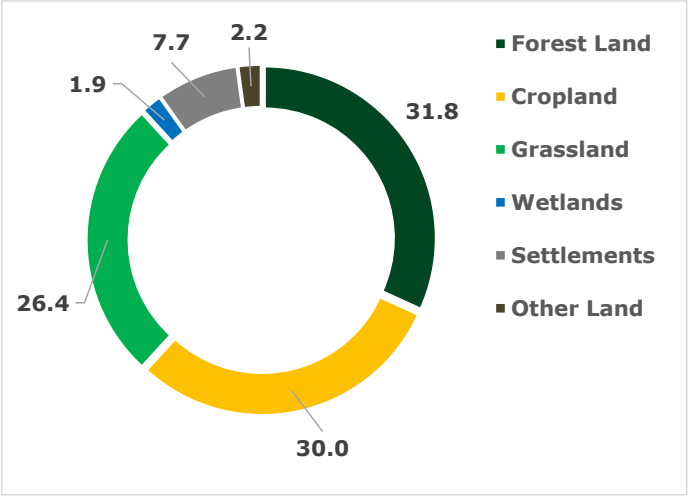
In the last decade, the decrease in the use of fertilizers is the result of both CAP and trend of the fertilizers market prices. The decrease in the use of mineral products with a corresponding increase of organic formulated products is also in line with the CAP aiming at promoting the use of organic 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 FSS 2016, the number of agricultural holdings that produce renewable energy is about 40,000, representing about double the amount of 2010.

2.3.4 LULUCF

From 1990, changes in the land use in Italy have resulted in an increase of the area included under the forest land category (26%), settlements (41%) and wetlands (15%), and a reduction of the cropland area (17%) and grassland area (10%). In Figure 2.19, the land use representation for 2020 is reported.

Figure 2.19 - Land use in Italy in 2020



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, like 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 land category was about 7,590 kha in 1990; 8,369 kha in 2000; 9,032 kha in 2010; and 9,578 kha in 2020, equivalent to 32% 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 2020.

The natural protected areas (established on various administrative levels: national, regional and local) include 30.5% of the total forested areas. The Italian forest area certified under international forest management certification schemes was 892,610 ha in 2021 under the Programme for Endorsement of Forest Certification schemes (PEFC).

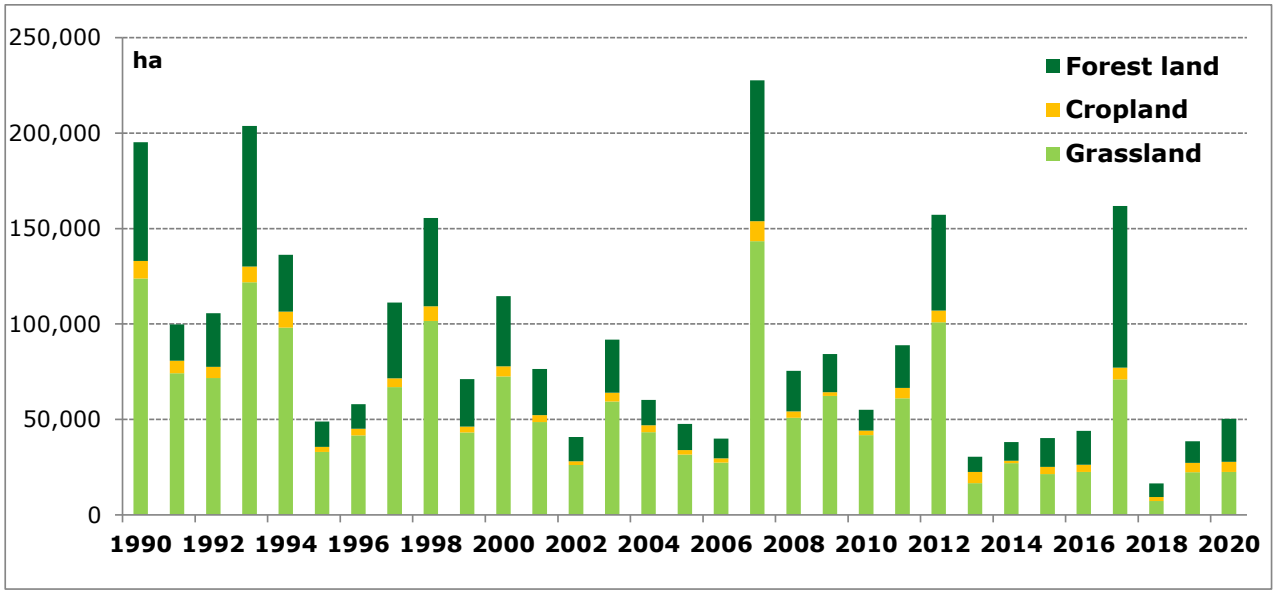
Table 2.8 - Italian land surface areas according to the GHG inventory, along the inventory period[21]

Categories	Area [kha]						
	1990	1995	2000	2005	2010	2015	2020
Forest land	7,590	7,980	8,369	8,759	9,032	9,305	9,578
Cropland	10,841	10,924	10,487	9,879	9,159	8,845	9,044
Grassland	8,891	8,278	8,186	8,265	8,584	8,513	7,953
Wetlands	510	512	515	517	534	571	586
Settlements	1,644	1,782	1,920	2,058	2,170	2,244	2,317
Other land	658	657	656	656	655	655	655
TOTAL	30,134	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 2.20: forested areas affected by fires in 2020 amount to approximately 45% of the total land surface burned by fire in the same year, similarly to the area affected by fires is classified under grassland category in 2020.

[21] ISPRA, NIR 2022

Figure 2.20 – Forest land, Cropland and Grassland (kha) affected by fires



2.3.5 Waste

From 1990, Italy has evolved a lot considering the management of waste. For what concerns wastewater, according to the National Institute of Statistics about 93% of the Italian municipalities were served by a sewer system in 2012 and about 79% of the population was connected to wastewater treatment plants, whilst in 2020 these percentages have increased to 99.5% and 88% respectively. In Table 2.9 estimates of the number of facilities for the treatment of waste in Italy are reported.

Table 2.9 – Waste and wastewater treatment in Italy: number of facilities

Type of waste facility	1990	1995	2000	2005	2010	2015	2020
Landfills	480	650	657	340	211	149	127
Incinerators	122	135	132	111	148	124	115
WWTP	6,820	9,550	12,003	14,473	17,532	19,108	20,684

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 29-30 Mt since 2019. Changes in lifestyle 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 and Covid-19 pandemic has contributed too. In 2020, approximately 28.9 Mt of municipal waste were produced, corresponding to 488.6 kg/year per person (EU27 average per capita MSW production was about 502 kg/year in 2019).

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 26.6 Mt in 2020.

Separate collection has been increasing since 1996: in 2020, about 18 Mt of MSW (63%) were subjected to separate collection compared to 11.4 Mt (35.3%) in 2010 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.

The municipal wastes have been managed as shown in Table 2.10 for the last two decades:

Table 2.10 – Main management systems of Municipal Waste (%)

Treatment	1990	2000	2005	2010	2015	2020
Landfilling	91.1	76	48.6	38.2	21.0	16.3
Incineration	4.6	8	10.2	13.3	15.0	15.0
Mechanical-biological treatment	2.4	10.8	22.5	22.6	28.3	26.1
Composting/anaerobic digestion	0.6	6.6	5.6	10.0	14.0	19.3
Other material recovery technologies			13.1	16.0	21.8	23.3

In Italy, the number of landfills has been decreasing since 1999: a reduction of 659 landfill installations was registered in 2020 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). The amount of methane deriving from landfill gas and sent to energy recovery was 132 kt in 2000, 278 kt in 2010 and 223 kt in 2020.

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 146.9 Mt in 2020. The per capita production of special waste in 2020 at national level was 2.5 t/y, 2.3 t/y for non-hazardous special waste and 0.2 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 2.11.

Table 2.11 - Special wastes produced in Italy between 1990 and 2015 (Mt)

	1990	1997	2000	2005	2008	2009	2010	2015	2020
Non-hazardous special waste	-	56.1	51.8	55.6	60.5	58.7	61.1	70.3	72.3
Hazardous special waste	-	3.4	3.9	7.9	11.3	10.3	9.6	9.1	9.8
Inert waste (Mt)	-	-	27.3	45.9	70.8	65.3	67	52.9	64.8
Total Special Waste	77.1	59.5	83.0	109.4	142.8	134.6	137.9	132.4	146.9

The different systems of special waste management in Italy for the last decade are reported in Table 2.12.

Table 2.12 - Management of Special Waste (%)

Treatment	2000	2005	2010	2015	2020
Storage	15.1	13.7	13.6	10.8	11
Other disposal operation	14.5	14.6	17.2	13.7	10.3
Energy recovery	2.5	2.7	1.6	1.5	1.1
Incineration	1	1.1	0.7	0.7	0.8
Recovery of material	39.8	48.6	57.5	65.1	70.6
Landfilling	27.1	19.4	8.2	8.2	6.2

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 2.13 - Wastewater treatment capacity in Italy

	1990	1995	2000	2005	2010	2015	2020
Number of WWTPs	6,820	9,550	12,003	14,473	17,532	19,108	20,684
Total treatment capacity (M p.e.)	46	60	65	73	76	75	91

2.4 Summary of the parameters in this chapter that affect GHG emissions inventory and projections

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[22]

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).

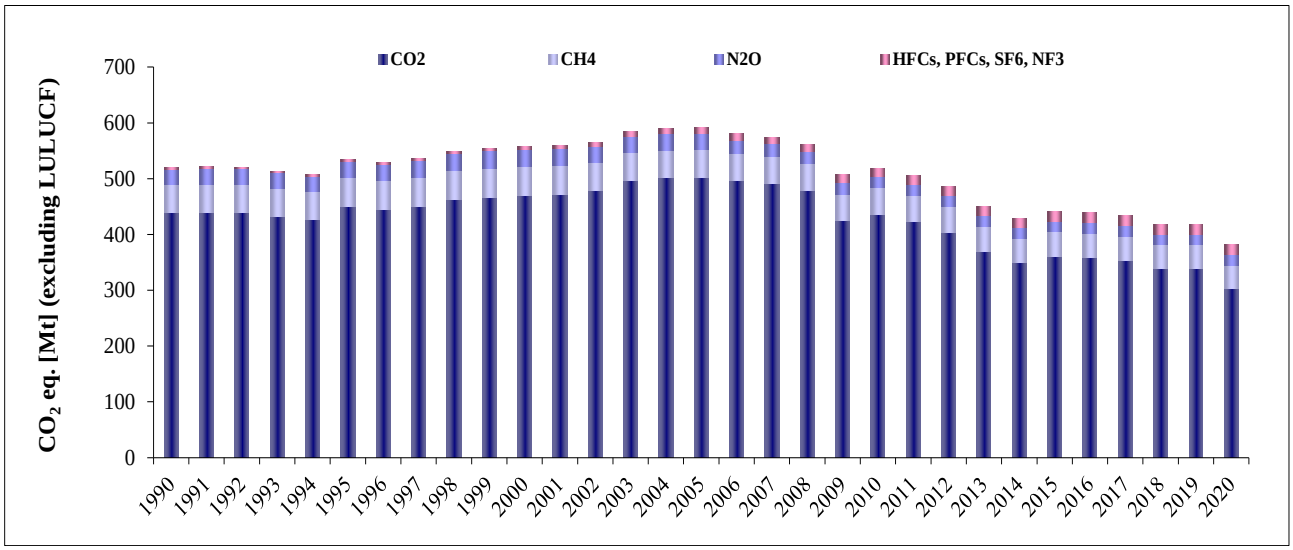
The emissions presented in this document are those communicated in the 2022 submission to the UNFCCC Secretariat and to the European Commission in the context of the Greenhouse Gas Monitoring Mechanism. A complete description of the factors underlying the Italian emission trends, the rationale for the choice of methodologies, the emission factors and parameters used to estimate emissions for the relevant sectors is provided in the National Inventory Report (ISPRA, 2022)[23].

The CRF files, national inventory reports and other related documents can be found at the following addresses: http://emissioni.sina.isprambiente.it/inventario-nazionale; https://unfccc.int/ghg-inventories-annex-i-parties/2022.

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

Figure 3.1 illustrates the national trend of greenhouse gases for 1990-2020, 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 2020 (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.

Total greenhouse gas emissions, in CO_2 equivalent, excluding emissions and removals from LULUCF, have decreased by 26.7% between 1990 and 2020, varying from 520 to 381 CO_2 equivalent million tons (Mt).

It should be noted that the economic recession and the Covid pandemic have had a remarkable influence on the emission trends of the last years with a reduction in the production levels which affected the energy and industrial process sectors, and a drop in the use of fuels for transport.

[22] Lead Authors: Daniela Romano (ISPRA); Chiara Arcarese (ISPRA; § 3.3).
Contributing Authors: Antonella Bernetti, Antonio Caputo, Marco Cordella, Eleonora Di Cristofaro, Andrea Gagna, Barbara Gonella, Federica Moricci, Guido Pellis, Ernesto Taurino, Marina Vitullo (ISPRA).
[23] ISPRA, 2022. Italian Greenhouse Gas Inventory 1990-2020. National Inventory Report 2022. ISPRA, 360/2022.

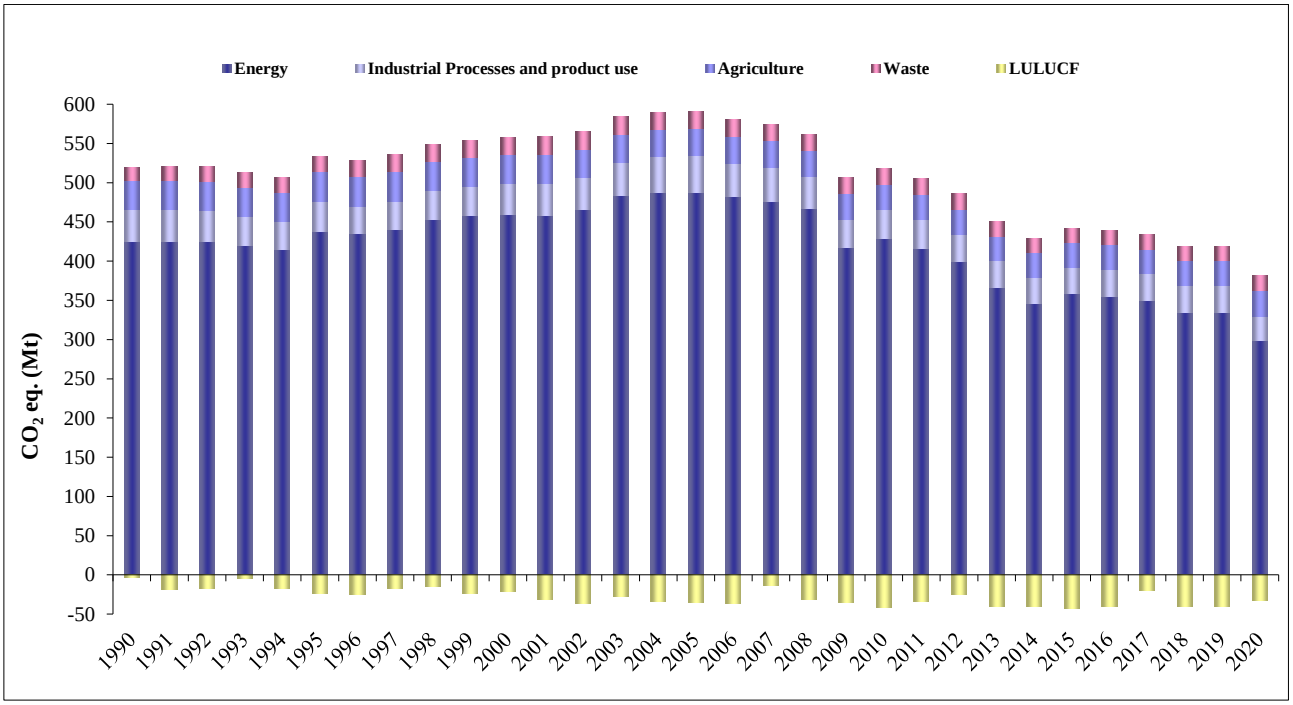
The most important greenhouse gas, CO_2, which accounts for 79.3% of total emissions in CO_2 equivalent, shows a decrease by 31.2% between 1990 and 2020. In the energy sector, in particular CO_2 emissions in 2020 are 29.6% lower than in 1990.

CH_4 and N_2O emissions are equal to 11.2% and 5.1% of the total CO_2 equivalent greenhouse gas emissions, respectively. CH_4 emissions decreased by 13.4% from 1990 to 2020, while N_2O has decreased by 28.4%.

As for other greenhouse gases, HFCs account for 4.2% of total emissions, PFCs and SF6 are equal to 0.2% and 0.1% of total emissions, respectively; the weight of NF_3 is about 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 2020 by sector



Emission trends excluding LULUCF

The share of the different sectors, in terms of total emissions, remains nearly unvaried over the period 1990-2020. Specifically, for the year 2020, the greatest part of the total greenhouse gas emissions is to be attributed to the energy sector, with a percentage of 78.4%, followed by agriculture and industrial processes and product use, accounting for 8.6% and 8.1%, respectively, and waste contributing with 4.9% to total emissions.

For the energy sector, the decrease in total emissions is equal to 29.7% in the period 1990-2020; in particular, an upward trend is noted from 1990 to 2004, with an increase by 14.5% in total greenhouse gas emissions in CO_2 equivalent excluding LULUCF, whereas a reduction by 38.7% between 2005 and 2020 is observed.

From 2005, 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) on 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 equal to -10.1% followed by a slight increase (+2.3%) from 2009 to 2010; since then, except for the two years 2014-2015, the annual variations are always negative until 2020.

In general, from 1990 to 2020 the decrease in emissions is driven by the reduction in the energy industries and manufacturing industries and construction, which account, in 2020, for 27.4% and 15.3% and reduced by 40.6% and 50.3%, 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.

A small increase in emissions still occurs in other sectors subcategory (0.2%), which account for 26.5% in 2020. Instead, the transport sector, accounting for 28.6%, in 2020, shows a decrease of 16.4%.

Road transport is the most relevant source in the transport sector, accounting in 2020 for 23.4% of total national CO_2 equivalent emissions. In 2020, GHG emissions from road transport were about 92.1% of the national emissions from transport. From 1990 to 2020, GHG emissions from the sector decreased by 16.3%. This trend has a two fold explanation: on one side, a strong increase starting from 1990 until 2007 (27.8%) 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 from 2007 to 2019 decrease of about -18.7%). During last year, from 2019 to 2020, there has been a sharp reduction in emissions, amounting to approximately -19.4%, as a result of the pandemic crisis.

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 96.4% of the total, whose levels have decreased by 29.6% from 1990 to 2020. 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 8.1% of total national greenhouse gas emissions, excluding LULUCF. Total emission levels, in CO_2 equivalent, reduced by 23.2% from 1990 to 2020. The decrease is prevalently to be attributed to the drop of emissions in the mineral and chemical industries, explaining 68.2% and 13.3%, respectively, of the sectoral total. Emissions from mineral production decreased by 52.8%, mostly for the reduction of cement production.

The decrease of GHG emissions in the chemical industry (-81.9%) is due to the decreasing trend of the emissions from nitric acid and adipic acid production (the last production process sharply reduced its emissions, due to a fully operational abatement technology).

On the other hand, a considerable increase is observed in F-gas emissions (338.4%), whose share on total sectoral emissions is 53.8%. 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 contributing with 8.6% to total greenhouse gases, excluding the LULUCF sector. Emissions mostly refer to methane and nitrous oxide levels, which account for 59.0% and 39.5% of total emissions of the sector, respectively; CO_2 accounts for the remaining 1.5%. The decrease observed in total emissions from 1990 to 2020 (-11.4%) is due to the decrease of CH_4 emissions from enteric fermentation (-13.0%) and N_2O from agricultural soils (-3.9%), which account for 41.4% and 33.1% 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 reduction of 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 4.9% of total national greenhouse gas emissions, excluding LULUCF, and shows an increase of 7.7% from 1990 to 2020. The trend is mainly driven by the emissions from solid waste disposal, accounting for 76.6% of the total sectoral emissions, which increased by 16.8%; 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 19.3% of the total, shows a decrease in emissions equal to 19.4% 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, national totals show a downward trend of 32.4% from 1990 to 2020.

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 98.0% 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 23%). Emissions and removals from the LULUCF sector are reported in Table 3.1.

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

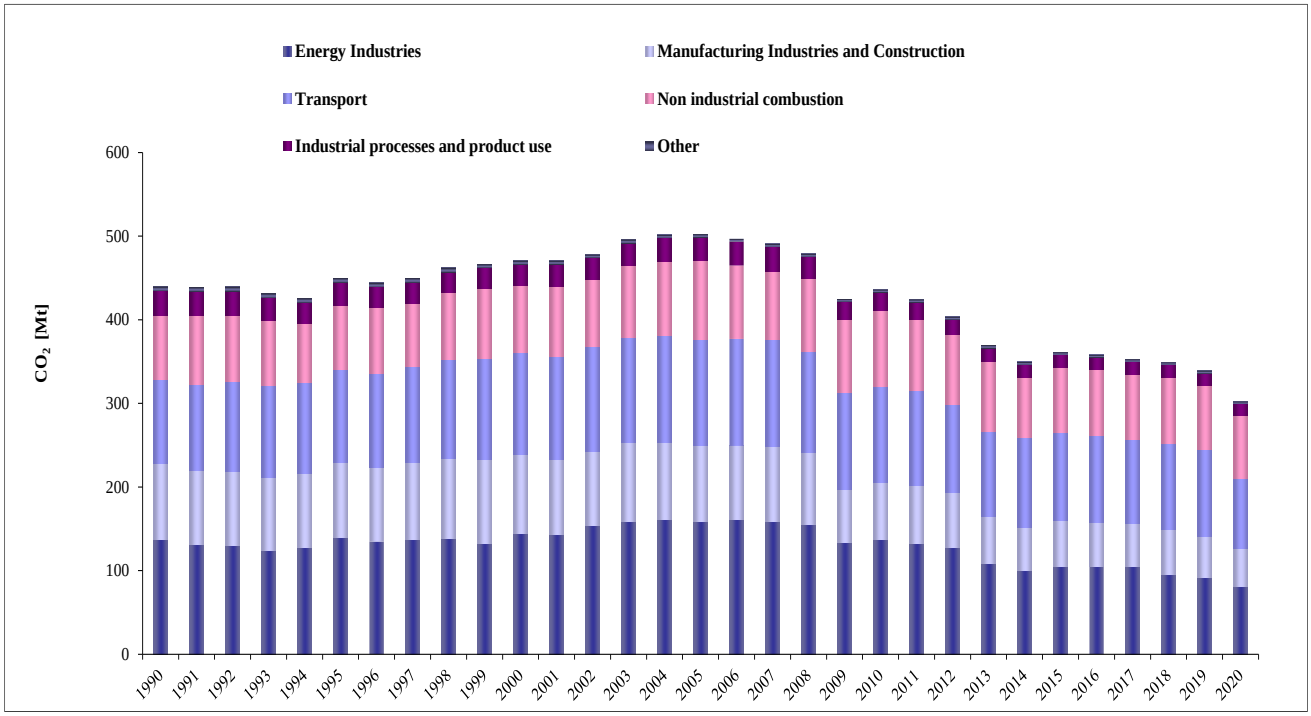
	1990	1995	2000	2005	2010	2015	2020
				kt CO_2 eq.			
Total emissions / removals	**-3,648**	**-23,956**	**-21,113**	**-35,241**	**-41,536**	**-43,093**	**-32,401**
Forest land	-17,255	-31,001	-25,694	-34,541	-36,146	-39,221	-30,115
Cropland	1,712	686	-540	-1,893	-866	575	-14
Grassland	5,122	-1,907	-1,425	-6,126	-9,210	-9,400	-7,207
Wetlands	0	5	8	8	130	130	32
Settlements	7,145	8,941	6,982	7,804	4,688	4,735	5,569
Harvested wood products	-388	-706	-454	-503	-142	89	-669

3.1.1 Carbon dioxide emissions

CO_2 emissions, excluding CO_2 emissions and removals from LULUCF, have decreased by approximately 31.2% from 1990 to 2020, reducing from 440 to 303 million tons.

The most relevant contributions derive from transportation (27.9%) and the energy industries (26.9%). Non-industrial combustion accounts for 24.9% and manufacturing and construction industries for 14.8%, while the remaining emissions derive from industrial processes (4.5%) and other sectors (0.9%). 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 2020



The main sectors in charge of the reduction of CO_2 emissions are the energy industries and manufacturing industries and construction; in the period 1990-2020, emissions from energy industries have decreased by 40.6% while those from manufacturing industries and construction show a decrease of 50.6%. 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.

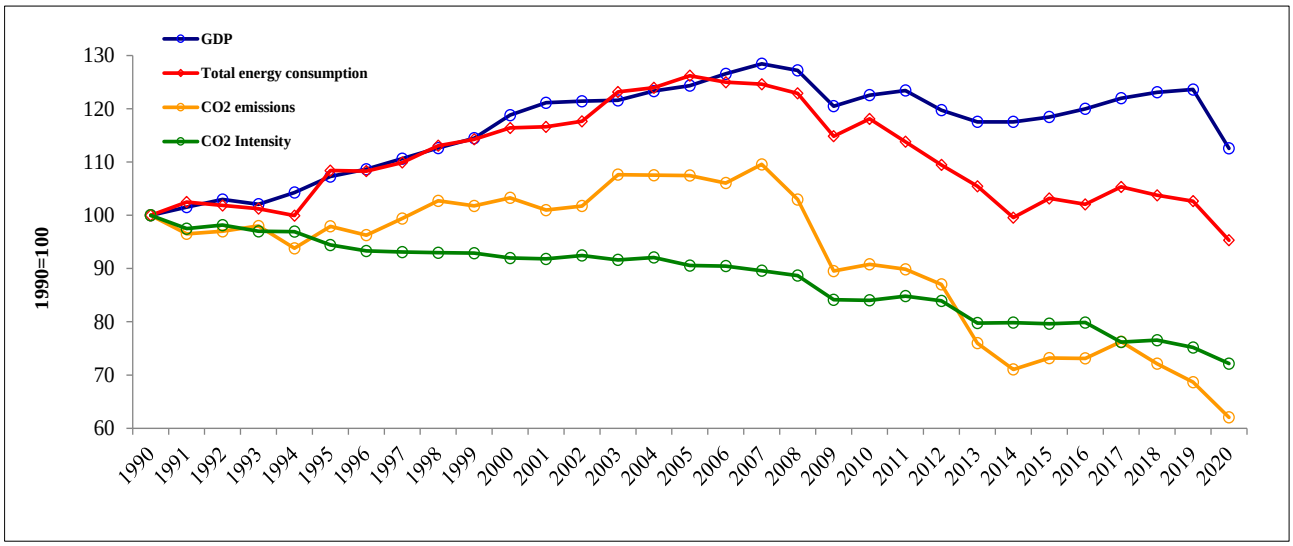
Non-industrial combustion emission trend is driven by the annual climatic variation while emissions from industrial processes decreased by 53.4% mainly for the decrease of cement production.

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

- Gross domestic product (GDP) at market prices as of 2010 (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. The last year of the time series is a special year. The pandemic situation due to Covid-19 has led to a sharp fall in emissions but also a slowdown in economic growth.

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



3.1.2 Methane emissions

Methane emissions, excluding the LULUCF sector, represent 11.2% of total greenhouse gases in 2020, equal to 42.8 Mt in CO_2-equivalent, and show a decrease of approximately 13.4% compared to 1990 levels.

CH_4 emissions, in 2020, originate mainly from the agriculture sector, which accounts for 45.1% of total methane emissions, as well as from waste (39.3%) and energy (15.6%).

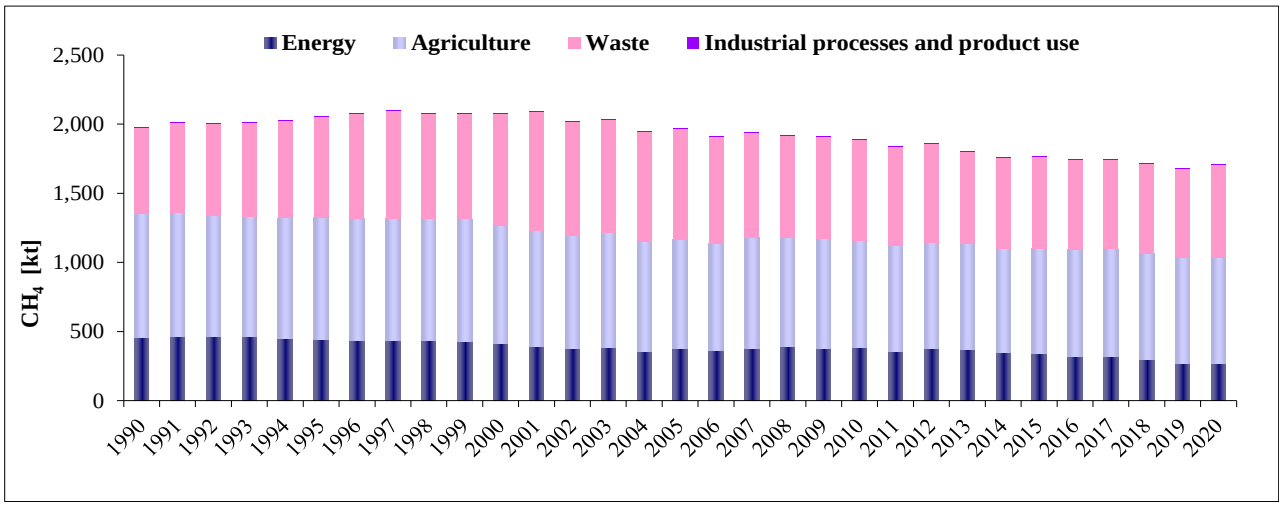
Emissions in the agriculture sector regard mainly the enteric fermentation (70.2%) and manure management (21.5%) categories. The agriculture sector shows a decrease of emissions equal to 13.5% compared 1990, attributable widely to a reduction in livestock and the recovery of biogas for energy purposes (for swine and poultry).

Activities typically leading to emissions in the waste-management sector are the operation of dumping sites and the treatment of industrial wastewater. The waste sector shows a decrease in CH_4 emission levels, equal to 21.7% compared to 1990; the largest sectoral shares of emissions are attributed to solid waste disposal on land (76.5.9%) and waste-water handling (13.5%), which show a decrease equal to 22.3% and 22.7%, respectively.

In the energy sector, the reduction of CH4 emissions (-42.0%) 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 2020



3.1.3 Nitrous oxide emissions

In 2020 nitrous oxide emissions, excluding the LULUCF sector, represent 5.1% of total greenhouse gases, with a decrease of 28.4% between 1990 and 2020, decreasing from 27.2 to 19.5 Mt CO_2-equivalent.

The major source of N_2O emissions is agriculture (66.3%), 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 8.4% in the 1990-2020 period, due to a reduction in livestock number.

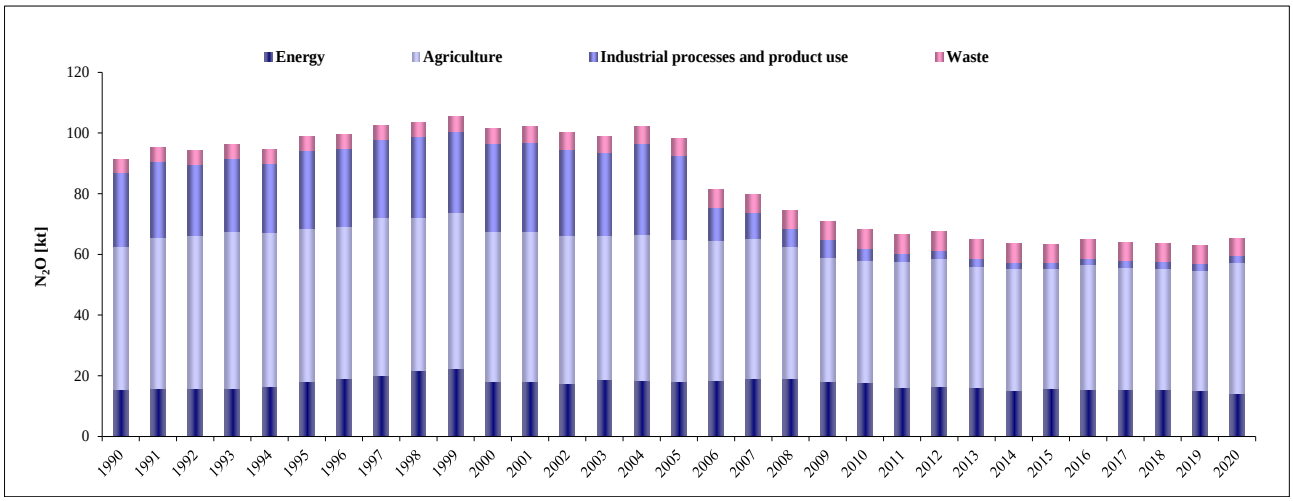
N_2O emissions in the energy sector (21.7% of the total) decreased by 8.4% from 1990 to 2020; this trend can be traced back primarily to the reduction of emissions by 47.6% in the manufacturing and construction industries, which account for 3.6% of the total, mainly due to the reduction of cement production in the last years. The downward trend was counterbalanced by the increase of emissions by 35.4% in the other sectors category (which accounts for 12.1% of the total), as a result of the increased use of biomass in heating systems.

The industrial sector accounts for about 3.2% of total N_2O emissions. The sector shows the most significant reduction in emission levels (about 91.3% from 1990 to 2020) almost totally due to the introduction of abatement systems in the nitric and adipic acid production plants which drastically reduced emissions from these processes. 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 and the biological treatment of solid waste, account for 8.9% 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 2020



3.1.4 Fluorinated gas emissions

Emissions of fluorinated gases represent 4.4% of total greenhouse gases in CO_2-equivalent in 2020 and they show a significant increase between 1990 and 2020. This increase is the result of different factors for the different gases.

HFCs, for instance, have increased considerably from 1990 to 2020, from 0.4 to 15.9 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 81.5% from 1990 to 2020. The level of PFC emissions in 2020 is 1.0 Mt in CO_2-equivalent, and it is due to by product emissions in the fluorochemical production (84.6%) and the use of the gases in the production of semiconductors (15.4%).

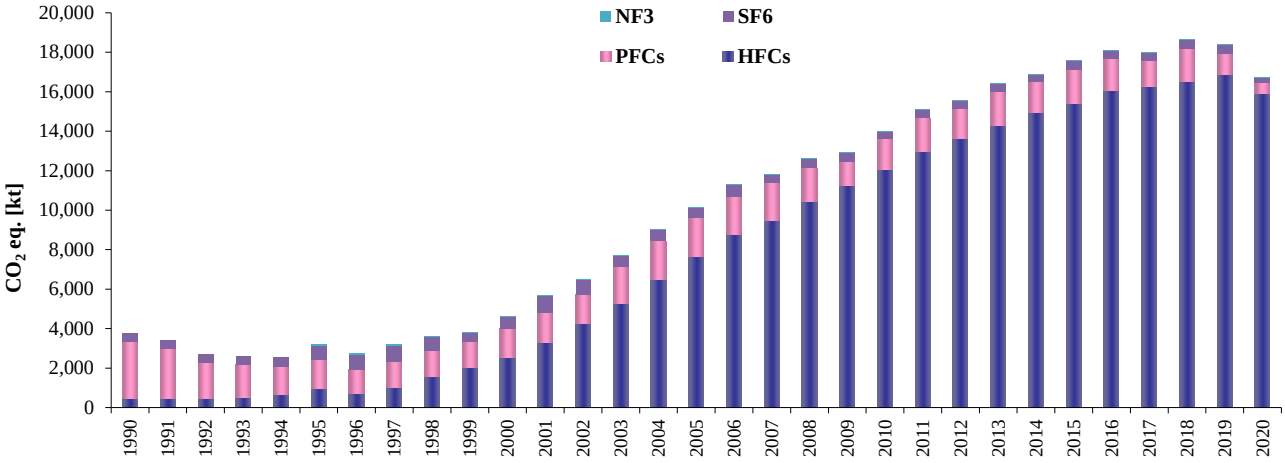
Emissions of SF_6 are equal to 0.3 Mt in CO_2 equivalent in 2020, with a decrease of 35.3% as compared to 1990 levels. In 2020, about 70.4% of SF_6 emissions derive from the gas contained in electrical equipment, 16.0% from the use of this substance in accelerators and 13.6% from the gas used in the semiconductors manufacture.

NF_3 emissions account for 0.004 Mt in CO_2 equivalent in 2020 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 2020



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 prepares 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 document is updated when there is the need to describe an annual change occurred in the system and submitted to the Ministry of Environment and Energy Security for approval.

As for the official consideration of the inventory, the Ministry of Environment and Energy Security 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.

As compared with the last submission of the National Communication, in the context of the Kyoto Protocol commitments and its amendment ('Doha amendment') for the second Commitment Period (2013-2020), Italy adopted, in 2016, Law n. 79/2016, "Ratification of the Doha amendment to the Kyoto Protocol", which establishes, according to article 12 of 525/2013/EU (the Monitoring Mechanism Regulation), the national system for policies, measures and emissions projections. ISPRA is also responsible of this system. With the establishment of this system, there has been a strengthening of roles and obligations for statistical data flow, some of which are useful for the inventory scope.

In order to complete the institutional framework, 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 of Environment and Energy Security is responsible for the management of the National Registry for Carbon sinks. 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. Additional information is included in the section 4.1.5, while a detailed description on the registry and additional information on activities under Article 3.3 and Article 3.4 is reported in the National Inventory Report (ISPRA, 2022).

A complete description of the Italian National System can be found in the document "National Greenhouse Gas Inventory System in Italy. Year 2018" (ISPRA, 2018), publicly available at http://emissioni.sina.isprambiente.it/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.

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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://emissioni.sina.isprambiente.it/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 approved the three-year plan for 2020-2022 (GU Serie Generale n.122, 26/05/2022).

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);
- National Energy Balance (annual), Petrochemical Bulletin (quarterly publication), by MSE (Ministry of Economic Development);
- Transport Statistics Yearbooks, by MIT (Ministry of Infrastructure and Transportation);
- Annual Statistics on Electrical Energy in Italy, by TERNA (National Independent System Operator);
- Annual Report on Waste, by ISPRA;
- National Forestry Inventory, by 'Carabinieri Forestali'.

The national emission inventory is a Sistan product.

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[24]; IPCC, 2006[25]; IPCC, 2000[26]; IPCC, 2003[27]; EMEP/EEA, 2009[28], EMEP/EEA, 2019[29]).

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.

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.

24 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.
25 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.
26 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.
27 IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. IPCC Technical Support Unit, Kanagawa, Japan.
28 EMEP/EEA, 2009. Air Pollutant Emission Inventory Guidebook. Technical report No 9/2009.
29 EMEP/EEA, 2019. Air Pollutant Emission Inventory Guidebook. Technical report No 13/2019.

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 Infrastructure and 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 Infrastructure and Transportation Major National Industry Corporation
2 Industrial Processes and Product Use	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 Agriculture	Agricultural surfaces Production data Number of animals Fertiliser consumption	Agriculture Statistical Yearbooks - National Institute of Statistics Sectoral Agriculture Associations
4 Land Use, Land Use Change and Forestry	Land classification Forest area, biomass increment and stock Agricultural management practises Fires	IUTI (Inventory of Land Use) Carabinieri Forestali - National Forestry Inventory Statistical Yearbooks - National Institute of Statistics National Information system on organic agriculture (SINAB); Annual Implementation Reports (RAE) and Annual Report on Operational Programs; EUROSTAT Universities and Research Institutes
5 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 3.1% for the year 2020; the uncertainty in the trend between the base year and 2020 is equal to 2.2%. When considering the LULUCF sector in the analysis, the uncertainty in total GWP emissions and removals increases to 4.5% for the year 2020 and to 3.0% 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.

Applying category analysis to the 2020 inventory, without considering the LULUCF sector, 43 key categories were identified in total, both at level and trend. When considering emissions and removals from the LULUCF sector, 45 key categories were identified.

Results of the key category assessment for the 2020 inventory are reported in Table 3.3. More details can be found in the National Inventory Report.

The results of the uncertainty analysis, generally associated with a key category assessment by Approach 2, are used to prioritize improvements for the next inventory submissions.

Emissions of key categories are usually estimated with a high level of accuracy in terms of the methodology used and characterised by a low uncertainty; some exceptions may occur and categories estimated with higher tiers may be affected by a high level of uncertainty. For instance, in the agriculture sector, direct N2O emissions from agricultural soils and indirect N2O from nitrogen used in agriculture are affected by a high level of uncertainty especially in the emission factors notwithstanding the advanced tiers used.

Table 3.3 - Key categories by the IPCC Approach 1 and Approach 2 (L=Level, T=Trend). Year 2020

	Key categories (excluding the LULUCF sector)	
1.A.1	Energy industries - CO2 gaseous fuels	L, T
1.A.1	Energy industries - CO2 liquid fuels	L, T
1.A.1	Energy industries - CO2 solid fuels	L, T
1.A.2	Manufacturing industries and construction - CO2 gaseous fuels	L, T
1.A.2	Manufacturing industries and construction - CO2 liquid fuels	L, T
1.A.2	Manufacturing industries and construction - CO2 solid fuels	L1, T
1.A.3.a	Transport - CO2 Civil Aviation	L1, T1
1.A.3.b	Transport - CH4 Road transportation	T2
1.A.3.b	Transport - CO2 Road transportation	L, T
1.A.3.d	Transport - CO2 Waterborne navigation	L1
1.A.4	Other sectors - CH4 commercial, residential, agriculture biomass	L, T
1.A.4	Other sectors - CO2 commercial, residential, agriculture gaseous fuels	L, T
1.A.4	Other sectors - CO2 commercial, residential, agriculture liquid fuels	L, T
1.A.4	Other sectors - CO2 commercial, residential, agriculture other fossil fuels	L1, T
1.A.4	Other sectors - CO2 commercial, residential, agriculture solid fuels	T1
1.A.4	Other sectors - N2O commercial, residential, agriculture biomass	L2, T
1.A.4	Other sectors - N2O commercial, residential, agriculture liquid fuels	L2
1.B.2.a	Fugitive - CO2 Oil and natural gas - Oil	L1
1.B.2.b	Fugitive - CH4 Oil and natural gas - Natural gas	L, T
1.B.2.d	Fugitive - CH4 Oil and natural gas - Other - flaring in refineries	L2, T2
1.B.2.d	Fugitive - CO2 Oil and natural gas - Other - flaring in refineries	T2
2.A.1	Mineral industry- CO2 Cement production	L, T
2.A.2	Mineral industry- CO2 Lime production	L1
2.A.4	Mineral industry- CO2 Other processes uses of carbonates	T1
2.B.1	Chemical industry- CO2 Ammonia production	T1
2.B.2	Chemical industry- N2O Nitric acid production	T
2.B.3	Chemical industry- N2O Adipic acid production	T
2.B.9	Chemical industry- HFCs Fluorochemical production	T2
2.C.1	Metal industry- CO2 Iron and steel production	T1
2.C.3	Metal industry- PFCs Aluminium production	T
2.D	Non-Energy products from Fuels and Solvent Use - CO2	L2
2.F.1	Product uses as substitutes for ozone depleting substances - HFCs Refrigeration and Air conditioning	L, T
2.F.2	Product uses as substitutes for ozone depleting substances - HFCs Foam blowing agents	T2
2.F.3	Product uses as substitutes for ozone depleting substances - HFCs Fire protection	L, T
3.A.1	Enteric Fermentation- CH4	L, T
3.A.2	Manure Management - CH4	L
3.A.2	Manure Management - N2O	L
3.C.4	Direct N2O Emissions from Managed soils	L, T
3.C.5	Indirect N2O Emissions from Managed soils	L, T2
3.C.7	Rice cultivations - CH4	L1
5.A	Solid waste disposal - CH4	L, T
5.B	Biological treatment of Solid waste - N2O	L2, T2
5.D	Wastewater treatment and discharge - CH4	L
5.D	Wastewater treatment and discharge - N2O	L, T2

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

Key categories (including the LULUCF sector)		
1.A.1	Energy industries - CO2 gaseous fuels	L, T
1.A.1	Energy industries - CO2 liquid fuels	L, T
1.A.1	Energy industries - CO2 solid fuels	L, T
1.A.2	Manufacturing industries and construction - CO2 gaseous fuels	L, T
1.A.2	Manufacturing industries and construction - CO2 liquid fuels	L1, T
1.A.2	Manufacturing industries and construction - CO2 solid fuels	L1, T
1.A.3.b	Transport - CO2 Road transportation	L, T
1.A.3.d	Transport - CO2 Waterborne navigation	L1, T1
1.A.4	Other sectors - CH4 commercial, residential, agriculture biomass	L, T
1.A.4	Other sectors - CO2 commercial, residential, agriculture gaseous fuels	L, T
1.A.4	Other sectors - CO2 commercial, residential, agriculture liquid fuels	L, T
1.A.4	Other sectors - CO2 commercial, residential, agriculture other fossil fuels	L1, T
1.A.4	Other sectors - N2O commercial, residential, agriculture biomass	L2, T
1.B.2.a	Fugitive - CO2 Oil and natural gas - Oil	L1
1.B.2.b	Fugitive - CH4 Oil and natural gas - Natural gas	L, T
1.B.2.d	Fugitive - CH4 Oil and natural gas - Other - flaring in refineries	L2, T2
2.A.1	Mineral industry- CO2 Cement production	L, T
2.A.2	Mineral industry- CO2 Lime production	L1
2.A.4	Mineral industry- CO2 Other processes uses of carbonates	T1
2.B.2	Chemical industry- N2O Nitric acid production	T1
2.B.3	Chemical industry- N2O Adipic acid production	T
2.B.9	Chemical industry- PFCs Fluorochemical production	L2
2.C.1	Metal industry- CO2 Iron and steel production	T1
2.C.3	Metal industry- PFCs Aluminium production	T
2.D	Non-Energy products from Fuels and Solvent Use - CO2	L2
2.F.1	Product uses as substitutes for ozone depleting substances - HFCs Refrigeration and Air conditioning	L, T
2.F.2	Product uses as substitutes for ozone depleting substances - HFCs Foam blowing agents	T2
2.F.3	Product uses as substitutes for ozone depleting substances - HFCs Fire protection	L, T
3.A.1	Enteric Fermentation- CH4	L, T
3.A.2	Manure Management - CH4	L, T1
3.A.2	Manure Management - N2O	L
3.C.4	Direct N2O Emissions from Managed soils	L, T
3.C.5	Indirect N2O Emissions from Managed soils	L, T
3.C.7	Rice cultivations - CH4	L1
4.A.1	Forest Land remaining Forest Land - CO2	L, T
4.A.2	Land Converted to Forest Land - CO2	L, T
4.B.1	Cropland Remaining Cropland - CO2	T
4.B.2	Land converted to cropland – CO2	T2
4.C.1	Grassland Remaining Grassland - CO2	L, T
4.C.2	Land Converted to Grassland - CO2	L, T
4.E.2	Land Converted to Settlements - CO2	L, T
5.A	Solid waste disposal - CH4	L, T
5.B	Biological treatment of Solid waste - N2O	L2, T2
5.D	Wastewater treatment and discharge - CH4	L, T2
5.D	Wastewater treatment and discharge - N2O	L, T2

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

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.

In the last years, major changes regarded the use of country specific information on parameters and data (e.g at plant level) allowing for more advanced methodologies to estimate emissions.

Details on the annual major recalculations are reported in the annual National Inventory Reports.

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, 2014)[30]. 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, 2022)[31]. These documents are available http://emissioni.sina.isprambiente.it/inventario-nazionale/quality-assurance-quality-control-plan-for-the-italian-emission-inventory/.

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, a bilateral review between Italy and Spain was undertaken in 2012, with a focus on the revision of the GHG inventories of both the Parties; in addition, an official independent review of the entire Italian greenhouse gas inventory was undertaken by the Aether consultants in 2013.

In 2022, ISPRA finalised the provincial inventory at local scale for the year 2019 and updated figures for 1990, 1995, 2000, 2005 and 2010 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://emissioni.sina.isprambiente.it/serie-storiche-emissioni/; a report has also been finalised[32].

Especially in the last years, there has been an intensification of the activities in order to establish national

[30] ISPRA, 2014. Quality Assurance/Quality Control plan for the Italian Emission Inventory. Procedures Manual. Manuali e Linee Guida 112/2014.
[31] ISPRA, 2022. Quality Assurance/Quality Control plan for the Italian Emission Inventory. Available on line at: http://emissioni.sina.isprambiente.it/inventario-nazionale/quality-assurance-quality-control-plan-for-the-italian-emission-inventory/

[32] ISPRA, 2022. La disaggregazione a livello provinciale dell'inventario nazionale delle emissioni. https://www.isprambiente.gov.it/en/publications/reports/la-disaggregazione-a-livello-provinciale-1?set_language=en

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 document concerning the state of implementation of commitments to reduce greenhouse gases emissions, and describing emission trend and projections, is prepared by MASE 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 was conceived for the administration of emissions allowances allocated to operators participating to the EU ETS

and it was developed according to the UN Data Exchange Standards document. Therefore, in October 2008, after the initialization process and a go-live phase with the UNFCCC, the registry established under Directive 2003/87/CE became part of the Kyoto system of registries, ensuring the precise tracking of holdings, issuances, transfers, cancellations and retirements of Kyoto units.

In 2012 all national registries of the EU Member States as well as the national registries of Norway, Liechtenstein and Iceland were grouped in a single central software system managed by the European Commission. The Consolidated System of European Registries, in short CSEUR, was developed together with the new EU registry on the basis 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 CSEUR, 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 National Inventory Report submission for year 2013.

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)

- 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 of Environment and Energy Security and the Ministry of 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

a) *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.

b) *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.

c) *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.

d) *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.

e) *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, while the use of soft token became mandatory in January 2022 for registry users to access the registry and sign transactions.

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

Non-confidential information required by Decision 13/CMP.1 annex II.E paragraphs 44-48, is publicly accessible via the Union Registry website at:

https://unionregistry.ec.europa.eu/euregistry/IT/public/reports/publicReports.xhtml

and it is also available on the informative website at:

https://www.isprambiente.gov.it/en/services/emission_trading_registry/public-reports

Information is updated on a monthly basis and is provided 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 Delegated Regulation (EU) No 2019/1122;

- 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 80 of Commission Delegated Regulation (EU) No 2019/1122.

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

The Italian registry is available at the following URL:

https://ets-registry.webgate.ec.europa.eu/euregistry/IT/index.xhtml

h) 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.

i) 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.

4 POLICIES AND MEASURES[33]

4.1 Policy making process

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

- the Kyoto Protocol and its amendment (Doha amendment);

- the European Climate and Energy Package for the period 2013-2020;

- the EU NDC, the European 2030 Climate and Energy Framework and Clean energy for all Europeans package for the period 2021-2030.

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

Under the Kyoto Protocol, the EU-15[34] has agreed to reduce its greenhouse gas (GHG) emissions by 8% in the period 2008–2012 (commitment period) compared to base year levels 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 reducing its GHG emissions by 6.5% below base-year levels (1990) over the first commitment period, 2008-2012. Following the review of the initial report of Italy under the Kyoto Protocol (FCCC/IRR/2007/ITA), the Italian target under the Kyoto Protocol has been established as 483.26 $MtCO_2$/year for each year of the first commitment period of the Kyoto Protocol. 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, to fulfill the commitments under Article 3.1 of the Kyoto Protocol[35], Italy took appropriate actions to achieve compliance.

In 2012 the Doha Amendment was adopted which implied new commitments for Annex I Parties for the period 2013-2020, with a revised list of GHGs that should be reported and amendments to several articles of the Kyoto Protocol.

To ensure reductions in the second commitment period of the Kyoto Protocol, the EU and its Member States pledging to reduce their collective emissions to 20% below their levels in 1990. The target has to be fulfilled jointly with Iceland[36].

4.1.2 The Climate and 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) committed the European Member States to achieve by 2020 the following targets:

- 20% reduction of EU GHG 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.

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[34] 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).

[35] http://unfccc.int/kyoto_protocol/true-up_process/items/9023.php

[36] Notification of the terms of the agreement to fulfil jointly the commitments of the European Union, its Member States and Iceland: https://unfccc.int/sites/default/files/resource/Agreement%20Notification_EU%20Joint%20fulfilment_E_.pdf

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 splits 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 track progress and assess compliance with the targets set by Directive 2009/29/CE and by Decision 406/2009/CE, starting from the year 2013 national emissions and projections have to be divided into two main sectors: EU ETS and all other sectors (non-ETS).

The 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. This directive had 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. National and international aviation, including only 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[37], had to reduce their emissions at least by 43% compared to 2005 levels[38]. The reduction target was not distributed at Member State level; therefore, an assessment of emissions of operators subject to ETS at national level is only possible ex post.

According to the above-mentioned Decision No 406/2009/EC (Effort Sharing Decision or ESD), Italy had to reduce to reduce its GHG emissions by 13% compared to 2005 levels, in all the sectors not covered by ETS, namely road and domestic maritime transport, buildings, agriculture, waste and small industries. 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. As shown in Table 4.1.1 Italy has overachieved its targets.

NF_3 emissions do not fall under either ETS or Effort Sharing until 2020.

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

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

Table 4.1.1 – ESD targets for Italy 2013 – 2020

	2013	2014	2015	2016	2017	2018	2019	2020
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
ITALY Effort Sharing Emissions	283.6	274.4	283.4	282.1	275.9	280.8	275.0	254.0
Overachievment	*-24.6*	*-31.8*	*-20.8*	*-20.2*	*-22.4*	*-15.0*	*-18.4*	*-37.0*

4.1.3 The 2030 EU Climate & Energy Framework and Clean energy for all Europeans package

On 12 December 2015, UNFCCC Decision 1/CP.21 adopted the Paris 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 2030 EU Climate and Energy Framework, defined in October 2014. In this framework, the European Union set the following binding targets to be reached by 2030:

- at least 40% reduction in GHG emissions compared to 1990 (compared to 2005 levels, -43%, for EU ETS sectors and -30% for ESD sectors);
- at least 27% of energy consumption from renewable sources;
- at least 27% of energy efficiency improvements[39].

New Regulations and Directives[40] have been adopted at EU level to effectively implement the NDC and the EU Climate and Energy Framework. In particular, the 40% reduction in GHG emissions is implemented through the update of the EU ETS, while the non-ETS target has been translated into individual binding targets for Member States with Regulation (EU) 2018/842, and Regulation (EU) 2018/841, setting the LULUCF target. In this way, all sectors will contribute to the achievement of the target by both reducing emissions and increasing removals.

The most relevant European legislative acts are:

- *Directive (EU) 2018/410 of the European Parliament and of the Council of 14 March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/1814*
- *Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013*
- *Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU*

[39] https://ec.europa.eu/clima/policies/strategies/2030_en
[40] https://energy.ec.europa.eu/topics/energy-strategy/clean-energy-all-europeans-package_en

- *Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council*
- *Commission Delegated Regulation (EU) 2021/268 of 28 October 2020 amending Annex IV to Regulation (EU) 2018/841 of the European Parliament and of the Council as regards the forest reference levels to be applied by the Member States for the period 2021-2025*
- *Commission Implementing Decision (EU) 2020/2126 of 16 December 2020 on setting out the annual emission allocations of the Member States for the period from 2021 to 2030 pursuant to Regulation (EU) 2018/842 of the European Parliament and of the Council*

As in the previous phases, the ETS reduction will be applied uniformly with an EU wide emissions cap that will decrease annually by 2.2% up to 2030.

On the other hand, the new Effort Sharing Regulation, as a follow-up of the previous EU Effort Sharing Decision (ESD), assigned to Italy a 33% emission reduction target in non-ETS sectors to be achieved by 2030 compared to 2005 levels.

The Commission Implementing Decision (EU) 2020/2126 set out the annual emission allocations of the Member States for the period from 2021 to 2030. The allocations for Italy are reported in Table 4.1.2.

Table 4.1.2 – ESR 2020-2030 targets for Italy

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Annual allocations for Italy	273,5	268,8	264,0	259,3	254,6	249,8	245,1	240,3	235,6	230,9

In December 2019, the European Council endorsed the objective of making the EU climate-neutral by 2050, in line with the Paris Agreement. The long-term strategy has been submitted to the UNFCCC in March 2020. On this basis, in December 2020 the European Consilium updated the NDC by increasing its climate ambition, endorsed a binding EU target for a net domestic reduction of at least 55% in greenhouse gas emissions by 2030 compared to 1990. To reach that target the European Commission proposed a comprehensive and interconnected set of new directives and regulations, known as the "fit for 55%" package.

In November 2022, the Council and the European Parliament reached a provisional political agreement on stronger emission reduction targets for member states under the Effort Sharing Regulation. The provisional deal endorses an EU-level GHG reduction target of 40% compared to 2005, by 2030, for the sectors not covered by the EU-ETS. For Italy, the proposal increases the national reduction target to 43.7%.

The other policies in the "fit for 55%" package are still under discussion. Since the formal adoption is still pending, the Policies and Measures presented in this Chapter as well as the projections presented in Chapter 5 do not include the effect of the "fit for 55%" package.

4.1.4 National decision-making process related to climate change policies

As reported in paragraph **Errore. L'origine riferimento non è stata trovata.** the protection of the environment, of the ecosystem and cultural resources are under the exclusive competences of the central Government. With the Decree Law 22/2021, converted with amendments into Law 55/2021, the MASE inherits the competences of the former Ministry of the Environment and is enriched with new competences that are closely linked to the ecological transition process, mainly related to the energy sector, Thus, its functions concern the sustainable development, the protection of biodiversity, ecosystems and the marine-coastal heritage, the safeguarding of land and water, policies to combat climate change and global warming, energy efficiency and the circular economy, integrated waste cycle management, the remediation of Sites of National Interest, the environmental assessment of strategic works, combating air-acoustic-

electromagnetic pollution and the risks arising from chemical products and genetically modified organisms. In relation to the energy sector, MASE was assigned the competences for energy and mining policy, previously assigned to the Ministry of Economic Development.

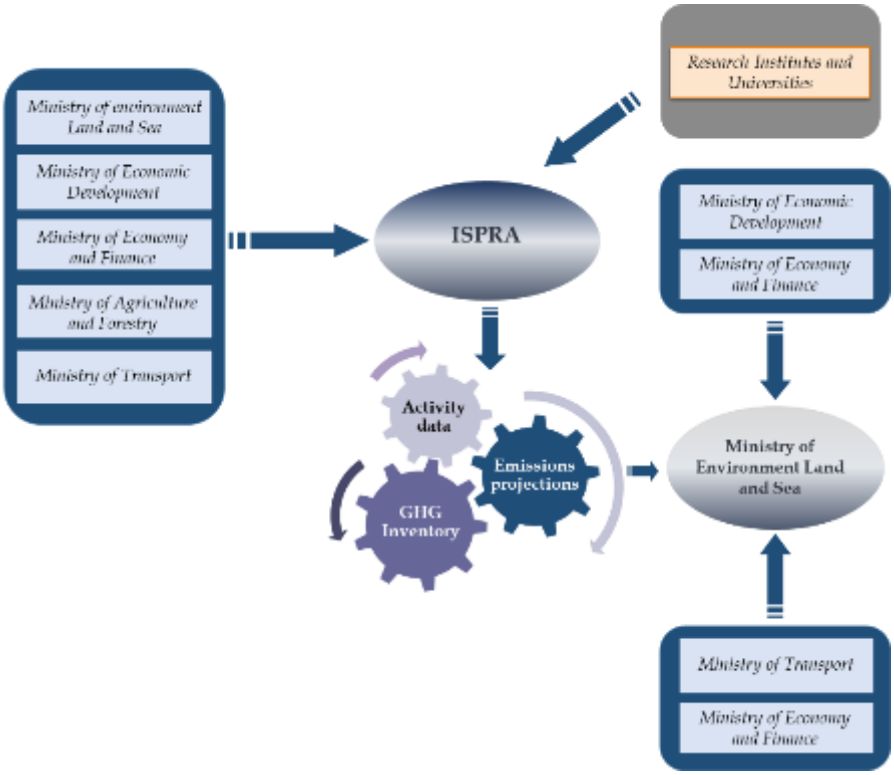
Furthermore, Art. 4 of the Decree Law 22/2021 establishes, at the Presidency of the Council of Ministers, the Inter-Ministerial Committee for Ecological Transition (CITE) with the task of ensuring the coordination of national policies for ecological transition and related programming.

The CITE has the task of approving the Plan for the Ecological Transition, in order to coordinate policies on the reduction of climate-changing gas emissions, sustainable mobility, hydrogeological instability and soil consumption, water resources and related infrastructures, air quality and circular economy. the Plan for the Ecological Transition (Pte) has been approved with CITE Resolution No. 1 of 8 March 2022. Besides, since 2011, the MASE, in consultation with other relevant ministries, is responsible for preparing a report on the status of implementation of GHG emission reduction commitments and emission trends and projections. The report is attached to the Economic and Financial Document (DEF), approved annually by the Government.

4.1.5 Monitoring and evaluation of progress with climate policies and measures

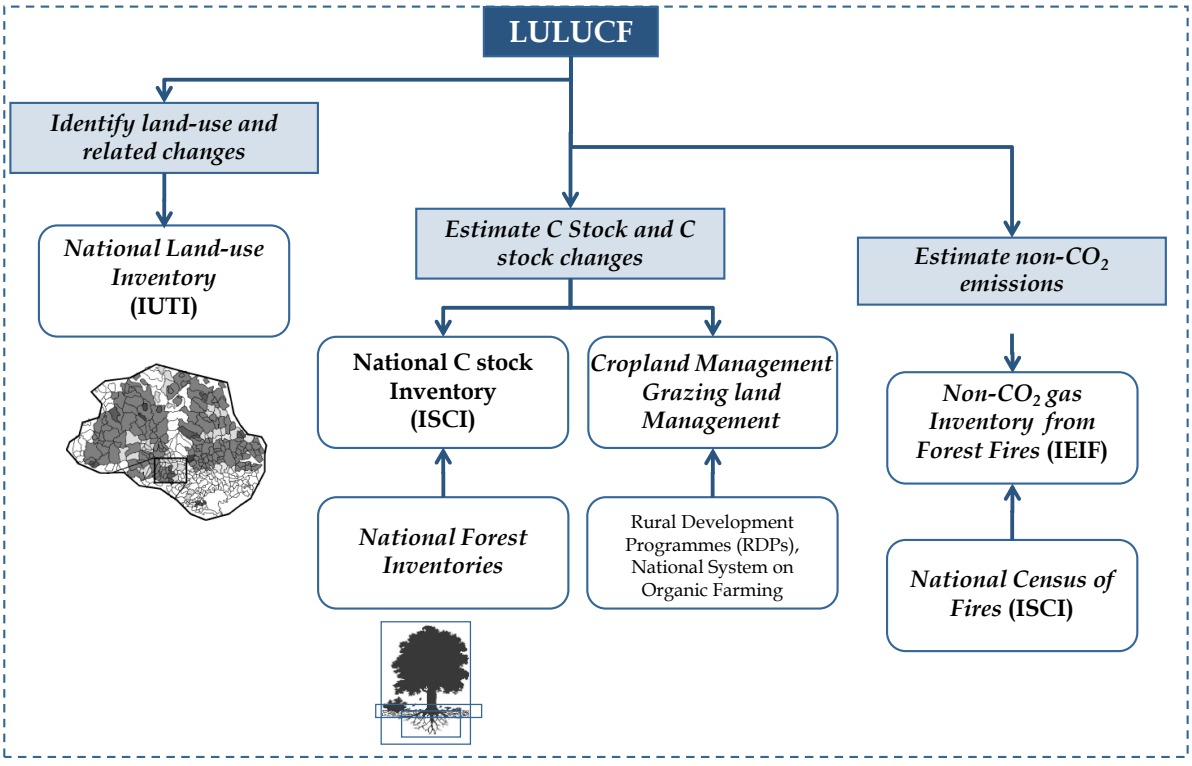
In 2016, in the context of the Kyoto Protocol commitments and its amendment (Doha amendment) for the second Commitment Period (2013-2020), the national system for policies, measures and emissions projections has been established, with the Law n. 79/2016, "Ratification of the Doha amendment to the Kyoto Protocol", in line with art. 12 of the European Union's Greenhouse Gas Monitoring Mechanism. ISPRA is responsible for this system and, in cooperation with the Ministry of Environment and Energy Security (MASE), collects all the information and data from the competent Ministries. Figure 4.1 shows the data flow in the National system for emission inventories, emission projections, and climate change policies.

Figure 4.1 - National system for emission inventories, emission projections and climate change policies



To be noted that the national system for emission inventories, emission projections and climate change policies includes a national legislative arrangement specifically related to the implementation of activities under the Article 3.3 3.3 and Article 3.3 3.4 of the Kyoto Protocol, i.e., the national registry for carbon sinks. The 'National Registry for Carbon sinks', instituted by a Ministerial Decree on 1st April 2008, is part of the Italian National System and 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 of Environment 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. Following an update of the abovementioned Ministerial Decree, in 2013, the Institute for Services on Agricultural and Agro-food Market (ISMEA) has been designated for the technical coordination of the section related to cropland and grazing land management of the National Registry of Carbon Sinks. A detailed description on the registry and additional information on activities under Article 3.3 and Article 3.4 is reported in the National Inventory Report (ISPRA, 2022).

Figure 4.2 – The national registry for carbon sinks



In addition, following the election of the 3.3 and 3.4 activities and on account of an in-depth analysis on the information needed to report LULUCF under the Kyoto Protocol, a Scientific Committee (Comitato di Consultazione Scientifica del Registro dei Serbatoi di Carbonio Forestali), constituted by the relevant national experts, has been established by the MASE in cooperation with the MASAF. Following the election of Cropland Management and Grazing land Management activities under article 3.4 of the Kyoto Protocol, the MASE jointly with the MASAF has established a Committee of National experts at institutional and scientific level, that deals with all issues related to reporting and coordination of activities related to LULUCF.

The abovementioned national legislative arrangements and administrative procedures in place for the implementation of activities under Article 3.3 and Article 3.4 of the Kyoto Protocol also contributes to the conservation of biodiversity and the sustainable use of natural resources. The areas of land subject to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol (in particular, afforestation and reforestation and forest management) include the forest areas designated primarily for the conservation of biological diversity (3,265 kha in 2020). Historical management practices in the Italian forests have been

guided by the Legislative Decree n. 22741 of 18 May 2001, although the design and implementation of specific guidelines has been carried out at regional level since, according to the Italian Constitutional Law, the forest management is a regional competence. From 2008 onward, such guidance has been further elaborated in the Framework Program for the Forestry Sector (Programma Quadro per il Settore Forestale - PQSF) for the protection, enhancement and sustainable management of the national forest patrimony in compliance with the commitments undertaken at international and European level. Such goals are to be achieved within 4 area of action: bioeconomy, conservation, including conservation and enhancement of the forest carbon stocks, rural and social development, socio-recreational and educational functions and public awareness. With the entry into force of the Testo unico in materia di Foreste e Filiere forestali (TUFF), article 6, the National Forest Strategy42 has been established, in continuation of the above-mentioned PQSF (paragraph 1, Article 6, Legislative Decree 3 April 2018, n. 34). Finally, the National Strategy for Biodiversity43, consistently with the EU Biodiversity Strategy to 2020, explicitly links biodiversity with the need to mitigate and adapt to climate change, aiming at sustainable management of the terrestrial ecosystem and the enhancement of the role of carbon sequestration.

As shown in Figure 4.3, to collect data and information needed for the evaluation of policies and the emission scenario regarding all sectors, ISPRA has established a wider network with other entities through temporary agreements and collaborations that can be activated when needed. Hereby more information is provided about the other entities reported in Figure 4.3:

- CRPA (Centro Ricerche Produzioni Animali), Research Centre on Animal Production, supports ISPRA in the fields of agricultural food production. Its activity is mainly focused on research, and establishment and management of services with the aim of promoting technical, economic, and social progress in the livestock farming sector and promoting the spread of the most advanced forms of environmentally friendly agriculture. In 1996, CRPA became a joint stock-holding company with the public sector as its majority shareholder, http://www.crpa.it/

- ENEA is the Italian National Agency for New Technologies, Energy and Sustainable Economic Development, https://www.enea.it/

- CMCC is a foundation which has been established in 2005 with the financial support of the Italian Ministry of University and Research, and the Ministry of the Environment. Its mission is to investigate and model climate system and its interactions with society, https://www.cmcc.it/

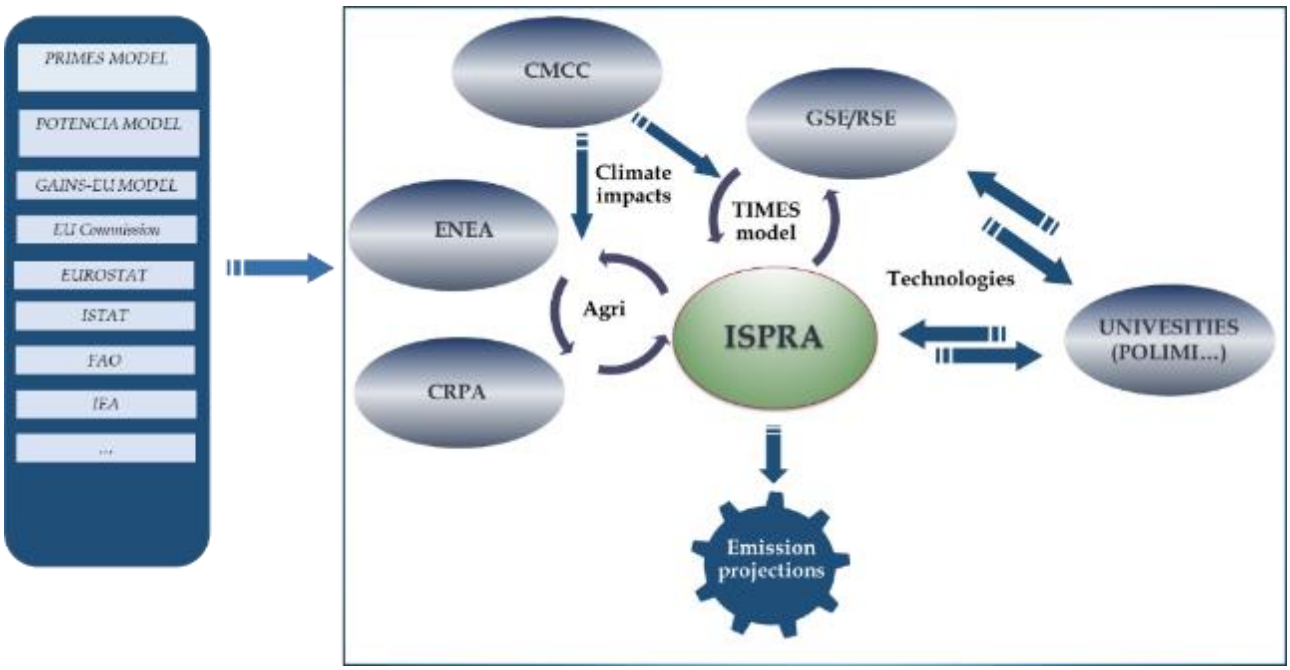
- GSE is a State owned company working on energy efficiency and renewables, www.gse.it

- RSE carries out research into the field of electrical energy with a special focus on national strategic projects funded through the Fund for Research into Electrical Systems. RSE is a total publicly-controlled Company owned by GSE, http://www.rse-web.it/

- POLIMI is the Polytechnic of Milan, which provides studies relating to the production, conversion, transport and use of energy.

[41] The Legislative Decree n. 227/2001 provides 5 general guidance on forest management: protect forest ecosystem functions, genetic resources, water basins and landscape; avoid conversion of forest land to other uses of land, and where occurring apply compensative; reforestations with endemic species; avoid conversion from forest stands to coppices; avoid clearcut; conserve biodiversity, including true conservation of old trees and dead wood.
[42] https://www.reterurale.it/foreste/StrategiaForestaleNazionale
[43] https://www.mite.gov.it/sites/default/files/archivio/allegati/biodiversita/Strategia_Nazionale_per_la_Biodiversita.pdf

Figure 4.3 - Process for selecting assumptions, methodologies and models for making projections



MASE is part of the National System and it is also supervising the dataflow pursuant to Decree 9/12/2016. Moreover, projections and PaMS evaluation is part of a specific Annex to the Economy and Financial Document (DEF), updated annually by the Ministrer of ecological transition and adopted by the Government[44]. The DEF outlines the objectives that the multiannual state budget intends to pursue and defines the scope within which to build the annual budget. The aim of the DEF is to enable Parliament to know in advance the Government's economic and financial policy lines; the latter is politically committed to drawing up the next annual budget in accordance with the criteria arising from the parliamentary debate. DEF is usually adopted each year in March or April.

Monitoring and evaluation of progress on policies and measures to cut greenhouse emissions are also reported in documents submitted, every two years, by Member States to the European Commission under the Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action, which repeals the former Regulation (EU) No 525/2013 on a mechanism for monitoring and reporting greenhouse gas emissions.

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 at sectoral level. The policies and measures hereinafter described are divided into two types:

- Measures implemented by 31st December 2019;
- Measures planned.

The measures envisaged as planned are consistent with the ones reported in the National Energy and Climate plan. The impact assessment has not been calculated for policies and measures individually, but at sectoral level because of interaction between the mitigation actions. Some planned measures have been

[44] https://www.dt.mef.gov.it/modules/documenti_it/analisi_progammazione/documenti_programmatici/def_2021/Allegato_Transizione_Ecologica.pdf

reported in more than one sector, anyway the effect assessed in terms of greenhouse gas emissions reduction is the one expected in the specific sector to avoid double counting. For each sector a table of mitigation actions is reported. Paragraph 4.7 provides the summary of all the policies and measures.

In 2020 and 2021, Italy adopted some new measure to face the effects of COVID-19 pandemic. One of the most important tools is the "National Recovery and Resilience Plan" (NRRP), adopted in July 2021, which includes several measures to tackle climate change and to purse sustainable economic growth towards an inclusive, climate resilient and net-zero emissions future. The Plan envisages investments and a consistent reform package, with €191.5 billion in resources being allocated through the Recovery and Resilience Facility and €30.6 billion being funded through the Complementary Fund. The NRRP has been developed around three strategic axes shared at EU level: digitalization and innovation, ecological transition, and social inclusion. It aims at repairing the economic and social damage caused by the pandemic crisis, contributing to addressing the structural weaknesses of the Italian economy, and leading the country along a path of ecological, environmental and just transition.

Approximately 40 percent of the total financial resources are allocated for ecological transition. The largest allocation of resources has been earmarked for Mission 2 "Green Revolution and Ecological Transition," amounting to 59.06 billion euros (31.05% of the total amount of the Plan) in order to implement measures on the following issues:

- incentives for energy efficiency in buildings (Superbonus),
- increasing the share of energy produced from renewables and innovation in the industrial supply chain, including hydrogen,
- smart grids strengthening,
- promotion of energy communities and self-consumption,
- development of biomethane and agro-voltaics,
- sustainable mobility with the strengthening of cycling, the development of mass rapid transport, the renewal of the rail and bus fleet and the installation of electric charging infrastructure,
- sustainable agriculture and circular economy.

In order to guarantee coherence with the EU submission, which relies on data provided by EU Member States in March 2021, the NRRP policies and measures have not been taken into account in the present Chapter nor in Chapter 5.

Policies and measures listed in the following sections are grouped according to the sector affected.

4.3 Policies in Energy Sector

4.3.1 Energy supply

4.3.1.1 Incentives for the promotion of electricity production by renewables

The measures for the electricity generation are aimed at supporting the installation of new plants and preservation and upgrading of the existing plants. Economic, regulatory, planning, informational and administrative measures are calibrated on the basis of the type of intervention (new construction or reconstruction), the size of plants and the state of development of technologies.

- Facilities for individual and collective self-consumption: regulatory and economic measures

The framework by which general system charges are collected from electricity tariffs, which was introduced in 2018 as part of the adjustment plan referred to in the EU framework on state aid for energy and the environment, constitutes, in itself, a general regulation that favours instantaneous self-consumption; in fact, the structure of the collection tariff provides for the application of variable parts (€/MWh) on the energy taken from public networks.

Work will also be done for the evolution of the on-site exchange mechanism (which allows the use of the grid as storage), in favour of a premium recognized to plants on the basis of the share of self-consumed

energy.

In all cases, the promotion of single self-consumption is aimed mainly at distributed systems for which, moreover, the simplicity and automaticity of support mechanisms are preferable to other instruments, in terms of complexity and costs.

Additional instruments to support self-consumption, both individual and collective, are:

- enhancement of obligations for minimum share of renewable sources in new buildings or buildings undergoing major renovations;
- gradual extension of the obligation of minimum share of renewable sources (which, as mentioned, is currently provided only for new buildings or those undergoing major renovations) to existing buildings, starting with certain categories such as warehouses used for production activities and tertiary buildings.

These two points are also connected with similar measures referring to thermal renewables.

- Measures for small installations

Additional measures, functional to facilitate both self-consumption where possible, and the construction of small systems that feed production into the electricity grid where self-consumption is not technically and economically feasible, are planned:

- simplified procedures for the construction, commissioning and management of plants;
- extension of the use of PAS (Procedura Abilitativa Semplificata, simplified enabling procedure), which at present can be used for individual installations with power between a few tens and a few hundred kW;
- promotion of the installation of photovoltaic systems on existing agricultural structures that do not fall within the definition of a building, including through the introduction of the concept of rural building for access to support measures;
- allow the aggregation of small systems for the purposes of participation in procedures to access to incentives on energy fed into the grid (see section on contracts for difference);
- specific incentive tariffs, for cases in which self-consumption is not feasible, and provided that there is accessible potential of some significance and prospects for the containment of costs and incentives themselves; of particular interest is the combined production of electricity and heat from waste and residues from the agro-industrial sector, to valorise the waste itself and optimize production cycles, with minority shares of raw materials from second harvest (in the case of biogas plants, moreover, benefits can also be obtained in terms of digestate utilization, of importance in areas vulnerable to nitrates);
- introduce premiums for the construction of photovoltaic plants whose modules are installed to replace roofing containing asbestos.

The first operational tool for incentivizing (also) small plants is the July 4, 2019 Decree, which takes effect in the first period of the 2012-30 decade, particularly for the purpose of meeting the first interim target of the trajectory of the renewable targets.

- Renewable energy communities

In order to avoid inefficiencies in the development of the grid itself, renewable energy communities will be promoted as a priority by enhancing the existing electricity grid and.

Energy communities can also be a tool to support the economies of small municipalities, which are often rich in renewable resources, and on the other hand, to provide opportunities for local production and consumption of renewable energy even in those contexts where self-consumption is technically difficult. On this perspective, renewable energy communities will also be able to play an important function in terms of local consensus for the authorization and construction of plants and infrastructure.

The economic promotion of energy communities will be ensured through direct support mechanisms on production, including from multiple facilities (similar to the general mechanisms for production support) and on locally consumed energy.

The promotion of renewable energy communities is pursued through information tools on locally available resources (including making use of the pathway for the identification of eligible areas discussed below) and the opportunities offered by support instruments. The development of standard tools for the establishment and management of communities and for the enhancement of energy production will also be considered. In local contexts where it will be possible and convenient, the enhancement by communities of thermal energy from renewables will also be promoted.

- Contracts for difference to be introduced into following competitive bidding.

The tried-and-tested competitive bidding mechanisms will continue to be used, adopting a neutrality approach among groups of technologies with similar structures and cost levels, possibly with safeguard mechanisms where technologies nevertheless deemed necessary to achieve the objectives are systematically losing out. The tenders will be aimed at concluding contracts for difference based on the total value of the tariff recognized following the conduct of the procedure, according to the "two-way" criterion (i.e., recognition of the difference between the tariff and the market price of electricity where the difference is positive; restitution by the producer where the same difference is negative). This mechanism will be the main tool to encourage the construction of new plants, but it could also be considered to support integral reconstructions and upgrades of existing plants, should long-term contracts and administrative simplifications prove insufficient.

Competition between groups of technologies with a similar cost structure is envisaged: thus, new wind and photovoltaic plants (to which the largest quotas are allocated), form a single group, in which the two types of plant compete on the basis of economic criteria only (if they have a capacity of 1 MW or more), or environmental and economic criteria if they are smaller than 1 MW. The same is true for the other group, in which hydroelectric plants compete on the same basis along with sewage gas plants, albeit with technological safeguard mechanisms. In particular, for registry installations (below 1 MW), solutions with high environmental value are favoured, such as a specific quota for PV on roofs with asbestos replacement or installation in areas of low environmental value, such as closed and restored landfills. Installations coupled with charging stations are also favoured, intending to give further impetus to electric mobility and smart and vehicle-to-grid charging technologies. Where self-consumed energy exceeds 40 percent of production, a specific premium is provided, which can also be an impetus for the spread of storage systems. In addition, aggregation of installations is encouraged through a specific priority criterion. Finally, it will be possible to opt for all-inclusive tariffs up to 250 kW.

- Power Purchase Agreements (PPAs)

Italy intends to widely promote the use of this instrument, to be placed side by side with contracts for difference, with regulations that encourage investors to enter into Power Purchase Agreements (PPAs) with parties interested in purchasing the energy that the plant will produce over a sufficiently long time interval to ensure the amortization of the investment required to build a new generation plant, or to rebuild or upgrade an existing plant. The July 4, 2019 Ministerial Decree stipulated that, within 180 days of its entry into force, regulations for the establishment of a market platform for long-term trading should be established. To this end, a study has already been launched to investigate what is the legal, regulatory and technical environment for widespread use of PPAs. The need for the study stems from the fact that the renewable sources with the greatest residual potential (solar and wind) are now usable at suitably low costs.

However, for these sources, the cost of energy production is overwhelmingly attributable to the initial investment and not to the operating costs, as is the case for conventional plants, on which the current electricity market structure is still based. As a result of the study, it is intended to arrive at a reference nomenclature, the definition of possible types of PPAs and their minimum elements for contracting, with an examination of the needs of the various parties involved (large consumers, traders, aggregators, producers, lenders), as well as the identification of any barriers to be removed, whether of a legislative or

regulatory nature. The ultimate goal is to encourage the spread of such contractual schemes without resulting in burdens on the state and consumers.

In a first phase, the possibility of the state providing an "initial push" will be evaluated, through pilot projects under the National Action Plan on Green Purchases of the Public Administration and procurement procedures for energy supplies through tenders carried out by Consip, a public company whose mission is to make the use of public resources more efficient and transparent, providing administrations with tools and skills to manage their purchases and stimulate companies to compete with the public system.

At the same time, it is counted on fostering dialogue between the parties, first through the qualification of the projects of production facilities by promoting the aggregation of potential demand, particularly of small and medium-sized enterprises, then, by promoting the participation of aggregators of potential demand, particularly of small and medium-sized enterprises and purchasing consortia/groups representing end customers, as also emerged in the PNIEC consultation process; it is also intended to promote the aggregation of the supply of energy producers even with different technologies.

As mentioned above, a contribution to the development of PPAs will come from the Ministerial Decree of July 4, 2019: in fact, this decree provides that the Manager of Energy Markets (GME) will prepare a framework for the creation of a market platform for the long-term trading of energy from renewable sources, to promote the trading of production from newly built renewable source plants, fully reconstructed or reactivated, subject to an upgrading or refurbishment intervention, which came into operation after January 1, 2017 and which do not benefit from incentives on the energy produced. Non-economic forms of support are provided, such as the qualification of plants (by the GSE), the removal (by ARERA) of any regulatory barriers, as well as an update of the rules on the guarantee of origin, to allow its cancellation also directly by end users.

Preliminarily from the stipulation of PPAs, a contribution of renewable energy of at least 0.5 TWh additional in each year is expected.

- Burden sharing among Regions and identification of areas suitable for plant construction

The achievement of the objectives on renewables, particularly in the electricity sector, is entrusted mainly to wind and photovoltaics, which require adequate areas and surfaces. Notwithstanding the fact that for PV, surfaces in built-up areas, previously compromised areas and areas that cannot be used for other purposes will be prioritized, the sharing of national objectives with the Regions will be pursued by defining a national regulatory framework which will establish criteria (shared with the Regions) on the basis of which the Regions themselves will proceed to define the areas suitable and unsuitable for the installation of renewable energy plants. This framework shall also be consistent with the requirements for the protection of agricultural and forest areas, cultural heritage and landscape, air quality and water bodies.

In this regard, spatial dislocation of existing plants, availability of primary renewable resources, demand dislocation, grid constraints and grid development potential will be adequately considered.

The identification of these areas will also be aimed at the coordinated development of plants, electricity grid and storage systems, with simpler and faster permitting procedures.

- Existing plants

Specific measures of noneconomic nature for revamping and repowering of existing plants include:

- simplified authorization procedures for revamping or repowering intervention;
- the establishment of basic conditions and limits in compliance with which simpler interventions (e.g., replacement of plant components, which do not alter the layout and committed land) can be carried out with mere communication;
- promote the conversion of certain types of plants that at the end of the incentive period should prove uncompetitive in the market, in favor of plants that are more functional to the needs of the system in the path of energy transition (e.g. conversion to biomethane of biogas plants)

This last option appears more complex for smaller plants, for which, especially in the agricultural sector,

efficient forms of support compatible with EU state aid rules will be promoted in order to safeguard production. The biogas plants in question must also be functional for the efficient use of livestock manure, with a view to the smooth functioning of the circular economy.

Specific measures for hydroelectric concessions are described in the following para 4.3.1.5.

4.3.1.2 Smaller islands as test projects for higher levels of penetration of renewables and for electrification of consumption

Italy has already started a process for the gradual coverage of the requirements of smaller islands not interlinked with energy from renewable sources. In this context, the Ministerial Decree of 14 July 2017 defined specific targets for the coverage of consumption with locally available renewable energy sources for each island. The Decree establishes specific incentives whose entity is defined by ARERA Decision No 558 of 6 November 2018 and is commensurate to the avoided fuel cost. The aim is to promote, for these islands:

- the modernisation of electricity networks, to allow a higher penetration of renewables;
- the implementation of pilot projects, designed to increase the use of renewables through the use of storage systems, development of electric transport, integration of the electric system with the island's water systems and with the scalable demand on the island.

In order to promote the implementation of the Ministerial Decree of 14 July 2017, the Call for Proposals "Innovative Integrated Projects for the Small Non-Interconnected Islands" was launched on 28 October 2020. 10 million euros were allocated for projects that demonstrate, in compliance with the conditions of security and continuity of supply, to reduce the conventional fossil fuels annual electricity production. Furthermore, the Decree No. 340 of July 14, 2017 launched a Call for Proposals, with a total budget of 15 million euros, aimed at implementing an integrated Ppogram on energy, climate and transport in small islands.

4.3.1.3 Cogeneration

Cogeneration is currently supported by incentive schemes, rewarding the production of both heat and 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 this sector, Italy already has a historically high use in the industrial sector, with many existing plants from medium to large size.

In the field of high-efficiency cogeneration, in accordance with the provisions of the Directive (EU) 2018/2002 amending Directive 2012/27/EU 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. 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.

4.3.1.4 Coal phase out

Italy has planned to ban coal for electricity production from 2025. This measure is implemented taking into account an adequate capacity replacement, the development of the electricity grid and the high penetration of renewable sources.

In order to reduce energy prices for businesses and to avoid employment crises in areas where coal-fired power plants are scheduled to be shut down, Paragraph 8 of Article 23 of Legislative Decree No. 47/2020, as amended by Budget Law No. 178/2020, provides that:

- the annual portion of revenues from EU ETS auctions in excess of 1 billion euros, is allocated, to the maximum overall extent of 100 million euros for the year 2020 and 150 million euros annually starting from the year 2021, to the *Industrial Sector Energy Transition Fund*, with the allocation of a portion of up to 10 million euros to the financing of decarbonization and energy efficiency

measures in the industrial sector

- the remaining portion, to the purposes referred to in paragraph 2 of Article 29, i.e., financial measures in favour of companies in sectors or subsectors considered to be exposed to a high risk of carbon leakage due to indirect costs related to GHG emissions transferred to electricity prices, as well as, for up to 20 million euros annually for the years 2020 to 2024, to the Fund for Employment Conversion in Territories where coal-fired power plants are located.

4.3.1.5 Hydroelectric concessions

Law No 12 of 11 February 2019 converting Decree-Law No 135 of 14 December 2018 gives the Regions authority in the area of existing large concessions. If there is no overriding public interest conflicting with the hydroelectric use, the Regions can grant concessions for large-scale diversions of water for electricity production to operators that meet the following criteria:

a) minimum improvements in terms of energy, production power and production potential to be achieved from the diversion, conveyance, regulation and supply of water and from the installations for generating, transforming and connecting electricity, with reference to the national strategic objectives on energy security and renewable energy sources. This includes the possibility of equipping the infrastructure with water storage facilities to promote the integration of renewables in the energy market.

b) minimum thresholds in terms of environmental improvement and rehabilitation of catchment areas, in line with the catchment area planning instruments provided for in Directive 2000/60/EC on water policy. These determine a compulsory minimum share of any revenues deriving from the allocation to be channelled into financing the measures contained in district management plans or plans for the environmental protection and rehabilitation of the bodies of water affected by the diversion. This measure is considered as planned.

Table 4.3 – Implemeted policies and measures in the energy supply

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
Incentives for the promotion of electricity production by renewables	Incentives for the electricity production by renewable from wind on shore, photovoltaic, hydroelectirc and residual gas	Energy Supply	Increase in renewable energy	Economic	National	2019	Ministry of economic development and Ministry of environment (National government)
Incentives for the promotion of electrical and thermal renewables in the small islands	Electricity network upgrade to have higher renewable penetration. Pilot projects regarding renewable productions, storage systems, development of electrical transport, integration of the electrical system with the water system	Energy Supply	Increase in renewable energy	Economic	Local	2020	Ministry of economic development and Ministry of environment (National government)
White certificates - Cogeneration	Supporting CHP and district heating plants	Energy Supply	Efficiency improvement in the energy and transformation sector (Energy Supply)	Economic	National	2015	GSE- Manager for Energy Service (National government)
Coal phase-out	Ban coal use for electricity production from 2025	Energy Supply	Switch to less carbon-intensive fuels	Regulatory	National	2019	Ministry of economic development (National government)

Table 4.4 – Planned policies and measures in the energy supply

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Energy production and transformation	**Promotion and support to the renewable energy sources**	**Energy Supply**	**Increase in renewable energy and increase in renewable energy in the heating and cooling sector**	**Regulatory; Economic**	**National**			**24800**
Revision of the regulations for the allocation of hydroelectric concessions	The auction procedures for the existing concessions will be integrated in the territorial planning, considering other uses of water, on the basis of homogeneous rules at national level, also in terms of fees. Procedures will transparently privilege the redevelopment of the plants, in order to ensure the useful storage capacity and increase the producibility, in	Energy Supply	Increase in renewable energy	Regulatory	National	2022	Ministry of economic development (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
	compliance with environmental constraints.							
Renewables in existing and new buildings	Extension and improvement of the obligation to integrate renewables into existing and new buildings	Energy Supply	Increase in renewable energy	Regulatory	National	2022	Ministry of economic development and Ministry of environment (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Incentives to electrical and thermal renewables use in the small islands	Electricity network upgrade to have higher renewable penetration. Pilot projects regarding renewable productions, storage systems, development of electrical transport, integration of the electrical system with the water system	Energy Supply	Increase in renewable energy	Economic	National	2022	Ministry of economic development, GSE-Manager for Energy Service (National government)	

4.3.2 Energy consumption by industries and buildings

4.3.2.1 National Fund for Energy Efficiency

Legislative Decree no. 102/2014 has established the National Fund for energy efficiency. The Fund aims to support energy efficiency measures implemented by companies and the Public Administration on buildings, plants and production processes. The financed interventions are aimed at reducing energy consumption in industrial processes, building and expanding district heating networks and/or for district cooling, making public services and infrastructures more efficient, including public lighting, as well as for the energy upgrading of buildings. The management of the Fund is entrusted to Invitalia SpA (the National Agency for inward investment and economic development, owned by the Italian Ministry of Economy and Finance), based on a specific agreement with the Ministry of Economic Development and the Ministry for the technological transition. With the interministerial decree of 5 April 2019, the operating procedures for the presentation of applications were approved and the legal forms and conditions of admissibility, the assessment process and the procedures for granting and disbursing subsidies were therefore identified. In May 2019 the Fund became operational. The Fund has a revolving nature and is divided into two sections:

- a section for the provision of guarantees on individual financing operations that covers the 30 percent of the resources that annually flow into the Fund;
- a section for granting subsidized loans that covers the 70% of the resources that annually flow into the Fund.

4.3.2.2 Energy audits in companies

Article 8 of Legislative Decree No. 102 of July 4, 2012, in paragraphs 1 and 3, identifies, which entities are obliged (large enterprises and energy-intensive enterprises) to perform the Energy audits, by December 5 of each year since 2015. In addition, the program provides for the co-financing of 50% of the cost of energy audits in SMEs by the State and Regions.

15 million euros per year have been allocated for the co-financing program of diagnoses of SMEs in the period 2014-2020. For the period 2021-2030 another 15 million euros per year have been allocated for the ISO50001[45] management systems financing program.

4.3.2.3 Impresa 4.0

The Impresa 4.0 National Plan is an evolution of the Industria 4.0 Plan, which, from 2017 to 2020, provided measures incentivizing digital transformation to facilitate business innovation.

The Impresa 4.0 Plan incorporates some innovations established by the Budget Law 2020 (Law No. 160 of December 27, 2019) for the purpose of accompanying small and medium-sized enterprises on the path to digital and technological transformation. In particular, the following measures are recalled:

- "bonus capital goods" for which the Budget Law 2020 allocates 540 million: the measure facilitates investments to purchase or acquire on lease plant and machinery, industrial and commercial equipment, capital goods for productive use, hardware, software and digital technologies. To support the innovation of micro and small enterprises in the South (Abruzzo, Basilicata, Calabria, Campania, Molise, Puglia, Sardinia and Sicily), the increase in the state contribution rises from 30 percent to 100 percent, up to a total limit of 60 million euros, of which 15 million euros are earmarked for machinery used in production processes with low environmental impact, to improve the eco-sustainability of products and production processes;
- new tax credit for investment in capital goods that replaces hyper and super depreciation, and provides for a different concessional percentage depending on the type of investment:
- hyper depreciation is replaced by a tax credit for the purchase of innovative machinery related to

[45] https://www.iso.org/iso-50001-energy-management.html

Industry 4.0 with two facilitation parameters:

- 40% of expenditure for investments up to 2.5 million;
- 20% for investments between 2.5 and 10 million;

- investments in digital services and software are eligible for the Tax Credit at 15 percent of the cost, for a maximum threshold of € 700,000;
- tax credit replaces super depreciation for investments in capital goods equal to 6% of the cost, and for a maximum amount of 2 million euros;
- tax credit for investments in technological innovation activities aimed at production: recognizes 10% of the relevant calculation base, taken net of other subsidies or contributions received on the same eligible expenses, up to a maximum amount of 1.5 million euros, to all those new or improved production activities, concerning tangible and intangible goods, services and processes provided that they differ from the previous ones in terms of characteristics, technological capabilities, eco-compatibility, or other factors relevant to the various production sectors;
- tax credit on expenses incurred for technological and digital training of employees, for which150 million euros are allocated and recognized to the extent of:
  - 50% of eligible expenses in the annual maximum limit of 300,000 € for small businesses;
  - 40% in the annual maximum limit of 250,000 € for medium-sized enterprises;
  - 30% in the annual maximum limit of 250,000 € for large enterprises.

4.3.2.4 Energy efficiency and renewables in residential buildings through tax deductions for building renovations and energy upgrading

Tax deductions for energy renovation of buildings were introduced in Italy by the 2007 Finance Act and are still active. This is a voluntary mechanism, whereby individuals or businesses may deduct, respectively from their personal (IRPEF) or corporate (IRES) income tax, a percentage of the expenditure incurred for certain types of energy upgrading works on existing buildings. The type of measures currently in place are:

- Ecobonus: tax deductions for energy saving in buildings. Different deduction rates are envisaged based on the intervention carried out, in order to better link the economic benefit to the energy savings that can be achieved
- Bonus casa: 50% of tax deduction for the "recovery" of the building stock

The budget allocated for these measures is around 2.2 billion €.

Furthermore, as indicated in the "NRRP" section, the Law Decree No. 34 of May 19, 2020 established the so-called "Superbonus" in Article 119. The "Superbonus" incentivizes energy and seismic upgrading interventions in residential buildings. Support is provided in the form of a tax deduction, deferred over 5 years, in favour of those who carry out the intervention. Eligible costs are those of design and implementation of the intervention, in the proportion of 110%, which the taxpayer benefits from directly or by opting for other financial instruments (so-called "assignment of credit" and "invoice discount"), so as to address the problem of high initial investment costs. These instruments provide for the tax credit accrued over the 5-year period to be transferred to the supplier who discounts it directly on the invoice (i.e., construction companies, designers, or more generally the general contractor), reducing the cost of the initial investment, or to a financial institution, which will advance the necessary capital. In order to ensure that energy upgrading interventions are classifiable as medium level according to Recommendation (EU) 2019/786, the minimum condition of a double energy class step (corresponding to a 40% primary energy saving compared to ex-ante) has been introduced. To this end, "leading" (higher savings) and "trailing" interventions were introduced, the latter being allowed only if carried out in conjunction with at least one leading intervention.

4.3.2.5 Minimum energy performance requirements for buildings

The directive 2002/91/CE on Energy Efficiency introduced stricter energy requirements and promoted the

diffusion of renewable energy sources in the building sector. The directive also required 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. Subsequently, the Directive 2010/31/EC on the European Energy Performance of Buildings Directive (EPBD) (transposed into national law with the decree 63/2013) 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 made it consistent in all regions. An important contribution to energy efficiency in buildings 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" that envisages the construction of near-zero energy buildings starting from 2021.

4.3.2.6 Conto termico

With Italian Ministerial Decree of 28 December 2012, the Conto Termico was introduced, an incentive for promoting the production of renewable thermal energy and, at the same time, to permit access by public sector bodies to energy-efficient building works and installations. The Thermal Account became operational in July 2013. In relation to production of heat from renewable sources, one or more interventions, carried out by public authorities and by private individuals, are incentivized. The budget allocated for this measure is 300 million €.

An update of the mechanism is envisaged starting 2023 so this measures in reported also as planned.

4.3.2.7 Energy upgrading program for the Central Public Administration (PREPAC)

The Interministerial Decree of 16 September 2016 has defined how to implement the Energy Requalification Program of the Central Public Administration (PREPAC), with a specific focus on identification and selection of interventions that can be admitted to financing and on needs of Pas in terms of information and technical assistance. In order to access the funding, the Public Administrations must develop proposals for intervention for the energy requalification of the buildings. In the period 2014 – 2020 355 million euros have been allocated for the program.

PREPAC will continue in the period 2021-2030, taking into account the experience gained during the start-up phase of the mechanism.

4.3.2.8 Efficient public lighting system

An energy efficiency program has been set up for the public administration starting from the public lighting. With the 2018 Budget law, public administration shall reshape public lighting networks by 31 December 2023, with a reduction in electricity consumption of at least 50% compared to the average consumption of 2015-2016. The main planned measures are replacement of light sources, installation of consumption monitoring systems and more efficient use. The budget allocated for this measure is 300 million €.

4.3.2.9 Mandatory integration of energy from renewable sources in buildings

Mandatory integration of energy from renewable sources in buildings Annex 3 of Legislative Decree No 28 of 2011, transposing the RED Directive, identifies obligations to integrate energy from renewable sources in new buildings or in buildings subject to major renovation, in force from 31 May 2012. The requirements are currently fixed in terms of percentages (increasing per year) of coverage with renewable energy sources of the building's energy requirement for providing heating, cooling and domestic hot water services. In particular, it is envisaged that in the case of new buildings or buildings subject to major renovation, installations for the production of thermal energy have to be designed and created so as to guarantee compliance with coverage, with energy produced from installations powered by renewable sources, of 50%

of expected consumers of domestic hot water and of the following percentages of expected consumers of domestic hot water, heating and cooling. Where it is technically impossible to meet the obligation to cover the energy requirements of buildings undergoing first-level restructuring, the possibility for the owner to install the mandatory percentage in another building, including a building owned by others, or transfer it to the local authority will be assessed. In such cases, the local authority could then build up sufficient quotas suitable for interventions on public buildings will be assessed, as long as this is compatible with the obligations deriving from the Directive on the energy efficiency of buildings.

On the basis of the results of the measures described above, and consistent with the measures for electric renewables, the step will be considered of introducing a mandatory minimum quota also for several categories of existing buildings, including tertiary buildings.

4.3.2.10 Fondo Rotativo Kyoto – "The Kyoto Fund"

The Kyoto Fund established by Law No. 296 of December 27, 2006, finances, through the granting of low-interest loans, measures for the reduction of GHGs emissions. Management of the Fund is entrusted, by law, to Cassa Depositi e Prestiti Spa, which is responsible, in particular, for its economic-financial aspects (stipulation of contracts, disbursement of amounts, collection of instalments).

Article 9 of Decree Law No. 91 of June 24, 2014, allocated 350 million euros from the Fund to the energy upgrading of publicly owned school buildings, including kindergartens and universities. The energy efficiency interventions financed ensure an improvement of at least two "energy classes," corresponding to consumption savings of about 20-25 percent. The call for applications was launched in June 2015 and ended on December 31, 2018, with a commitment of resources of about 150 million euros, related to interventions on more than 300 buildings. In addition, 435 energy diagnoses, worth a total of about 2.5 million euros, were eligible for subsidies.

The 2019 Budget Law extended the possibility of accessing Kyoto Fund financing to publicly owned sports facilities and healthcare facilities as well. To this end, a new call has been launched from the remaining uncommitted resources (200 million euros). Funded projects must achieve an improvement in the building's energy efficiency parameter of at least two classes, which corresponds to a reduction in consumption of around 25-30 percent.

Table 4.5 Implemented policies and measures in the energy consumption by industries and buildings

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
White certificates – Industry	Supporting electric energy saving in the industry sector	Energy Consumption	Efficiency improvement in industrial end-use sectors (Energy Consumption)	Economic	National	2009	GSE- Manager for Energy Service (National government)
National Industry 4.0 Plan (Impresa 4.0)	Tax breaks and reductions to stimulate companies - micro, small and medium-sized enterprises and innovative startups - to invest in innovation.	Energy Consumption	Efficiency improvement in industrial end-use sectors (Energy Consumption)	Fiscal	National	2019	Ministry of economic development (National government)
"Ecobonus" and "Bonus casa"	Supporting of energy saving and renewables in existing buildings through tax deduction.	Energy Consumption	Efficiency improvements of buildings	Fiscal	National	2008	Ministry of economy and finance (National government)
Energy audits in companies	Co-financing of energy audits in SMEs; adoption of energy management systems compliant with ISO 50001 standards; extension to energy-intensive businesses in the gas sector and correlation of the benefit to the execution of energy efficiency interventions	Energy Consumption	Efficiency improvement in industrial end-use sectors	Regulatory	National	2014	ENEA - Italian National agency for new technologies, Energy and sustainable economic development (Research institutions)

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
Minimum energy performance requirements for buildings	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	Energy Consumption	Efficiency improvements of buildings	Regulatory	National	2006	Ministry of economic development (National government)
Thermal account	Incentives for small-scale energy efficiency measures in buildings and production of thermal energy from renewable sources	Energy Consumption	Efficiency improvements of buildings and in services/ tertiary sector	Economic	National	2012	Ministry of economic development, GSE- Manager for Energy Service (National government)
Efficient public lighting system	Obligation to make public lighting system more efficient	Energy Consumption	Demand management/reduction	Regulatory	National	2020	Ministry of economic development and Ministry of environment (National government)
Energy program for the Central Public Administration (PREPAC)	Support to Public Administration buildings	Energy Consumption	Efficiency improvement in services/ tertiary sector	Economic	National	2020	Ministry of economic development and Ministry of environment (National government)
Kyoto Fund Review	Extension of the granting subsidized loans for financing energy efficiency in sport facilities and health buildings	Energy Consumption	Efficiency improvements of buildings	Economic	National	2020	Ministry of economic development and Ministry of environment (National government)

Table 4.6 Planned policies and measures in the energy consumption by industries and buildings

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Energy efficiency, renewables and electrification in the industrial sector	**Increase energy efficiency and renewable energy production in the industrial sector**	**Energy Consumption**	**Efficiency improvement in industrial end-use sectors**	**Economic; Regulatory; Fiscal**	**National**			**4600**
White certificates (Certificati bianchi) mechanism with upgrading	Update and widen mechanism to support energy savings	Energy Consumption	Efficiency improvement in industrial end-use sectors	Economic	National	2022	GSE- Manager for Energy Service (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Energy audits in companies	Co-financing of energy audits in SMEs; adoption of energy management systems compliant with ISO 50001 standards; extension to energy-intensive businesses in the gas sector and correlation of the benefit to the execution of energy efficiency interventions	Energy Consumption	Efficiency improvement in industrial end-use sectors	Regulatory	National	2021	ENEA - Italian National agency for new technologies, Energy and sustainable economic development (Research institutions)	
National Industry 4.0 Plan	Update Tax breaks and reductions to stimulate companies - micro, small and medium-sized enterprises and innovative startups - to invest in innovation.	Energy Consumption	Efficiency improvement in industrial end-use sectors	Fiscal	National	2021	Ministry of Economic Development (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Energy efficiency, renewables and electrification in the civil sector	**Increase energy efficiency and renewable energy production and emission reduction in the civil sector**	**Energy Consumption**	**Efficiency improvements of buildings, increase in renewable energy in the heating and cooling sector, demand management/reduction, efficiency improvement in services/ tertiary sector**	**Economic; Regulatory; Fiscal**	**National**			**9300**
White certificates (Certificati bianchi) mechanism with upgrading	Update and widen mechanism to support energy savings	Energy Consumption	Efficiency improvements of buildings (Energy Consumption)	Economic	National	2022	GSE- Manager for Energy Service (National government)	
Thermal account (Conto termico) mechanism with upgrading	Update of the incentive schemes for small-scale energy efficiency measures in buildings and production of thermal energy from renewable sources	Energy Consumption	Efficiency improvements of buildings	Economic	National	2023	Ministry of economic development , GSE-Manager for Energy Service (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Renewables in existing and new buildings	Extension and improvement of the obligation to integrate renewables into existing and new buildings	Energy Consumption	Increase in renewable energy in the heating and cooling sector	Regulatory	National	2022	Ministry of economic development and Ministry of environment (National government)	
Efficient public lighting system	Extension of obligation to make public lighting system more efficient	Energy Consumption	Demand management/reduction	Regulatory	National	2022	Ministry of economic development and Ministry of environment (National government)	
Energy upgrading program for the Central Public Administration (PREPAC)	Support to upgradings in Public Administration buildings will be strengthened, in order to play a guide role for the entire economic sector.	Energy Consumption	Efficiency improvement in services/ tertiary sector	Economic	National	2022	Ministry of economic development and Ministry of environment (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
"Superbonus 110%"	Increase the propensity towards radical interventions on the building through efficiency improvements and renewables for energy generation and consumption.	Energy Consumption	Efficiency improvements of buildings	Fiscal	National	2021	Ministry of economic development and Ministry of environment (National government)	

4.3.3 Transport

4.3.3.1 Emission standard for new vehicles

The Regulation (EU) No 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO2 emission performance standards for new passenger cars and for new light commercial vehicles, and repealing Regulations (EC) No 443/2009 and (EU) No 510/2011.

From 1 January 2020, this Regulation sets an EU fleet-wide target of 95 g CO2/km for the average emissions of new passenger cars and an EU fleet-wide target of 147 g CO2/km for the average emissions of new light commercial vehicles registered in the Union, as measured until 31 December 2020 in accordance with Regulation (EC) No 692/2008 together with Implementing Regulations (EU) 2017/1152 and (EU) 2017/1153, and from 1 January 2021 measured in accordance with Regulation (EU) 2017/1151.

From 1 January 2025, for the average emissions of the new passenger car fleet and of the new light commercial vehicles fleet, shall apply an EU fleet-wide target equal to a 15 % reduction of the target in 2021.From 1 January 2030, for the average emissions of the new passenger car fleet, shall apply an EU fleet-wide target equal to a 37.5 % reduction of the target in 2021 and equal to a 31% for the average emissions of the new light commercial vehicles fleet.

4.3.3.2 Incentives to biomethane and other advanced biofuels

Promotion of biogas and advanced biofuels for the performance obligation existing for blending of fossil fuels with biofuels. To monitor the quantity of biofuels supplied to the Italian market, are created certificates known as "Certificati Immissione in Consumo (CIC)" (Ministerial Decree 2 March 2018), that are tradable through a dedicated platform. The incentive fee is charged to the obliged parties (oil companies that introduce fossil fuels for consumption) and does not affect the electricity and gas bills. This incentive system is expected to cover the expected demand for methane in road transport with biomethane, corresponding to around 1.1 billion m^3 per year.

4.3.3.3 Certification of biofuel sustainability

Biofuel sustainability certification systems measure and verify environmental performance of fuels throughout all major stages of the product life cycle, production, fuel production, and end use including feedstock. This is in accordance with-Italian National Biofuels and Bioliquids Sustainability Certification System (“Sistema Nazionale di Certificazione della sostenibilità dei biocarburanti e dei bioliquidi”), established by the Decree of 23 January 2012 of the Italian Ministry of the Environment.

4.3.3.4 Implementation of the RED II with specific obligations on biofuels and other renewable

This Directive, approved by European Parliament on 13 November 2018, establishes a common framework for the promotion of energy from renewable sources. It sets a binding Union target for the overall share of energy from renewable sources in the Union's gross final consumption of energy in 2030, equal to 32%. The Commission’s original proposal did not include a transport sub-target, which has been introduced by co-legislators in the final agreement: Member States must require fuel suppliers to supply a minimum of 14% of the energy consumed in road and rail transport by 2030 as renewable energy. Moreover, fuels used in the aviation and maritime sectors can opt in to contribute to the 14% transport target but are not subject to an obligation. It also lays down rules on financial support for electricity from renewable sources and establishes sustainability and greenhouse gas emissions saving criteria for biofuels, bioliquids and biomass fuels.

4.3.3.5 Renewal of public vehicles

1. The National Strategic Plan for Sustainable Mobility allocated 3.7 billion euros (200 million euros for 2019 and 250 million euros for each of the years 2020 to 2033) + 185 million from the 2019 investment

fund (L.145/2018 art. 1 c. 95). The resources are earmarked for regions (2.2 billion), metropolitan cities and municipalities over 100 inhabitants (1.287 billion), and municipalities with high PM10 and nitrogen dioxide pollution (398 million in 2019-2023).

2. Renewal of public vehicles for passenger transport (renewal of the fleet used for local public transport) in the Regions of the Po Valley Basin. With the Prime Minister's Decree of November 28, 2018, the government allocated resources from the Fund for Investment and Infrastructural Development of the Country referred to in Article 1, Paragraph 1072, of Law No. 205 of December 27, 2017, allocating 180 million euros to the Ministry of the Environment (now the Ministry of Environment and Energy Security) for the renewal of the road-based rolling stock used for Local Public Transport for the period 2018-2022 in the Regions of the Po Valley Basin. These are specifically electric, hybrid and CNG buses, and electric boats for the integration and replacement of the existing fleet, and the measure is part of the national strategy for improving air quality. Allocated resources: €180 million.

3. Obligation for public administrations to purchase vehicles using alternative fuels: the target is to accelerate the implementation set out in paragraph 10 of Article 18 of Italian Legislative Decree 257/2016 (transposition of the DAFI directive). Public administrations (national and local level) must ensure that at least 30% (by 2022), 50% (by 2025) and 85% (by 2030) of the vehicles purchased must be electric and hybrid with off-vehicle charging, powered by methane and hydrogen, and electricity and methane in the case of buses.

4.3.3.6 Renewal of private passenger vehicles

1. Incentives to buy more efficient vehicles and with lower GHG emissions: Promoting and supporting renewal of car fleet with low carbon fuels, speed up the replacement of vehicle fleet with new vehicles, including CNG and LPG cars

2. Strengthening of charging networks in the country to promote the spread of electric-powered vehicles. Multiple policies regarding this measure have been implemented, namely:

    a. Law Decree No. 83 of June 22, 2012, on Urgent Measures for the Growth of the Country converted into Law No. 134 of August 7, 2012, Article 17 - septies provided for the National Infrastructure Plan for the Recharging of Electric Energy Powered Vehicles (PNIRE), which was approved by DPCM of September 26, 2014, updated by DPCM April 16, 2016. Allocated resources: €10 million (Article 4, paragraph 7-bis, of Decree-Law No. 32 of April 18, 2019, converted, with amendments, by Law No. 55 of June 14, 2019).

    b. With the Prime Minister's Decree of June 11, 2019, the government allocated the fund referred to in Article 1, paragraph 95 of Law No. 145 of December 30, 2018, allocating 500 million euros to the Ministry of the Environment (now the Ministry of Environment and Energy Security) for the strengthening of urban and highway charging networks in the country to encourage the spread of electric-powered vehicles. Allocated resources: 50 million euros.

    c. By Decree Law No. 104 of August 14, 2020, converted with amendments by Law No. 126 of October 13, 2020, with particular reference to Article 74, paragraph 3, a fund with an allocation of 90 million euros for the year 2020 was established in the budget of the Ministry of Economic Development, aimed at providing contributions for the installation of infrastructure for charging electric vehicles carried out by individuals in the exercise of business, arts and professions, as well as by persons liable to corporate income tax (IRES). Allocated resources: 90 million euros.

4.3.3.7 Regulatory measures

1. Refueling points for alternative fuels (DAFI): an increase of charging points (public and private) for electric vehicles from the current 2,900, approximately, up to at least 6,500 in 2020, an increase of CNG supply station from the current number of around 1,100 to around 2,400 in 2030, an increase of LNG supply station from the current number of a few dozen to around 800 in 2030.

2. Replacement of vehicles used for the transport of good: Decree 122/2018 provides incentives for purchasing commercial vehicles with alternative motorisation for transport of goods

4.3.3.8 *Infrastructural measures*

The Budget Law for 2017 provided for the establishment of a fund , with an allocation of 1,900 million euros for the year 2017, 3,150 million euros for the year 2018, 3,500 million euros for the year 2019 and 3,000 million euros for each of the years from 2020 to 2032, to ensure the financing of investment and infrastructure development of the country in the areas of expenditure related to, among other things, transportation, road, sustainable mobility, road safety, upgrading and accessibility of railway stations. Ministerial Decree No. 360 of 6/8/2018 provided for the allocation of the fund intended for the completion of mass rapid transport interventions, allocating 1.4 billion euros for this purpose. The fund was refinanced by the Stability Law for 2018, in the amount of €800 million for the year 2018, €1,615 million for the year 2019, €2,180 million for each of the years 2020 to 2023, €2,480 million for the year 2024, and €2,500 million for each of the years 2025 to 2033.

4.3.3.9 *Modal shift of freight transport*

1. Marebonus: provides for incentives to be given to road transport companies for adopting combined road-sea modes of transport.
2. Ferrobonus: provides for incentives to be given to road transport companies for adopting combined road-rail modes of transport.
3. National Logistics Platform: development of the National Logistics Platform with the aim to provide services to all logistics and transport operators through an increase of interconnection and facilitation of data management.

4.3.3.10 *Modal shift of passenger transportation (mobility management measures)*

Decree-Law No. 111 of October 14, 2019, in Article 2, paragraph 2, as amended by Article 229 of Decree-Law No. 34 of May 19, 2020, finances projects for the creation, extension, modernization and retrofitting of local public transport lanes and bike lanes, authorizing a total expenditure of 40 million euros. The measure is reserved for municipalities with a population of more than 50,000 inhabitants, or by one or more neighboring municipalities also in associated form referring to a territorial area with a population of more than 50,000 inhabitants for the implementation of a single work, affected by EU infringement procedures No. 2014/2147 of July 10, 2014 and No. 2015/2043 of May 28, 2015 for Italy's non-compliance with its obligations under Directive 2008/50/EC on air quality.

The main goals of the measure are:

1. development of mobility for cyclists through cycle paths;
2. promoting shared mobility (bike, car and motorbike sharing with low or zero)
3. integration between sustainable mobility services (for example, parking structures for bicycles or car and bike sharing services close to public transport stops) and interchange parking
4. promotion of smart working tools
5. promotion of car-pooling
6. development of ITS (traffic management, infomobility, smart roads).
7. Electric Road System (ERS): promotion of initiatives for potential electrification of the highway network using ERS technologies.

4.3.3.11 *Renewal of vehicles for freight transport*

Promoting and supporting renewal of HDV and LDV fleet with low carbon fuels, speed up the replacement of vehicle fleet with new vehicles powered by alternative fuels, including CNG and LNG.

4.3.3.12 Urban Plans for Sustainable Mobility – PUMS

All metropolitan cities, municipalities with more than 100,000 inhabitants and for cities with high levels of PM10 and/or nitrogen dioxide pollution (also with a population of fewer than 100,000 inhabitants), should prepare a PUMPS by 2021. Municipalities with more than 50.000 inhabitants should prepare a PUMS by 2025. Decree of the Ministry of Infrastructure and Transport of August 4, 2017 establishes guidelines for urban sustainable mobility plans, with the explicit purpose of encouraging homogeneous and coordinated application throughout the country.

4.3.3.13 Sustainable Urban Mobility Incentive Program (PrIMUS)

The Sustainable Urban Mobility Incentive Program (PrIMUS), adopted in 2019, is aimed at municipalities with at least 50,000 inhabitants and provides 15 million euros for sustainable urban mobility actions on three themes: development of cycle infrastructure, sharing mobility and mobility management activities.

4.3.3.14 Support to LNG penetration in heavy freight transport (maritime and road) through taxation

The development of LNG for navigation maritime and inland, as well as for road transport deriving from the Alternative Fuel Directive (DAFI) was taken into account. 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 refuelling 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 refuelling points.

4.3.3.15 Experimental mobility voucher program

Law Decree No. 111 of October 14, 2019 (so-called "DL Clima"), in Article 2, paragraph 1, establishes the fund called "Experimental mobility voucher program." The measure is reserved for residents in municipalities affected by EU infringement procedure No. 2014/2147 of July 10, 2014 and No. 2015/2043 of May 28, 2015 for non-compliance with obligations under Directive 2008/50/EC who, from October 15, 2019 to May 18, 2020 and from January 1, 2021 to December 31, 2021, scrap cars homologated up to euro 3 class or motorcycles homologated up to euro 2 and euro 3 two-stroke class. These individuals are granted a mobility voucher of 1,500 euros per car or 500 euros per scrapped motorcycle. This voucher can be used within three years to purchase, including for cohabiting persons, local and regional public transport subscriptions and bicycles, including pedal-assisted bicycles.

Following the epidemiological emergency from COVID-19 and in relation to the measures to be activated in view of the inevitable and relevant changes that mobility in urban and metropolitan areas will undergo, Art. 229 of Decree-Law No. 34 of May 19, 2020 (the so-called "Relaunch Decree") made amendments to Art. 2, paragraphs 1 and 2 of Decree-Law 111/2019, providing incentives for sustainable forms of mobility alternative to local public transport that guarantee the right to mobility of people in urban areas. Specifically, it provides for, from May 4 to December 31, 2020, the recognition to all people over 18 years of age residing in regional capitals, metropolitan cities, provincial capitals or municipalities with a population of more than 50. 000 inhabitants, of a "mobility voucher," equal to 60 percent of the expenditure incurred and in any case not exceeding 500 euros, from May 4, 2020 until December 31, 2020, for the purchase of bicycles, including pedal-assisted bicycles, as well as vehicles for personal mobility with predominantly electric propulsion, such as segways, hoverboards, scooters and monowheels or for the use of shared mobility services for individual use excluding those by means of motor vehicles.

4.3.3.16 Experimental projects for the implementation of school transportation service

Decree Law No. 111 of October 14, 2019 (the so-called "climate decree"), in Article 3, authorizes the total expenditure of 20 million euros for the financing of investments necessary for the execution of experimental projects for the realization of school transport service for state and municipal kindergarten

children and state schools of the first cycle of education with hybrid or electric means of transport, selected by the Ministry of the Environment (now the Ministry of Environment and Energy Security) based on the size of the number of students involved and the estimated reduction of air pollution. The measure is reserved for municipalities with a population over 50,000 affected by EU infringement procedures No. 2014/2147 of July 10, 2014 and No. 2015/2043 of May 28, 2015 for Italy's non-compliance with its obligations under Directive 2008/50/EC on air quality.

4.3.3.17 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[46] 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:

1. establishing a system for monitoring, reporting and verifying (MRV) of CO2 emissions;
2. setting reduction targets for the maritime transport sector, in particular, a reduction in carbon intensity of international shipping (to reduce CO2 emissions per transport work, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008); and that total annual GHG emissions from international shipping should be reduced by at least 50% by 2050 compared to 2008;
3. 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[47] of the European 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

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[46] 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.

[47] 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.

element of the commodities' prices) are expected to have minor effects[48]. 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.

[48] 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 4.7 Implemented policies and measures in the transport sector

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
Emission standard for new vehicles	Fleet update	Transport	Efficiency improvements of vehicles	Regulatory	National	2019	Ministry of economic development (National government)
Incentives to biomethane and other advanced biofuels	Biofuels promotion: consumption in the transport sector of bio-methane and about advanced biofuels through the conversion of refineries and / or traditional biodiesel plants	Transport	Low carbon fuels/electric cars	Economic	National	2020	Ministry of economic development (National government)
Implementation of the RED II with specific obligations on biofuels and other renewables	This Directive establishes a common framework for the promotion of energy from renewable sources. It sets a binding Union target for the overall share of energy from renewable sources in the Union's gross final consumption of energy in 2030. It also provides that 14% of the energy consumed in road and rail transport by 2030 shall be renewable energy.	Transport	Low carbon fuels/electric cars	Regulatory	National	2020	Ministry of economic development (National government)

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
Certification of biofuel sustainability	Biofuel sustainability certification systems measure and verify environmental performance of fuels throughout all major stages of the product life cycle, production, fuel production, and end-use including feedstock.	Transport	Low carbon fuels/electric cars	Regulatory	National	2020	Ministry of economic development (National government)
Sustainable Urban Mobility Incentive Program (PrIMUS)	The Sustainable Urban Mobility Incentive Program (PrIMUS) is aimed at municipalities with at least 50,000 inhabitants and provides 15 million euros for sustainable urban mobility actions on three themes: development of cycle infrastructure, sharing mobility and mobility management activities.	Transport	Improve sustainable urban mobility	Planning	National	2020	Ministry of economic development (National government)
National Infrastructural Plan for the recharging of electricity powered vehicles – PNIRE	The PNIRE (National Plan for Electric charging Infrastructure), adopted by the Ministry of Infrastructures and Transport, has as its object the construction of infrastructure networks for recharging vehicles powered by electricity. It also defines the guidelines to guarantee the unitary development of the recharge service	Transport	Electric road transport	Planning	National	2019	Ministry of Infrastructures and Transports (National government)

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
	vehicles powered by electricity in the national territory.						
Infrastructure upgrading (regional rail transport and rapid mass transport systems)	Increase of high capacity and high speed rail networks	Transport	Modal shift to public transport or non-motorized transport	Planning	National	2018	Ministry of Infrastructures and Transports (National government)

Table 4.8 Planned policies and measures in the transport sector

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Energy efficiency, renewables and electrification in the transport sector	**Increase energy end-use efficiency, support biofuels and other fuels with low environmental impact, support intermodality and emission reduction**	**Transport**	**Low carbon fuels/electric cars, modal shift to public transport or non-motorized transport, electric road transport, modal shift in freight transport**	**Regulatory; Planning; Economic**	**National**			**24200**
Certification of biofuel sustainability	Biofuel sustainability certification systems measure and verify environmental performance of fuels throughout all major stages of the product life cycle, production, fuel production, and end use including feedstock.	Transport	Low carbon fuels/electric cars	Regulatory	National	2022	Ministry of Economic Development, Ministry of Environment and Ministry of Agricultural and Forestry	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Infrastructure upgrading (regional rail transport and rapid mass transport systems)	Increase of high capacity and high speed rail networks	Transport	Modal shift to public transport or non-motorized transport	Planning	National	2024	Ministry of Infrastructures and Transports (National government)	
Urban Plans for Sustainable Mobility - PUMS	A Sustainable Urban Mobility Plan has as its central goal improving accessibility of urban areas and providing high-quality and sustainable mobility and transport to, through and within the urban area.	Transport	Modal shift to public transport or non-motorized transport	Planning	National	2021	Ministry of Infrastructures and Transports (National government)	
Renewal of public transport vehicles	Renewal of public vehicles for passenger transport (renewal of the fleet used for local public transport)	Transport	Low carbon fuels/electric cars, electric road transport	Economic	National	2021	Ministry of Infrastructures and Transports (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Renewal of private passenger vehicles (incentives to buy more efficient vehicles and with lower GHG emissions, regulatory measures, alternative fuel refueling points - DAFI)	Promoting and supporting renewal of car fleet with low carbon fuels, speed up the replacement of vehicle fleet with new vehicles, including CNG and LPG cars.	Transport	Low carbon fuels/electric cars, electric road transport	Economic	National	2021	Ministry of Infrastructures and Transports (National government)	
Modal shift of passenger transportation (mobility management measures)	Modal shift from private cars to public transport, car-pooling, bikes and walking	Transport	Modal shift to public transport or non-motorized transport	Economic	National	2022	Ministry of Infrastructures and Transports (National government)	
Modal shift in freight transport	Marebonus and Ferrobonus incentive to shift goods away from road	Transport	Modal shift in freight transport	Planning	National	2022	Ministry of Infrastructures and Transports (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Support to LNG penetration in heavy freight transport (maritime and road) through taxation	The development of LNG for navigation maritime and inland, as well as for road transport deriving from the DAFI directive.	Transport	Low carbon fuels/electric cars	Regulatory	National	2022	Ministry of Infrastructures and Transports (National government)	
Renewal of vehicles for freight transport	Promoting and supporting renewal of HDV and LDV fleet with low carbon fuels, speed up the replacement of vehicle fleet with new vehicles powered by alternative fuels, including CNG and LNG.	Transport	Low carbon fuels/electric cars	Economic	National	2022	Ministry of Infrastructures and Transports (National government)	

4.4 Policies in non-Energy Sectors

4.4.1 IPPU

As regards IPPU sector, no new measures have been implemented or planned after the previous National Communication.

4.4.2 Agriculture

In defining the scenarios to 2030, account was taken of the study carried out by the Centro Ricerche Produzioni Animali (CRPA) on behalf of ISPRA in 2018[49]. The study assumed the dissemination of measures to reduce ammonia and nitrous oxide emissions, as provided for in the Industrial Emissions Directive (IED), the Nitrates Directive and the Nitrates Action Programmes, in the Air Plans and the Rural Development Programmes (RDP) of the Po Valley regions. The measures considered are related to interventions on animal feeding (considering low protein diets), animal housing, storage (including treatment of manure in anaerobic digestion plants for biogas production) and manure spreading for cattle, pig and poultry livestock categories. These measures are also contained in the 'Guidelines for the reduction of atmospheric emissions from agricultural and livestock activities', published in 2016 by the Ministry of Agricultural, Food Sovereignty and Forestry (MASAF). Similar reduction measures have also been included in the "National Indicative Code of Good Agricultural Practices for the Control of Ammonia Emissions", prepared by MASAF as an annex to the National Air Pollution Control Programme drawn up under the National Emission Ceilings Directive (NEC Directive 2016/2284/EU), approved by decree of the President of the Council of Ministers of 23 December 2021. After 2030, no further emission reduction measures are considered, so the assumption for the year 2030 is kept constant until 2050, with no change.

In the agricultural sector, ammonia emissions are considered in addition to GHG emissions as they have nitrogen as a common emission source. This implies that ammonia reduction measures will in many cases also reduce nitrous oxide emissions. Protein-reduced feeding techniques reduce the nitrogen ingested by animals and consequently the nitrogen excreted, reducing ammonia emissions but also nitrous oxide emissions, in the various stages of manure management. Reduced ammonia emissions at housing and storage result in less ammonia nitrogen being lost to the atmosphere and a consequent reduction in indirect nitrous oxide emissions from the storage and treatment of livestock manure, calculated on the basis of the fallout to soil from the nitrogen forms. However, these reductions lead to an increase in the nitrogen available for agronomic spreading, which subsequently leads to an increase in nitrous oxide emissions. Finally, in the manure spreading phase, measures to reduce ammonia emissions result in less ammonia nitrogen loss and a consequent decrease in indirect nitrous oxide emissions from spreading.

On the basis of policies encouraging the use of biomethane and biogas (Ministerial Decree of 2 March 2018 on biomethane; Ministerial Decree of 23 June 2016 on biogas for electricity production), an increase in the percentage of cattle, pig and poultry manure sent to anaerobic digesters for biogas production has been assumed. This technique of manure management results in a reduction of methane emissions at storage. In 2020 the estimated amount of livestock manure going to digesters is about 14% of the total manure produced and it is assumed that this percentage will become 40% in 2030, based on the mentioned incentive system for electricity production from biogas and biomethane production.

The next scenarios to be defined will need to consider a range of emission reduction measures laid out in national and European policy documents, such as the Common Agricultural Policy National Strategic Plan 2023-2027 (PSN), the National Recovery and Resilience Plan (PNRR), and the European Farm to Fork (F2F) strategy. Italy completed during 2022 the definition of the PSN, which will be sent to the European Commission in a short time, which provided for the application of the new common agricultural policy (CAP) from January 1, 2023. The PSN defines the actions to be taken to support the primary sector to address climate and environmental challenges. The Plan includes measures to reduce emissions from livestock and

[49] Study to assess the effects on emissions of ongoing transformations in the livestock sector, by CRPA, Reggio Emilia, 2018

soil management, indicating for each measure the funding, description of the technique to be adopted, and eligibility criteria for beneficiaries. The PNRR envisages an investment of 1.92 billion euros for the measure bearing on the development of biomethane and the promotion and dissemination of environmentally friendly practices at the biogas production stage in order to reduce the use of synthetic fertilizers, increase the supply of organic matter in soils, and create consortium hubs for the centralized treatment of digestates and effluents with the production of fertilizers of organic origin. The F2F strategy has as one of its goals to reduce nutrient losses by at least 50 percent, while ensuring that soil fertility does not deteriorate; this will reduce fertilizer use by at least 20 percent by 2030.

Table 4.9 Implemented policies and measures in agriculture

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
Rationalization in the use of nitrogen fertilizer	Interventions on animal feeding (considering low protein diets), animal housing, storage (including treatment of manure in anaerobic digestion plants for biogas production) and manure spreading for cattle, pig and poultry livestock categories.	Agriculture	Reduction of ammonia and nitrous oxide emissions	Regulatory / Planning	Po Valley region	2007	Ministry of Agricultural and Forestry (National government)
Recovery of biogas from animal storage system	Increase in the percentage of cattle, pig and poultry manure sent to anaerobic digesters for biogas production	Agriculture	Reduction of methane emissions	Planning	National	2007	Ministry of economic development (National government)

4.4.3 Waste

Emissions reduction in the waste sector in the past was 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. This has implied a continuous updating of the regulatory system. 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. measures to promote the recycling of organic waste (Italian Prime Ministerial Decree of 7 March 2016) and other waste (End of Waste decrees) consistent with the updating of the relevant legislation.

According to the Directive 2008/98/EC on waste Italy is taking the necessary measures to achieve the recycling of municipal waste to a minimum of 55 %, 60% and 65% by weight by 2025, 2030 and 2035 respectively. Furthermore, the European Commission adopted the new circular economy action plan (CEAP) in March 2020. It targets how products are designed, promotes circular economy processes, encourages sustainable consumption, and aims to ensure that waste is prevented and the resources used are kept in the EU economy for as long as possible. It introduces legislative and non-legislative measures targeting areas where action at the EU level brings real added value.

Table 4.10 Implemented policies and measures in waste

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
Increase separate collection of urban waste	Recycling of municipal waste to a minimum of 55 %, 60% and 65% by weight by 2025, 2030 and 2035 respectively	Waste	Compliance with separate collection targets and reduction of biodegradable waste disposed of into landfills	Regulatory	National	2008	Regions

4.4.4 F-gases

Italy has already taken actions to reduce HFCs, in line with the objectives of Kigali Amendment, by adopting in 2014 the EU Regulation 517/2014 on fluorinated greenhouse gases, transposed into a national decree in 2018 by the Decree of the President of the Republic 16 November 2018, n. 146. Because of this, the sectors that use HFCs in their products and appliances need technological innovations as the case of Italy where many companies have been developing advanced technological solutions aimed at mitigating the greenhouse effects and complying with EU Regulation 517/2014.

In order to achieve the targets of the EU Regulation 517/2014 Italian companies are focusing on research and development of new technologies in the sectors using HFCs or alternatives. Although Italy is no longer a producer of refrigerants, however Italian companies stand out worldwide as leading companies in the investigated sectors because they are able to produce innovative technologies and customize their product according to customer needs, climatic conditions and local conditions. In many sectors, Italy has already made the leap in technology with the aim to be in line also with the potential targets of the revision of the EU Regulation.

Table 4.11 Implemented policies and measures in industrial processes

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
Use of F-gas	Research and development of new technologies in the sectors using HFCs or alternatives	Industrial processes	To reduce HFCs	Regulatory	Nationale	2018	National government

4.4.5 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 and are not included in the 2020 target. Following the entry into force of the Paris Agreement, the European Union set a binding target to cut its emissions by at least 40% below 1990 levels by 2030, including the Land Use, Land-Use Change and Forestry (LULUCF) sector. The LULUCF Regulation (EU) 2018/841 defines the LULUCF target at European and national scale. For the period from 2021 to 2025, each Member State shall ensure that emissions do not exceed removals, calculated as the sum of total emissions and removals on their territory in the land accounting categories (i.e. *afforested land, deforested land, managed cropland, managed grassland, managed forest land*). For 2026 to 2030 period, a LULUCF target for Italy has been set to -35.8Mt CO2 eq.

The LULUCF Regulation sets requirements for the accounting of emissions and removals for the period 2021-2025, in relation to the following land accounting categories:

- afforested[50] and deforested[51] land
- managed cropland[52], managed grassland[53], and managed wetlands[54]
- managed forest land

For the 2026-2030, the national target has to be compared with the total sum of greenhouse gas emissions and removals from the land reporting categories: *forest land; cropland; grassland; wetlands; settlements; other land; harvested wood products; other; atmospheric deposition; nitrogen leaching and run-off*.

In addition, the Effort Sharing Regulation (EU) 2018/842 includes a flexibility provision 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.

The Italian National Forestry Accounting Plan, prepared in accordance with paragraph 3 of article 8 of the LULUCF Regulation, includes the Forest Reference Level (FRL), for the period from 2021 to 2025.

Under the Kyoto Protocol, forest is defined by Italy using the same definition[55] 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. Italy has elected cropland management (CM) and grazing land management (GM) as additional activities under Article 3.4 for the second commitment period of the Kyoto Protocol (2013-2020); following Decision 2/CMP.7 forest management (FM) is a mandatory activity to be accounted for under Article 3.4. Detailed description of activity data and methodologies used to estimate emissions and removals from activities subject to the article 3.3 and article 3.4 of the Kyoto Protocol is reported in the National Inventory Report (ISPRA, 2022).

Measures have been not currently implemented or planned.

4.5 Cross Cutting policies

4.5.1 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 end-use energy sectors: industrial,

[50] land use reported as *cropland, grassland, wetlands, settlements, or other land, converted to forest land*
[51] land use reported as *forest land converted to cropland, grassland, wetlands, settlements, or other land*
[52] *cropland remaining cropland; grassland, wetlands, settlements or other land, converted to cropland; cropland converted to wetlands, settlemenst or other land*;
[53] *grassland remaining grassland; cropland, wetlands, settlement or other land, converted to grassland; grassland converted to wetlands, settlements or other land*
[54] *wetlands remaining wetlands; settlements or other land, converted to wetlands; wetlands converted to settlements or other land*
[55] 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.

residential, service. A Ministerial Decree firstly introduced the system on 24th April 2001.

In December 2012, the so called "White Certificate Decree" was issued. The new decree defines the criteria, the conditions and the procedures to implement energy efficiency measures in end-use energy. The Decree has also transferred, from 2013, competences concerning the management, assessment and certification of energy saving projects carried out under white certificates system to a State owned company (Gestore dei Servizi Energetici – GSE).

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

In the 2017 and 2018 two decrees have fixed annual energy saving targets for the period 2017-2020.

For the period 2021-2024 the annual targets for the energy distributors set by the decree adopted in 2020 are:

- 0,45 MTEE in final use of electricity and 0,55 MTEE in final use of natural gas for 2021;
- 0,75 MTEE in final use of electricity and 0,93 MTEE in final use of natural gas for 2022;
- 1,05 MTEE in final use of electricity and 1,30 MTEE in final use of natural gas for 2023;
- 1,08 MTEE in final use of electricity and 1,34 MTEE in final use of natural gas for 2024.

The annual public expenditure commitment is between 0.7 and 1 billion euros.

4.6 Other policies at local level

4.6.1 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 requested 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[56].

4.7 Summary of policies and measures

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

[56] https://eu-mayors.ec.europa.eu/en/home

Table 4.4.7.1- Summary of implemented policies and measures

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
Incentives for the promotion of electricity production by renewables	Incentives for the electricity production by renewable from wind on shore, photovoltaic, hydroelectirc and residual gas	Energy Supply	Increase in renewable energy	Economic	National	2019	Ministry of economic development and Ministry of environment (National government)
Incentives for the promotion of electrical and thermal renewables in the small islands	Electricity network upgrade to have higher renewable penetration. Pilot projects regarding renewable productions, storage systems, development of electrical transport, integration of the electrical system with the water system	Energy Supply	Increase in renewable energy	Economic	Local	2020	Ministry of economic development and Ministry of environment (National government)
White certificates - Cogeneration	Supporting CHP and district heating plants	Energy Supply	Efficiency improvement in the energy and transformation sector (Energy Supply)	Economic	National	2015	GSE- Manager for Energy Service (National government)
Coal phase-out	Ban coal use for electricity production from 2025	Energy Supply	Switch to less carbon-intensive fuels	Regulatory	National	2019	Ministry of economic development (National government)

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
White certificates – Industry	Supporting electric energy saving in the industry sector	Energy Consumption	Efficiency improvement in industrial end-use sectors (Energy Consumption)	Economic	National	2009	GSE- Manager for Energy Service (National government)
National Industry 4.0 Plan (Impresa 4.0)	Tax breaks and reductions to stimulate companies - micro, small and medium-sized enterprises and innovative startups - to invest in innovation.	Energy Consumption	Efficiency improvement in industrial end-use sectors (Energy Consumption)	Fiscal	National	2019	Ministry of economic development (National government)
"Ecobonus" and "Bonus casa"	Supporting of energy saving and renewables in existing buildings through tax deduction.	Energy Consumption	Efficiency improvements of buildings	Fiscal	National	2008	Ministry of Economy and Finance (National government)
Energy audits in companies	Co-financing of energy audits in SMEs; adoption of energy management systems compliant with ISO 50001 standards; extension to energy-intensive businesses in the gas sector and correlation of the benefit to the execution of energy efficiency interventions	Energy Consumption	Efficiency improvement in industrial end-use sectors	Regulatory	National	2014	ENEA - Italian National agency for new technologies, Energy and sustainable economic development (Research institutions)

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
Minimum energy performance requirements for buildings	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	Energy Consumption	Efficiency improvements of buildings	Regulatory	National	2006	Ministry of economic development (National government)
Thermal account	Incentives for small-scale energy efficiency measures in buildings and production of thermal energy from renewable sources	Energy Consumption	Efficiency improvements of buildings and in services/ tertiary sector	Economic	National	2012	Ministry of economic development, GSE- Manager for Energy Service (National government)
Efficient public lighting system	Obligation to make public lighting system more efficient	Energy Consumption	Demand management/reduction	Regulatory	National	2020	Ministry of economic development and Ministry of environment (National government)
Energy program for the Central Public Administration (PREPAC)	Support to Public Administration buildings	Energy Consumption	Efficiency improvement in services/ tertiary sector	Economic	National	2020	Ministry of economic development and Ministry of environment (National government)
Kyoto Fund Review	Extension of the granting subsidized loans for financing energy efficiency in sport facilities and health buildings	Energy Consumption	Efficiency improvements of buildings	Economic	National	2020	Ministry of economic development and Ministry of environment (National government)

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
Emission standard for new vehicles	Fleet update	Transport	Efficiency improvements of vehicles	Regulatory	National	2019	Ministry of economic development (National government)
Incentives to biomethane and other advanced biofuels	Biofuels promotion: consumption in the transport sector of bio-methane and about advanced biofuels through the conversion of refineries and / or traditional biodiesel plants	Transport	Low carbon fuels/electric cars	Economic	National	2020	Ministry of economic development (National government)
Implementation of the RED II with specific obligations on biofuels and other renewables	This Directive establishes a common framework for the promotion of energy from renewable sources. It sets a binding Union target for the overall share of energy from renewable sources in the Union's gross final consumption of energy in 2030. It also provides that 14% of the energy consumed in road and rail transport by 2030 shall be renewable energy.	Transport	Low carbon fuels/electric cars	Regulatory	National	2020	Ministry of economic development (National government)

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
Certification of biofuel sustainability	Biofuel sustainability certification systems measure and verify environmental performance of fuels throughout all major stages of the product life cycle, production, fuel production, and end-use including feedstock.	Transport	Low carbon fuels/electric cars	Regulatory	National	2020	Ministry of economic development (National government)
Sustainable Urban Mobility Incentive Program (PrIMUS)	The Sustainable Urban Mobility Incentive Program (PrIMUS) is aimed at municipalities with at least 50,000 inhabitants and provides 15 million euros for sustainable urban mobility actions on three themes: development of cycle infrastructure, sharing mobility and mobility management activities.	Transport	Improve sustainable urban mobility	Planning	National	2020	Ministry of economic development (National government)
National Infrastructural Plan for the recharging of electricity powered vehicles – PNIRE	The PNIRE (National Plan for Electric charging Infrastructure), adopted by the Ministry of Infrastructures and Transport, has as its object the construction of infrastructure networks for recharging vehicles powered by electricity . It also defines the	Transport	Electric road transport	Planning	National	2019	Ministry of Infrastructures and Transports (National government)

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
	guidelines to guarantee the unitary development of the recharge service vehicles powered by electricity in the national territory.						
Infrastructure upgrading (regional rail transport and rapid mass transport systems)	Increase of high capacity and high speed rail networks	Transport	Modal shift to public transport or non-motorized transport	Planning	National	2018	Ministry of Infrastructures and Transports (National government)
Rationalization in the use of nitrogen fertilizer	Interventions on animal feeding (considering low protein diets), animal housing, storage (including treatment of manure in anaerobic digestion plants for biogas production) and manure spreading for cattle, pig and poultry livestock categories.	Agriculture	Reduction of ammonia and nitrous oxide emissions	Regulatory / Planning	Po Valley region	2007	Ministry of Agricultural and Forestry (National government)

Name of PaM	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy
Recovery of biogas from animal storage system	Increase in the percentage of cattle, pig and poultry manure sent to anaerobic digesters for biogas production	Agriculture	Reduction of methane emissions	Planning	National	2007	Ministry of economic development (National government)
Increase separate collection of urban waste	Recycling of municipal waste to a minimum of 55 %, 60% and 65% by weight by 2025, 2030 and 2035 respectively	Waste	Compliance with separate collection targets and reduction of biodegradable waste disposed of into landfills	Regulatory	National	2008	Regions
Use of F-gas	Research and development of new technologies in the sectors using HFCs or alternatives	Industry	To reduce HFCs	Regulatory	National	2018	National government

Table 4.4.7.2- Summary of planned policies and measures

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Energy production and transformation	**Promotion and support to the renewable energy sources**	**Energy Supply**	**Increase in renewable energy and increase in renewable energy in the heating and cooling sector**	**Regulatory; Economic**	**National**			**24800**
Revision of the regulations for the allocation of hydroelectric concessions	The auction procedures for the existing concessions will be integrated in the territorial planning, considering other uses of water, on the basis of homogeneous rules at national level, also in terms of fees. Procedures will transparently privilege the redevelopment of the plants, in order to ensure the useful storage capacity and increase the producibility, in	Energy Supply	Increase in renewable energy	Regulatory	National	2022	Ministry of economic development (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
	compliance with environmental constraints.							
Renewables in existing and new buildings	Extension and improvement of the obligation to integrate renewables into existing and new buildings	Energy Supply	Increase in renewable energy in the heating and cooling sector	Regulatory	National	2022	Ministry of economic development and Ministry of environment (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Incentives to electrical and thermal renewables use in the small islands	Electricity network upgrade to have higher renewable penetration. Pilot projects regarding renewable productions, storage systems, development of electrical transport, integration of the electrical system with the water system	Energy Supply	Increase in renewable energy	Economic	National	2022	Ministry of economic development, GSE-Manager for Energy Service (National government)	
Energy efficiency, renewables and electrification in the industrial sector	**Increase energy efficiency and renewable energy production in the industrial sector**	**Energy Consumption**	**Efficiency improvement in industrial end-use sectors**	**Economic; Regulatory; Fiscal**	**National**			**4600**
White certificates (Certificati bianchi) mechanism with upgrading	Update and widen mechanism to support energy savings	Energy Consumption	Efficiency improvement in industrial end-use sectors	Economic	National	2022	GSE- Manager for Energy Service (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Energy audits in companies	Co-financing of energy audits in SMEs; adoption of energy management systems compliant with ISO 50001 standards; extension to energy-intensive businesses in the gas sector and correlation of the benefit to the execution of energy efficiency interventions	Energy Consumption	Efficiency improvement in industrial end-use sectors	Regulatory	National	2021	ENEA - Italian National agency for new technologies, Energy and sustainable economic development (Research institutions)	
National Industry 4.0 Plan	Update Tax breaks and reductions to stimulate companies - micro, small and medium-sized enterprises and innovative startups - to invest in innovation.	Energy Consumption	Efficiency improvement in industrial end-use sectors	Fiscal	National	2021	Ministry of Economic Development (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Energy efficiency, renewables and electrification in the civil sector	**Increase energy efficiency and renewable energy production and emission reduction in the civil sector**	**Energy Consumption**	**Efficiency improvements of buildings, increase in renewable energy in the heating and cooling sector, demand management/reduction, efficiency improvement in services/ tertiary sector**	**Economic; Regulatory; Fiscal**	**National**			**9300**
White certificates (Certificati bianchi) mechanism with upgrading	Update and widen mechanism to support energy savings	Energy Consumption	Efficiency improvements of buildings (Energy Consumption)	Economic	National	2022	GSE- Manager for Energy Service (National government)	
Thermal account (Conto termico) mechanism with upgrading	Update of the incentive schemes for small-scale energy efficiency measures in buildings and production of thermal energy from renewable sources	Energy Consumption	Efficiency improvements of buildings	Economic	National	2023	Ministry of economic development, GSE-Manager for Energy Service (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Renewables in existing and new buildings	Extension and improvement of the obligation to integrate renewables into existing and new buildings	Energy Consumption	Increase in renewable energy in the heating and cooling sector	Regulatory	National	2022	Ministry of economic development and Ministry of environment (National government)	
Efficient public lighting system	Extension of obligation to make public lighting system more efficient	Energy Consumption	Demand management/reduction	Regulatory	National	2022	Ministry of economic development and Ministry of environment (National government)	
Energy upgrading program for the Central Public Administration (PREPAC)	Support to upgradings in Public Administration buildings will be strengthened, in order to play a guide role for the entire economic sector.	Energy Consumption	Efficiency improvement in services/ tertiary sector	Economic	National	2022	Ministry of economic development and Ministry of environment (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
"Superbonus 110%"	Increase the propensity towards radical interventions on the building through efficiency improvements and renewables for energy generation and consumption.	Energy Consumption	Efficiency improvements of buildings	Fiscal	National	2021	Ministry of economic development and Ministry of environment (National government)	
Energy efficiency, renewables and electrification in the transport sector	**Increase energy end-use efficiency, support biofuels and other fuels with low environmental impact, support intermodality and emission reduction**	**Transport**	**Low carbon fuels/electric cars, modal shift to public transport or non-motorized transport, electric road transport, modal shift in freight transport**	**Regulatory; Planning; Economic**	**National**			**24200**

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Certification of biofuel sustainability	Biofuel sustainability certification systems measure and verify environmental performance of fuels throughout all major stages of the product life cycle, production, fuel production, and end use including feedstock.	Transport	Low carbon fuels/electric cars	Regulatory	National	2022	Ministry of Economic Development, Ministry of environment and Ministry of Agricultural and Forestry	
Infrastructure upgrading (regional rail transport and rapid mass transport systems)	Increase of high capacity and high speed rail networks	Transport	Modal shift to public transport or non-motorized transport	Planning	National	2024	Ministry of Infrastructures and Transports (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Urban Plans for Sustainable Mobility - PUMS	A Sustainable Urban Mobility Plan has as its central goal improving accessibility of urban areas and providing high-quality and sustainable mobility and transport to, through and within the urban area.	Transport	Modal shift to public transport or non-motorized transport	Planning	National	2021	Ministry of Infrastructures and Transports (National government)	
Renewal of public transport vehicles	Renewal of public vehicles for passenger transport (renewal of the fleet used for local public transport)	Transport	Low carbon fuels/electric cars, electric road transport	Economic	National	2021	Ministry of Infrastructures and Transports (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Renewal of private passenger vehicles (incentives to buy more efficient vehicles and with lower GHG emissions, regulatory measures, alternative fuel refueling points - DAFI)	Promoting and supporting renewal of car fleet with low carbon fuels, speed up the replacement of vehicle fleet with new vehicles, including CNG and LPG cars.	Transport	Low carbon fuels/electric cars, electric road transport	Economic	National	2021	Ministry of Infrastructures and Transports (National government)	
Modal shift of passenger transportation (mobility management measures)	Modal shift from private cars to public transport, car-pooling, bikes and walking	Transport	Modal shift to public transport or non-motorized transport	Economic	National	2022	Ministry of Infrastructures and Transports (National government)	
Modal shift in freight transport	Marebonus and Ferrobonus incentive to shift goods away from road	Transport	Modal shift in freight transport	Planning	National	2022	Ministry of Infrastructures and Transports (National government)	

Name of PaM or group of PaMs	Short description	Sector affected	Objective	Type of policy Instrument	Geographical coverage	Start year of implementation	Entities responsible for implementing the policy	GHG emissions reductions for year 2030 (kt CO2-equivalent per year)
Support to LNG penetration in heavy freight transport (maritime and road) through taxation	The development of LNG for navigation maritime and inland, as well as for road transport deriving from the DAFI directive.	Transport	Low carbon fuels/electric cars	Regulatory	National	2022	Ministry of Infrastructures and Transports (National government)	
Renewal of vehicles for freight transport	Promoting and supporting renewal of HDV and LDV fleet with low carbon fuels, speed up the replacement of vehicle fleet with new vehicles powered by alternative fuels, including CNG and LNG.	Transport	Low carbon fuels/electric cars	Economic	National	2022	Ministry of Infrastructures and Transports (National government)	

4.8 Costs analysis

Budget regulations and laws often have to comply with specific requirements regarding timing, resources and administrations responsible for the expenditures, and it is not always possible to provide a detailed description of the costs borne by the public system. Where available, the budget allocations for each PaM are reported in the specific paragraphs.

4.9 Summary of policies and measures no longer in place

Compared to the previous NC VII, there are no policies and measures that are no longer in place. Policies and measures reported as implemented in NC VII either are still in place or have been updated to include more binding targets for the forthcoming years.

4.10 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[57]. 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

[57] 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

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 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 2022 annual inventory submission.

5 PROJECTIONS AND EFFECTS OF POLICIES AND MEASURES[58]

5.1 Introduction

In the most recent years, actions taken by Italy to mitigate climate change have been driven by the commitments taken under the Kyoto Protocol and its amendment (Doha amendment), the European Climate and Energy Package (for the period 2013-2020), the EU NDC, and the European 2030 Climate and Energy Framework and Clean energy for all Europeans package for the period 2021-2030.

Pursuant to Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action, in 2020 Italy submitted the first integrated national energy and climate plan (NECP) to the European Commission. The plan is the result of a common effort of the former Ministries of Economic Development, of Environment and of Infrastructures and Transport and it is largely based on data and information provided by ISPRA, GSE and RSE. The plan was finalized in December 2019, but the analytical process has started in 2016 under the Head of Government Office.

In 2021, pursuant article 17 of the Regulation (EU) 2018/1999, new GHG emission projections were calculated and submitted to the European Commission using updated historic data and macroeconomic and demographic drivers. The present National Communication is based on the NECP, but emission projections have been updated to be consistent with the parameters updated in June 2020 used by the European Commission for draft PRIMES 2020 Reference scenario The base year for the projections is 2020, even though only provisional data were available when projections have been calculated, in order to include, as far as possible, the effects of the COVID-19 pandemic. WM scenario considers the policies and measures implemented before December 31st, 2019.

The scenarios have been calculated 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 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 energy supply and environmental criteria and bounds.

CO_2 emissions are directly calculated by the model implemented by ISPRA using the 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

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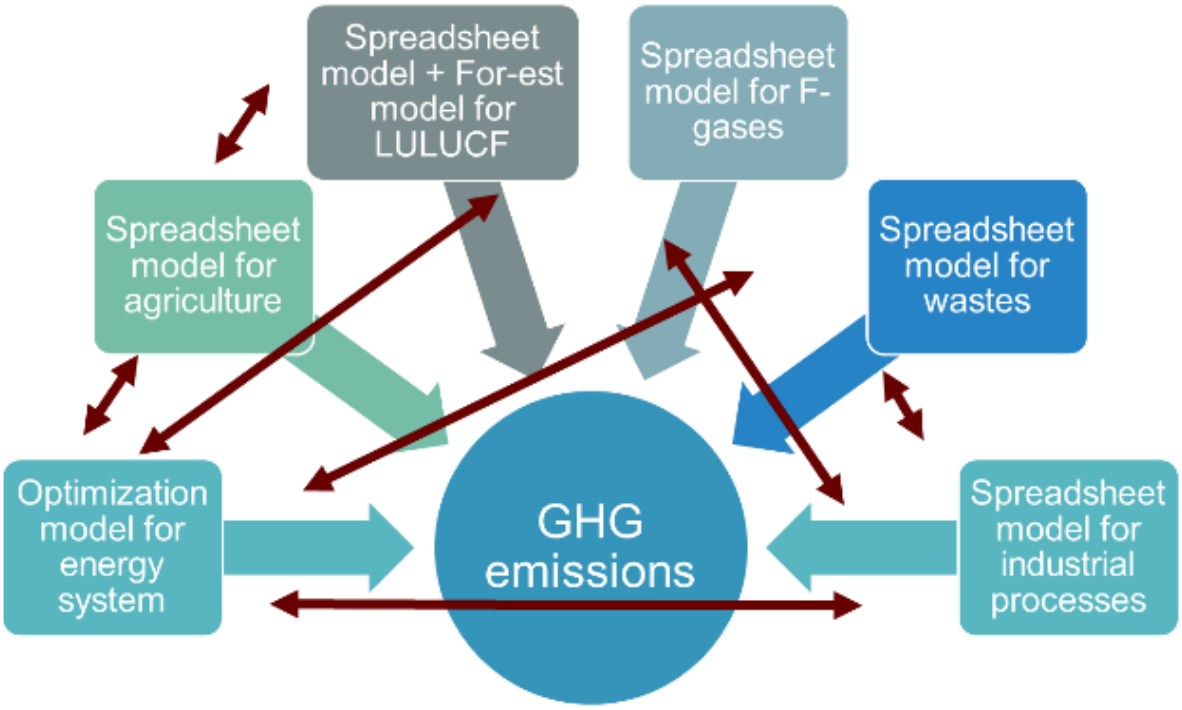
cost.

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

The overall GHG emissions and the share between ETS and non-ETS sectors are the results of the mentioned models implemented by ISPRA (Figure 5.1)

Figure 5.1 – The modeling system implemented by ISPRA for emission projections



The "With Additional Measures" (WAM) scenario, calculated with the same methodology of WM scenario, considers all the Policies and Measures foreseen in the NECP that were not yet implemented before 2020 (see Table 4.4.7.1 and Table 4.4.7.2).

The "Without Measures" (WOM) scenario could not be included, as most data on PaMs are not available starting from 1990. Moreover, since many structural changes occurred in the period 2000-2007, linked to economical and technological changes as well as to fuel shifts, it is not possible to determine how the Italian 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) as well as 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.

As reported in paragraph 4.2, Italy adopted new policies and measure in 2020 and 2021 to face the effects of COVID-19 pandemic. The "National Recovery and Resilience Plan" (NRRP) was adopted in July 2021, and includes several measures to tackle climate change and to purse sustainable economic growth towards an inclusive, climate resilient and net-zero emissions future.

The Plan envisages investments and a consistent reform package, with €191.5 billion in resources being allocated through the Recovery and Resilience Facility and €30.6 billion being funded through the Complementary Fund. The NRRP has been developed around three strategic axes shared at EU level: digitalization and innovation, ecological transition, and social inclusion. It aims at repairing the economic and social damage caused by the pandemic crisis, contributing to addressing the structural weaknesses of the Italian economy, and leading the country along a path of ecological, environmental and just transition.

In order to guarantee coherence with EU submission, which relies on data provided by EU Member States in March 2021, the NRRP policies and measures have not been taken into account in the definition of WM and WAM scenario described in this Chapter. Anyway, in order to give a preliminary overview of the effects that can be espected, a synthesis of the analysis conducted at national level in May 2022 is provided in paragraph 5.7.

5.2 WM scenario

5.2.1 Main assumptions

The WM scenario was elaborated in 2021 and projections include all PaMs implemented or adopted up to the end of 2019. The base year for projections is 2020. The projected years are from 2025 to 2050 with 5-year pace. Year 2020 already includes some preliminary estimate on primary fuels consumptions. The main assumptions of the scenario can be summarized as follow:

- GDP: economic growth from 2015 to 2020 with average annual rate of -1.32%. For the period 2020-2025 the average annual rate is +2.41%, for period 2025-2030 is +0.30%, and for period 2030-2040 is 0.20%;
- energy: increase of efficiency in finale uses and renewable sources toward EU 2030 targets;
- population: decrease up 2040 with average annual rate of -0.21% since 2015, quite constant for each five-years period.

The scenario considers a slow 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, as well as for activity levels of the industrial processes, 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 according to historic market trends.

5.2.1.1 General Economic Parameters

General economic parameters used for the scenario are those provided by the draft EU reference scenario for Italy in December 2020. Table 5.2.1 shows actual and projected values for GDP and GVA.

As already mentioned, the GDP is assumed to be reduced from 2015 to 2020 with an average year rate of -1.32%, at it is expected to recover at +0.78% yearly up to 2040. The GDP value for 2020 considers the effect of lockdown due to SARS-Cov2 pandemic. As for value added from productive sectors, a higher recovery for services is projected as compared to industry after 2020. In future years, tertiary sector is expected to continue growing at higher rate than industry, further increasing its role in the Italian economy.

Table **5.2.2** shows the energy and carbon international prices according to the suggested projections by European Commission. The prices show increasing trends for all the commodities. The increase in carbon price is particularly steep during the periods 2015-2030 (average annual rate 9.4%) and 2030-2040 (5.9% yearly), while the foreseen growth for energy prices is much slower (average annual rate from 0.4% for natural gas to 4.1% for oil in the period 2015-2040).

Table 5.2.1 – Actual and projected GDP, and GVA

billion € 2016 constant prices basis	2015	2020	2025	2030	2035	2040	2050
GDP	1,683	1,574	1,773	1,800	1,813	1,837	2,003
Average annual rate (%)	-0.50%	-1.32%	2.41%	0.30%	0.14%	0.27%	1.04%
GVA – industry	239	236	259	260	260	262	278
Average annual rate (%)	-0.16%	-0.26%	1.88%	0.08%	0.04%	0.10%	0.72%
GVA – construction	65	61	69	71	71	72	79
Average annual rate (%)	-6.08%	-1.36%	2.57%	0.36%	0.17%	0.32%	1.12%
GVA – tertiary	1,136	1,061	1,204	1,226	1,236	1,256	1,379
Average annual rate (%)	-0.17%	-1.36%	2.57%	0.36%	0.17%	0.32%	1.12%
GVA – agriculture	35	33	34	34	34	34	34
Average annual rate (%)	0.74%	-0.73%	0.14%	-0.03%	0.00%	0.00%	0.31%

Table 5.2.2 – Energy and carbon international prices

		2015	2020	2025	2030	2035	2040	2050
Coal prices	€ 2016 / GJ	1.8	1.8	2.7	2.9	3.1	3.3	3.5
Oil prices	€ 2016 / GJ	6.0	6.6	11.8	14.0	15.1	16.2	16.6
Gas prices	€ 2016 / GJ	7.5	3.5	5.7	6.0	6.8	8.2	8.6
Carbon price	€ 2016 / t CO_2	7.8	25	28	30	40	53	84

Table 5.2.3 – Actual (up to 2015) and projected GVA and Average annual rate (%) for industrial sectors

billion € 2016 constant prices basis	2015	2020	2025	2030	2035	2040	2050
GVA Iron and steel	5.10	5.58	5.95	5.94	5.93	5.92	6.00
Average annual rate (%)		1.79%	1.31%	-0.06%	-0.02%	-0.04%	0.18%
GVA Non ferrous metals	2.65	2.72	2.93	2.94	2.93	2.93	2.95
Average annual rate (%)		0.51%	1.54%	0.00%	-0.01%	-0.03%	0.08%
GVA Fertilisers/inorganic chemicals	1.88	1.91	1.93	1.89	1.88	1.85	1.71
Average annual rate (%)		0.27%	0.22%	-0.39%	-0.13%	-0.27%	-0.98%
GVA Petrochemicals	2.49	2.84	2.96	2.95	2.95	2.96	3.06
Average annual rate (%)		2.63%	0.88%	-0.08%	0.00%	0.04%	0.34%
GVA Other chemicals/ cosmetics	6.65	6.65	7.12	7.18	7.22	7.29	7.99
Average annual rate (%)		-0.01%	1.38%	0.19%	0.09%	0.21%	1.08%
GVA Pharmaceuticals	8.99	9.89	10.01	10.18	10.27	10.46	11.51
Average annual rate (%)		1.93%	0.25%	0.32%	0.18%	0.37%	1.13%
GVA Cement and derived products	2.26	2.11	2.39	2.43	2.44	2.47	2.73
Average annual rate (%)		-1.36%	2.48%	0.30%	0.12%	0.25%	1.22%
GVA Ceramics, bricks, etc.	2.74	3.03	3.26	3.30	3.30	3.32	3.44
Average annual rate (%)		1.98%	1.50%	0.24%	0.04%	0.10%	0.32%

billion € 2016 constant prices basis	2015	2020	2025	2030	2035	2040	2050
GVA Glass production	2.21	2.32	2.44	2.47	2.48	2.51	2.70
Average annual rate (%)		0.95%	1.07%	0.23%	0.09%	0.18%	0.92%
GVA Other non metallic minerals	2.33	2.08	2.35	2.38	2.39	2.41	2.54
Average annual rate (%)		-2.18%	2.46%	0.20%	0.07%	0.16%	0.58%
GVA Paper and pulp production	5.18	5.10	5.24	5.26	5.28	5.31	5.68
Average annual rate (%)		-0.34%	0.56%	0.06%	0.07%	0.15%	0.78%
GVA Printing and publishing	4.24	4.44	4.68	4.71	4.72	4.75	5.09
Average annual rate (%)		0.92%	1.06%	0.13%	0.05%	0.13%	0.83%
GVA Food, drink and tobacco	27.28	28.01	29.73	30.10	30.27	30.61	33.15
Average annual rate (%)		0.53%	1.20%	0.25%	0.11%	0.23%	0.93%
GVA Textiles	24.29	19.43	22.39	21.99	21.84	21.62	20.86
Average annual rate (%)		-4.37%	2.88%	-0.36%	-0.13%	-0.20%	-0.36%
GVA Engineering	101.86	102.95	114.69	115.33	115.59	116.17	124.70
Average annual rate (%)		0.21%	2.18%	0.11%	0.05%	0.10%	0.87%
GVA Other industries	38.60	36.61	40.62	40.80	40.89	41.06	43.58
Average annual rate (%)		-1.05%	2.10%	0.09%	0.04%	0.08%	0.69%

5.2.1.2 Population and transport

The population grew significantly from 2005 to 2015 with annual average rate of 0.49% and started to decline from 2015 to 2020 with annual rate -0.19%. The declining trend is expected all along the time series until 2050. In forthcoming years, the difference with the previous submission is noticeable with a growing divergence (Table 5.2.4).

Table 5.2.4 – Population

	2015	2020	2025	2030	2035	2040	2050
BR4	60,796	61,193	62,232	63,327	64,416		
Present WM/WAM	60,796	60,233	59,583	58,941	58,341	57,711	55,860

The next table shows the number of persons per household adopted for GHG projections in residential sector.

Table 5.2.5 – Inhabitants per household

	2015	2020	2025	2030	2035	2040	2050
BR4	2.35	2.33	2.31	2.29	2.27		
Present WM/WAM	2.35	2.31	2.42	2.40	2.37	2.35	2.29

Table 5.2.6 shows data of transport demand for passengers, freights, domestic navigation, and air traffic. The expected activity scenario for transport shows a sharp decline in 2020 due to the mentioned lockdown. After 2020 projections show a steady growth up to 2050. The transport demand decreases up to 2020 compared to 2015 with annual rate of -4.3% for passengers while show a weak growth of 0.24% for goods.

After 2020, up to 2050, the annual growth rate is around 1.2% for passengers and goods, with a much steeper increase until 2025 as a consequence of the end of the pandemic.

Table 5.2.6 – Transport demand for passengers and freights

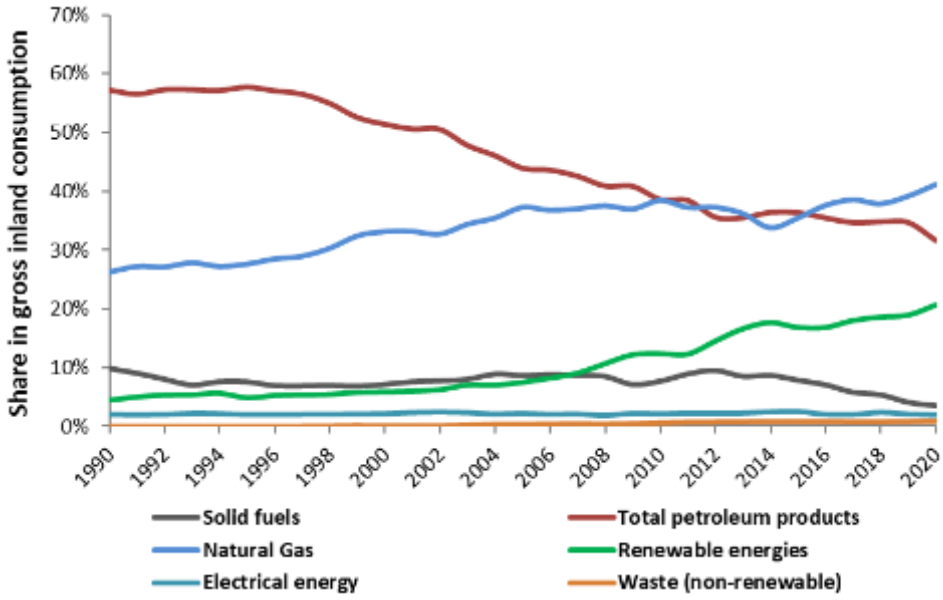
				2015	2020	2025	2030	2035	2040	2050
WM	**Passenger**	Road	billion pass-km	820.2	670.7	875.2	877.1	885.4	898.1	919.6
		Rail	billion pass-km	59.5	31.7	60.3	64.8	66.5	68.1	72.4
		Domestic aviation	Number of Landing and Take-Off cycle (LTO)	380.6	121.0	383.2	434.1	471.5	512.2	567.8
		International aviation	Number of Landing and Take-Off cycle (LTO)	325.4	115.7	366.3	416.3	457.6	497.6	558.2
		Total	**billion pass-km**	**876.8**	**702.4**	**935.5**	**941.9**	**951.9**	**966.1**	**992.0**
	Freight	Road	billion ton-km	124.9	144.5	168.3	183.8	190.1	196.2	208.6
		Rail	billion ton-km	20.8	20.5	24.1	25.9	26.9	27.7	29.0
		Domestic navigation (inland waterways and national maritime)	billion ton-km	51.2	44.6	59.8	61.1	61.8	62.6	65.2
		Total	**billion ton-km**	**207.1**	**209.6**	**252.3**	**270.8**	**278.8**	**286.5**	**302.8**

5.2.2 Consumption of primary and final energy

The gross inland consumption of energy (GIC), estimated according to the methodology adopted by Eurostat, is expected to be about 138.7 Mtoe in 2030 with an average yearly decrease rate of -0.8% since 2015. After the further fall in 2020 and the rebound effect in 2025 the projected gross inland consumption shows constant decrease to 124.6 Mtoe up to 2050.

GIC 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 +1.7%. The share of natural gas increased constantly since 1990 counterbalancing the corresponding decrease of oil share. Since 2007 it is also evident the growing role of renewable energies (Figure 5.2).

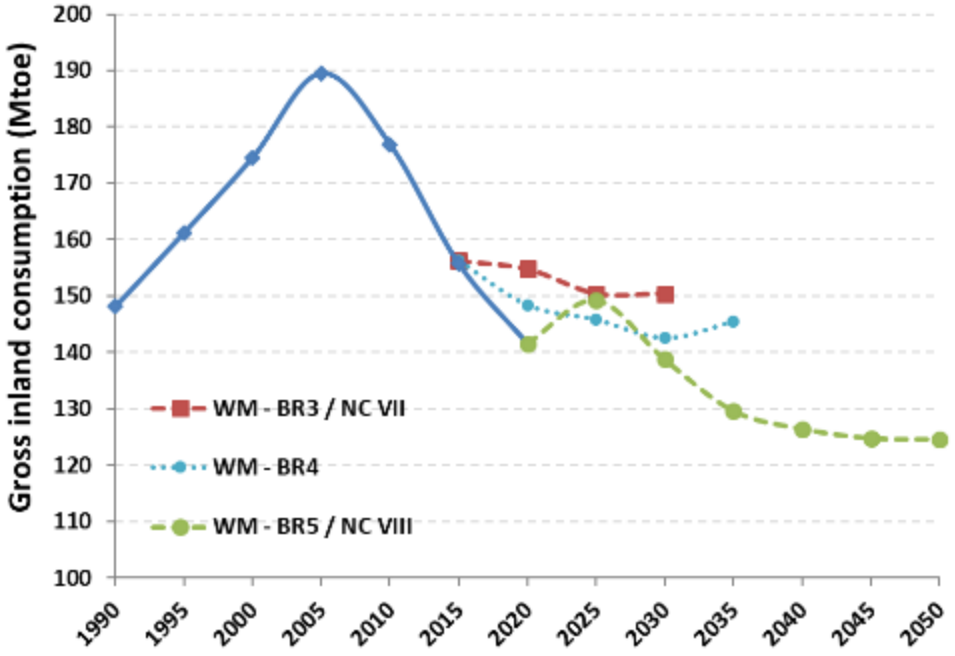
Figure 5.2– Fuel mix of GIC, historic data



Source: ISPRA

Figure 5.3 shows the projections of GIC according to the present submission compared to previous one (BR4 and BR3/NC7). Relevant changes can be observed in the estimated total energy consumption between the previous projections and the last one due to updated data for base year and adoption of new measures. The most relevant changes occurred in 2020 following the measures adopted to slow down the diffusion of SARS-Cov2 pandemic followed by the rebound effect in the next years.

Figure 5.3 - Actual and projected gross inland consumption, Mtoe



Source: ISPRA

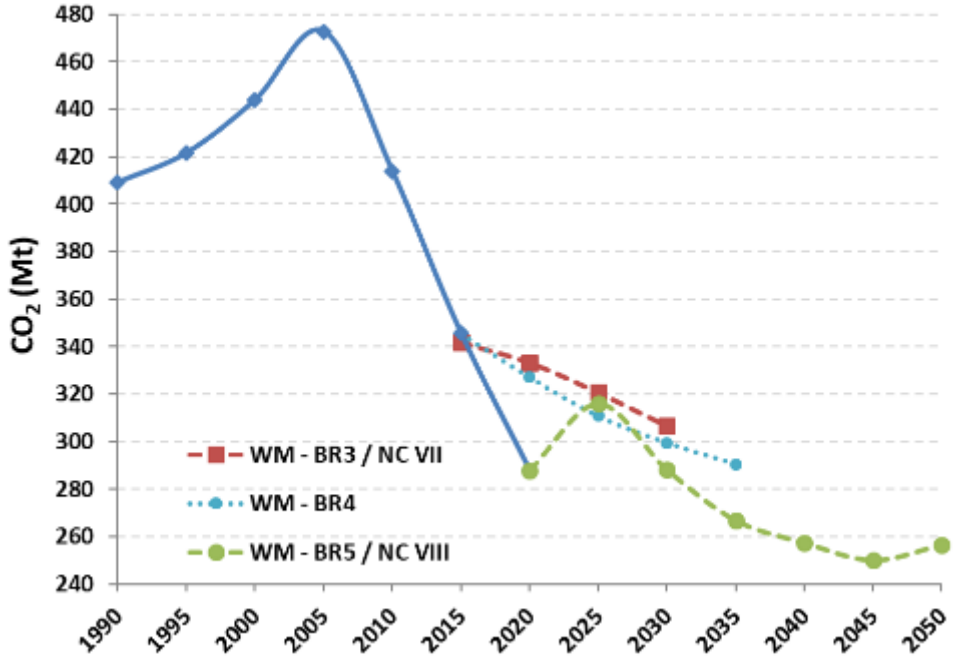
5.2.3 GHG Emissions

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 emission factors. Emissions up to 2020 are the inventory data as submitted to UNFCCC in 2022. As can be seen in Figure 5.4, remarkable emission reductions already occurred up to 2020. The reduction of emissions is due to many factors, some of them structural and other only temporary. The most important for historical data are:

- increasing share of renewable in the energy mix, due to 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.

As for the emission projected it is evident further reductions in comparison with previous projections due to updated data for base year, adoption of new measures, and the effects of lockdown on 2020 due to the SARS-Cov2 pandemic followed by the rebound effect in the next five years.

Figure 5.4 – Actual and projected CO2 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 5.2.7 shows the WM scenario projections up to 2050. Emissions are disaggregated by source of emissions sector. The rebound effect is particularly evident for the transport sector where, without appropriate policies, private cars will play a major role as a consequence of the pandemic.

Table 5.2.7 - WM Scenario's GHG emissions, disaggregated by source of emission sector (MtCO2 eq.)

	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040	2050
FROM ENERGY USES, of which:	**425.3**	**437.9**	**459.6**	**487.6**	**428.9**	**358.8**	**298.9**	**328.0**	**299.6**	**277.7**	**267.7**	**266.9**
Energy industries	137.6	140.6	144.9	159.9	137.5	106.1	81.8	76.3	75.7	79.7	80.2	85.8
Industry	92.3	90.3	96.4	92.4	70.2	55.6	45.9	50.6	49.0	47.9	46.3	46.2
Transport	102.2	114.3	123.8	128.3	115.5	106.1	85.4	116.6	95.3	75.9	72.9	66.2
Residential and Commercial	69.8	69.2	73.6	86.7	88.0	74.8	71.3	68.3	64.0	58.6	55.8	54.4
Agriculture (energy use)	9.1	9.6	8.9	9.3	8.1	7.7	7.9	8.1	8.1	8.5	5.5	7.7
Other	14.3	13.9	12.0	11.1	9.6	8.5	6.6	8.1	7.5	7.1	7.0	6.6
FROM OTHER SOURCES, *of* which:	**94.6**	**95.9**	**97.7**	**103.3**	**88.9**	**83.0**	**82.3**	**72.6**	**66.7**	**61.4**	**58.6**	**55.2**
Industrial Processes + F-gas	40.4	38.3	39.1	47.2	37.0	33.2	31.0	29.7	26.4	23.5	21.8	21.1
Agriculture	36.9	37.6	36.7	34.2	31.6	31.2	32.7	28.2	28.0	27.1	27.2	26.4
Waste	17.3	20.0	21.9	21.9	20.4	18.5	18.6	14.6	12.2	10.8	9.6	7.8
TOTAL	**519.9**	**533.9**	**557.3**	**590.9**	**517.8**	**441.8**	**381.2**	**400.6**	**366.3**	**339.1**	**326.3**	**322.1**

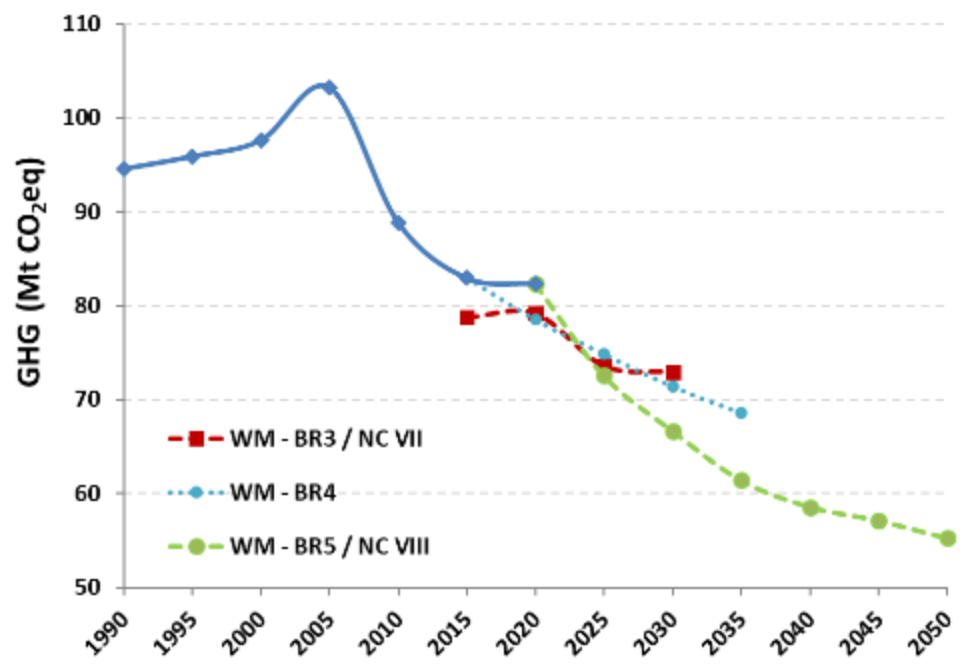
Source: ISPRA

Sector by sector analysis for the period 2020 – 2050 shows that:

- a small emissions reduction in energy industries is projected (-2%) mainly due to power production; in this subcategory, 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 trend observed in the projected years is the result of increasing production offset by further increasing thermoelectric efficiency, renewable share, and fuel shift toward low carbon fuels as natural gas;
- the projected emissions from transport will decrease by 22% as results of implemented measures, notwithstanding the increasing transport demand;
- emissions from residential and commercial show a relevant decrease (-21.8%) 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 2005–2020 (-50.4% for energy emissions and 34.2% for industrial processes); 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, after 2020 industrial emissions show a decreasing trend with increasing GVA;
- emissions from waste sector show the highest rate of reduction among sectors (-48.7% in 2040 compared to 2020) mainly due to the decrease of waste disposal in landfills.

In Figure 5.5 the emissions of CO2 from non-energy sectors and other GHGs (CH4, N2O, and NF3) from energy and non-energy sectors are reported. It can be noted that emissions reduction was sharp between 2005 and 2020 (-20.3%). According to the scenario, the projected emissions will further decrease by 28.9% from 2020 up to 2040 as result of emissions reduction for all sectors.

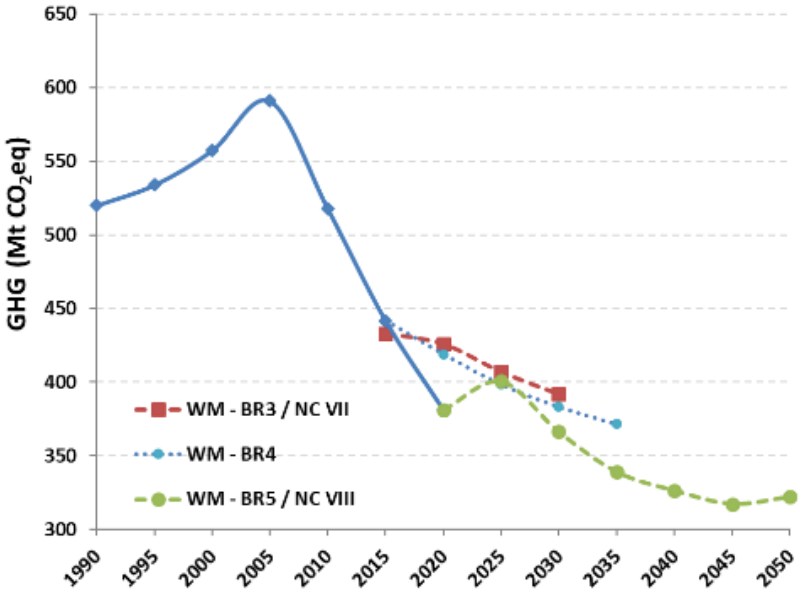
Figure 5.5 - Actual and projected emissions of CO2 from non-energy sectors and other GHGs from energy and non-energy sectors.



Source: ISPRA

The resulting trend in total GHGs emissions is reported in Figure 5.6. The current WM scenario is compared with the ones reported in the previous two submissions.

Figure 5.6 – Actual and projected total GHG emissions (Mt CO2 eq.)



Source: ISPRA

Table 5.2.8 reports emissions by gas expressed as CO_2eq. Along the time series CO_2 emissions are about 83% of total emissions. It is worth noting the sharp reductions of methane, and HFCs emissions in the period 2020-2040, amounting to 30% and 70% respectively. As previously noted, the methane emissions contraction is mainly due to the waste sector. The decreasing emissions of HFCs are mainly due to the implementation of the European Regulation n. 517/2014 on F-gases.

Table 5.2.8 – WM Scenario's GHG emissions from 1990 to 2030, disaggregated by gas (MtCO2 eq.)

	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040	2050
CO_2	439.5	449.8	470.5	502.3	436.1	361.2	302.3	330.6	302.8	281.6	272.2	272.7
CH_4	49.4	51.4	51.9	49.2	47.3	44.1	42.8	38.6	36.0	33.6	32.3	29.8
N_2O	27.2	29.4	30.3	29.3	20.3	18.9	19.5	16.5	15.9	15.3	14.9	14.8
HFCs	0.4	0.9	2.5	7.6	12.1	15.4	15.9	13.0	9.7	6.7	4.9	3.0
PFCs	2.9	1.5	1.5	1.9	1.5	1.7	0.5	1.6	1.6	1.6	1.6	1.6
Un-specified mix of HFCs & PFCs	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
SF_6	0.4	0.7	0.6	0.5	0.4	0.5	0.3	0.3	0.3	0.3	0.3	0.3
NF_3	0.0	0.08	0.01	0.03	0.02	0.03	0.02	0.0	0.0	0.0	0.0	0.0
TOTAL	**519.9**	**533.9**	**557.3**	**590.9**	**517.8**	**441.8**	**381.2**	**400.6**	**366.3**	**339.1**	**326.3**	**322.1**
% change from base year, total emissions		2.7%	7.2%	13.7%	-0.4%	-15.0%	-26.7%	-22.9%	-29.4%	-34.6%	-37.1%	-38.0%

Source: ISPRA.

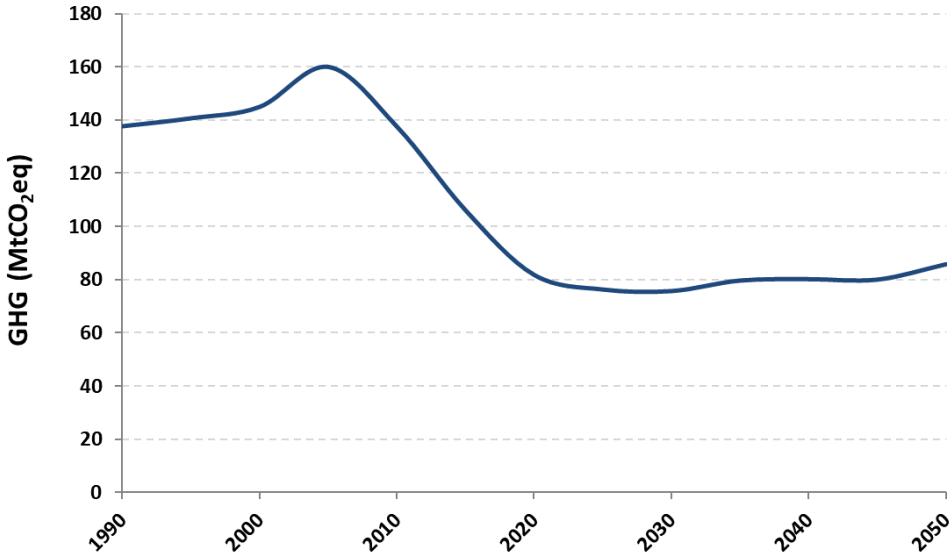
5.2.4 Energy industries

According to IPCC guidelines, the energy industries subcategory includes the electricity production from fossil fuels, refineries and the production of coke and of electricity from coal gases in integrated steel plants. Emissions due to self-generated and self-consumed electricity are not included in the energy industries as they are included among industrial emissions. The emissions from self-generated and self-consumed electricity were relevant in the past, but in recent years they amount to less than 10% of emissions from total electricity production.

The emissions from refineries are relevant, but the lower consumption of fossil fuels by transport 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 5.7, between 1990 and 2005 a noticeable increase in emissions of 16.2% has been registered by energy industries, about 1% yearly. From 2005 to 2015, emissions sharply decreased at an average annual rate of -4%. 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 and, for 2020, the lockdown of economic activities due to the SARS-Cov2 pandemic. A further slight decrease of emissions is expected up to 2030 with recovery up to 2040 with an annual average rate around 0.6% in the decade. The stable trend of emissions starting from 2020 is due to the balancing effect of increasing electricity generation and increasing share of renewable sources. 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.

Figure 5.7 – Energy industries actual and projected GHG emissions (Mt CO2 eq.)



Source: ISPRA

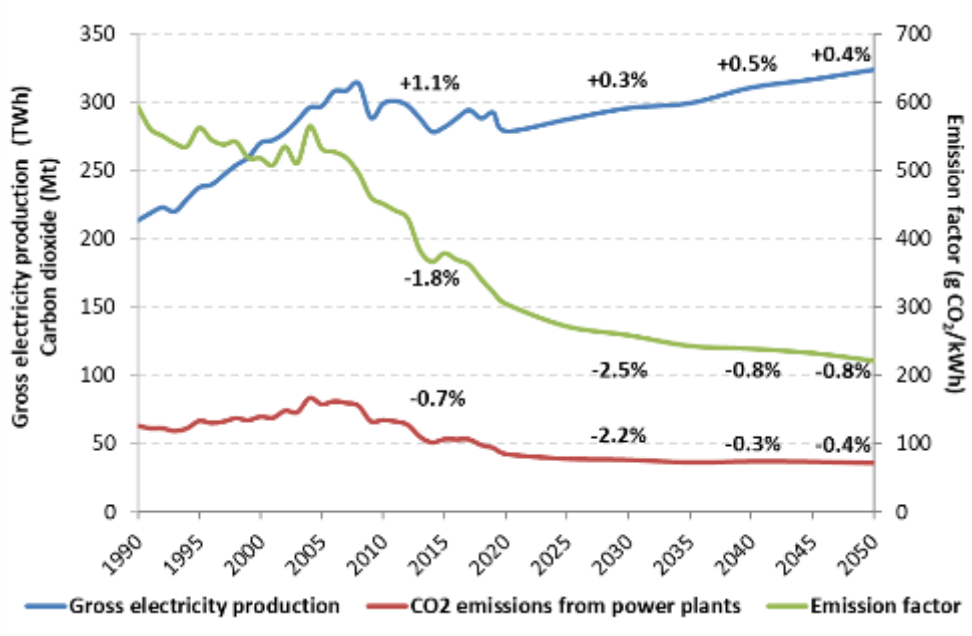
5.2.4.1 Electricity production

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 5.8 and Figure 5.9). 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 (1.2% 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. The oscillating values after 2009 up to 2020 are due to continuous recovery and fall of economy.

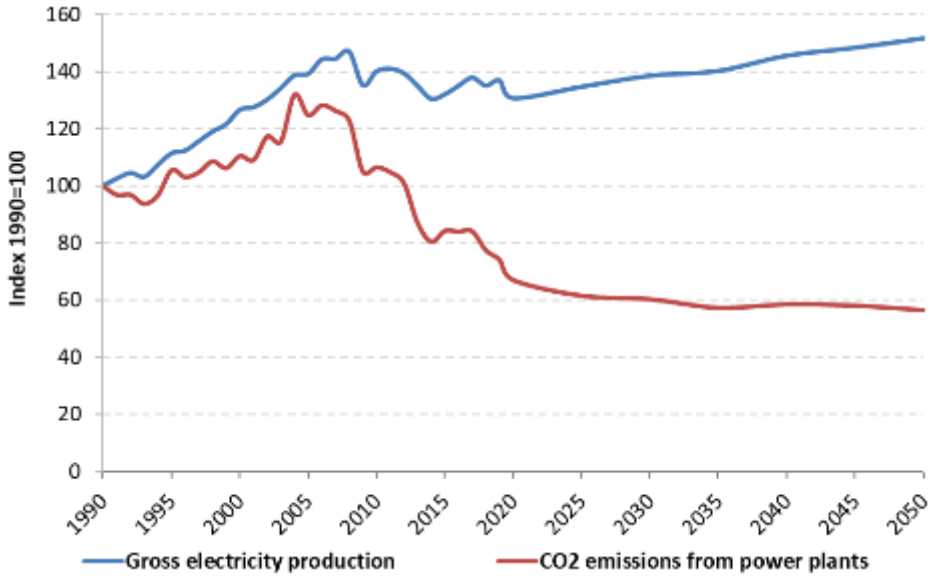
Figure 5.8 – Electricity production and CO2 emissions from power plants. Average annual rates

are reported for the periods 1990-2015, 2015-2030, 2030-2040, and 2040-2050



Source: ISPRA

Figure 5.9 – Electricity production and CO2 emissions from power plants relative trends in 1990

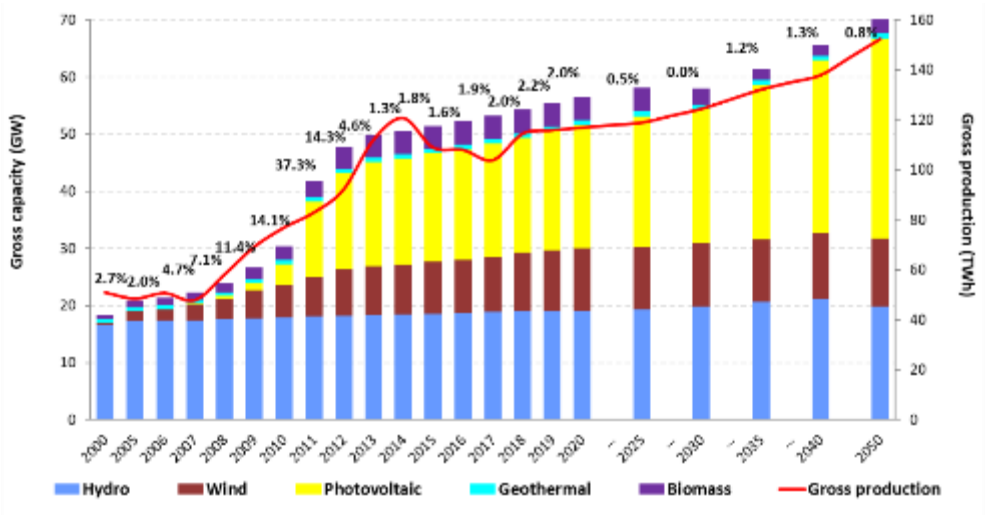


Source: ISPRA

The decoupling between electricity generation and atmospheric emissions, particularly evident since 2004, is mainly due to fuel shift toward lower carbon content fuels, and 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 5.9). 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 2020 was 56.6 GW, with an average growth rate of 5.2% per year from 2000 to 2010 and 6.4% per year in the following years up to 2020. 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 5.10). The installed renewable capacity projected for 2030 and 2040 are about 58 GW and 65.7 GW respectively, mainly due to the increase of photovoltaic.

Figure 5.10 – Renewable contribution to gross electricity production. The percentage represents the annual average power rate



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 up to 2013, renewable power represents the main component of new installations (26 GW out of 26.3 GW). Since 2011, a growing decommissioning of thermal capacity has been registered (about 18 GW). In 2020, the gross efficient power capacity is 119.1 GW with 47.5% 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 2020 share of renewables was 38.1% of gross final consumption of electricity[59]. 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 124.4 TWh in 2030 and 137.8 TWh in 2040, out of total generation of 295.4 and 310.4 TWh, respectively.

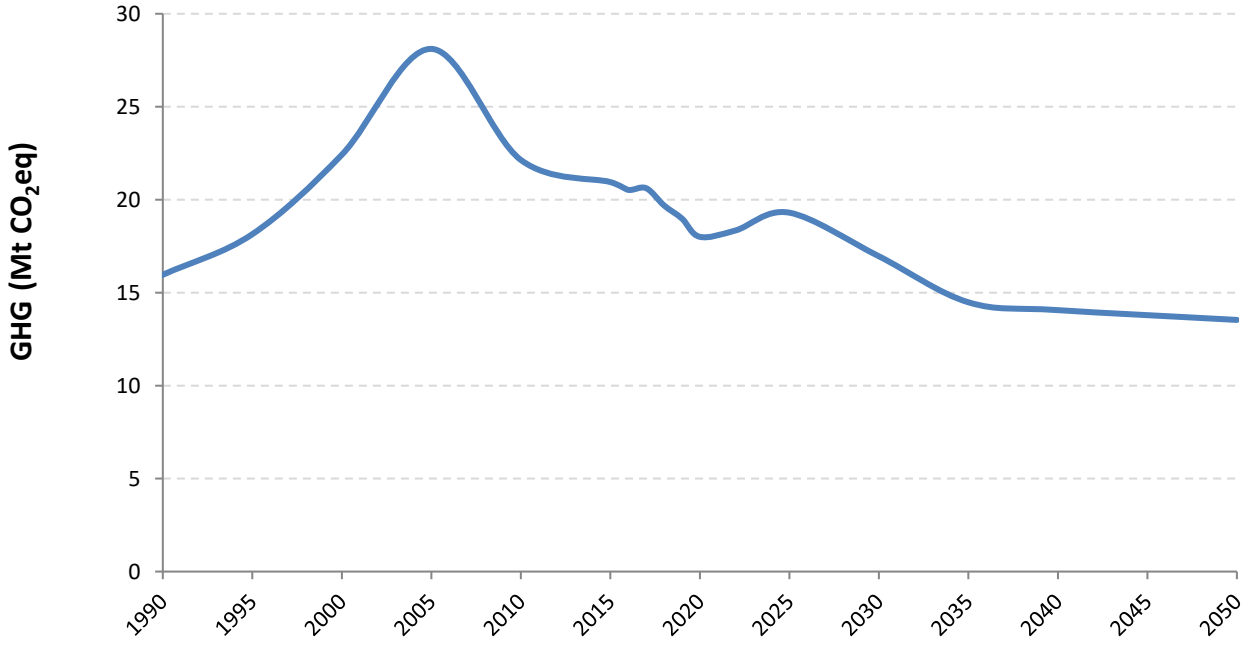
5.2.4.2 Refineries

The level of activity of the refineries is strictly linked to the activity of the transport sector (about 80% of final energy consumption ad 60% of GIC of total petroleum products from 2010 to 2020) whose energy needs still rely mainly on oil products. During the past decade, under the economic crisis, the transport subcategory has been heavily affected, thus leading to a reduction of the activity of refineries too, which also led to a reduction of the number of operating plants. 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 environmentally 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, which can use heavy residuals to produce electricity, heat and hydrogen. Liquid fuel consumptions have reached a plateau in 2010 and are

[59] EUROSTAT, Data Shares (renewables), 2022 http://ec.europa.eu/eurostat/web/energy/data/shares

now in a downward trend that is expected to continue as a consequence of the reduction of the final demand of oil products in the transport sector, especially until 2035. In the longer term other sectors demand of oil products sustains the activity, and the emissions, of refineries.

Figure 5.11 – CO_2 emissions from refineries



5.2.5 Final uses of energy

The next table reports historical data and projections for final uses of energy according to Eurostat current methodology updated in January 2019.

Table 5.2.9 - Final energy consumption (Mtoe)

	2005	2010	2015	2020	2025	2030	2035	2040	2050
Total final uses	131.5	123.1	112.1	103.1	116.8	108.3	100.7	99.5	99.7

The scenario shows a sharp reduction of final energy consumption after 2015, followed by rebound effect in 2025 and further decrease in the next years up to 2040. Comments to data are provided in the sector-by-sector analysis.

5.2.5.1 Manufacturing industries and construction

According to section 1.A.2 of CRF, the industrial sector considered herein includes manufacturing industries and construction. Reference is made only to emissions connected to energy use, excluding process emissions reported in section 2.A-C of CRF (see paragraph 2.6).

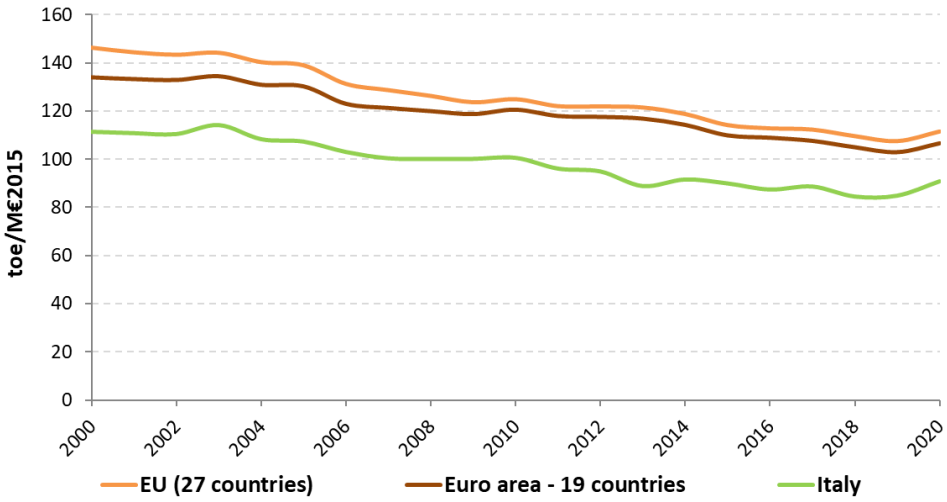
Table 5.10 reports the projections for final energy consumption in industry (Mtoe) for WM scenario, while the emission trend is reported in Figure 5.13. A primary tool to reduce the emissions of greenhouse gases is by improving the level of energy efficiency of the industrial processes. The 2018 International Energy Efficiency Scorecard, issued by the American Council for an Energy-Efficient Economy (ACEEE), assigned the first position to Italy, together with Germany among 25 nations globally, with scores assigned according to quantitative and qualitative parameters, including efficiency indicators and policies aimed at reducing consumption. The last edition of the International Energy Efficiency Scorecard, issued by ACEEE on 1st

April 2022, reported for Italy the drop of four ranks mainly due to buildings section, but Italy managed to rank within the top five, after France, UK, Germany, and the Netherlands. According to Eurostat data, Italy stands well below the average energy intensity among EU27 (-15.6%) and Euro area countries (-24.9%). Figure 5.12 shows the energy intensity of the industrial sector calculated as the ratio between the final consumption in industry sector for energy and non-energy use and the GVA for Industry and Construction estimated according to latest Eurostat methodology.

Table 5.2.10 – Final energy consumption in industry sector (Mtoe)

	2005	2010	2015	2020	2025	2030	2035	2040	2050
Industry	37.2	29.0	24.9	23.9	23.5	23.4	23.4	22.4	23.0

Figure 5.12 – Energy intensity of industrial activities in Italy and EU

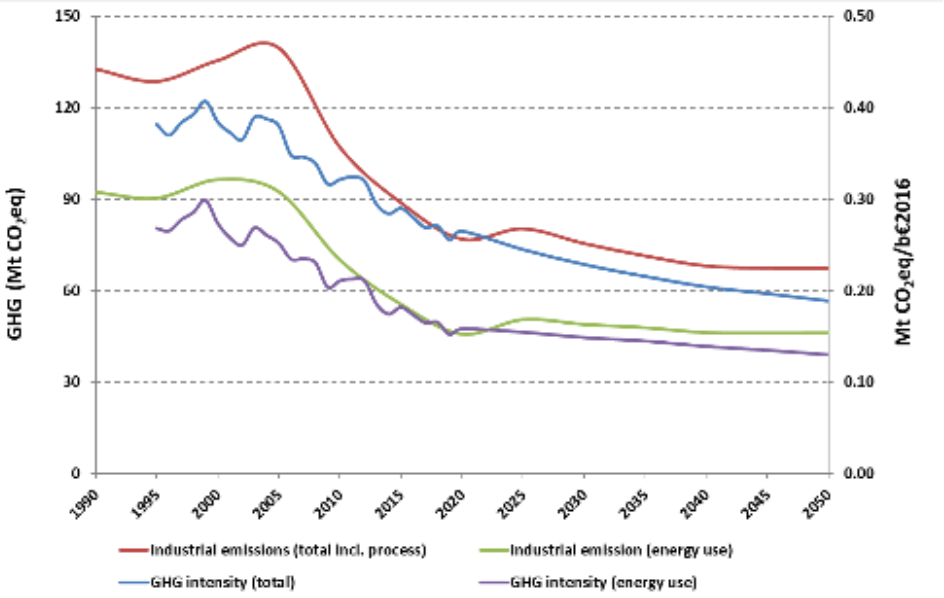


Source: ISPRA on EUROSTAT data

Manufacturing industries and construction have 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 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 of efficiency. 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. Figure 5.13 shows GHG emissions from energy consumption in industry and the GHG intensity of the sector as well total emissions and intensity including emissions generated from industrial processes. Compared to energy intensity, GHG 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. Looking at total emissions from the industrial sector the decrease is more evident reflecting a continuous change in the production structure.

Figure 5.13 – Trends of GHG emissions and intensity for Manufacturing industries and

construction



Source: ISPRA

5.2.5.2 Transport

In line with the IPCC Guidelines, the transport category 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 decreases up to 2020 and will rebound up in 2025. After 2025 the projected energy consumption shows a decreasing trend with average annual rate of -1.17% per year up to 2040.

Table 5.2.11 – Trends of final energy consumption for transport

	2005	2010	2015	2020	2025	2030	2035	2040	2050
Transport	41.8	38.6	36.4	29.0	44.3	37.9	32.6	32.4	33.0

GHGs emissions from transport registered a strong historical growth from 1990 to 2007 (+26.8%). Following the economic downturn, the trend has changed direction registering a reduction of 18% in the period 2007-2015. The declining trend of the sector is confirmed up to 2017 (-5% with reference to 2015) while 2018 and 2019 show a new increase of emissions (+4.5% in 2019 with reference to 2017) followed by the fall down in 2020 (-18.9% with reference to 2019) due to the lockdown measures to contrast the SARS-CoV-2 pandemic. Projected emissions are expected to increase up to 2025 as rebound effect for the end of the pandemic which will especially affect the private cars use. After 2025 up to 2050, emissions reduction of 43.3% is expected.

Road transport accounts for almost the totality of sector emissions (92.1% in 2020). Passenger transport is responsible for about 66% of emissions, while goods and other fuel-uses (Public administration, fisheries) account for the balance. The application of the Regulation (EU) No 2019/631, which set CO_2 emission performance standards for new passenger cars and new light commercial vehicles, will overcompensate the increasing demand of transport resulting in a decreasing trend of projected emissions.

Table 12 shows historical and projected emissions related to fuels sold to ships and aircrafts for international transport. For international aviation, after the fall down in 2020 the emissions are expected to increase (+260.5% in the period 2020-2050). The same trend is foreseen for international maritime transport, projected emissions show a steady increase up to 2040 (+46.1% since 2020) followed by a decrease in

2050 (-22%).

Table 5.2.12 – Emissions from international bunkers (Mt CO2 eq).

	1990	2005	2010	2015	2020	2025	2030	2035	2040	2050
Aviation	4.3	8.6	8.9	9.6	3.8	11.2	11.8	12.5	13.2	13.7
Marine	4.5	6.9	7.0	5.7	5.6	7.4	7.8	8.0	8.2	6.4

Source: ISPRA

5.2.5.3 Other sectors

The next table reports historical data and projections for energy final consumption in services, residential and agriculture.

Table 5.2.13 – Final energy consumption in other sectors (Mtoe)

	2005	2010	2015	2020	2025	2030	2035	2040	2050
Services	15.1	17.0	15.4	16.6	16.6	16.6	15.4	16.0	16.1
Residential	33.9	35.4	32.5	30.7	29.5	27.5	26.1	26.2	24.7
Agriculture	3.0	2.7	2.7	2.8	2.9	2.9	3.2	2.5	2.9

The sectors are characterized by the following features:

- agriculture: moderate penetration of gas in the agricultural sector results in slight decrease of CO2eq missions from energy uses (from 7.9 Mt in 2020 to 7.7 Mt in 2050 going through a slight increase of emissions in the period 2020-2035);
- buildings (residential and tertiary): the main driver in the residential sector is the number 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 0.37% has been considered. Another parameter taken into account to elaborate the energy demand of heating and cooling is the anomaly climate index. The index projections are ISPRA elaboration starting from data of the Euro Mediterranean Center on Climate Change[60] under the EURO-Cordex project[61].Such effects will result in emission reductions (from 70.6 Mt CO_2eq in 2020 to 54.4 Mt CO_2eq in 2050).

The residential and services sectors show a decrease of energy consumption from 2020 to 2050 (-24.2% and -3.1% respectively).

5.2.6 Emissions from non-energy sectors

In Figure 5.5, 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 decreased waste disposal in landfills (especially the organic fraction) and to increased recovery of methane;
- reduction of other process emissions due to a reduction of related industrial production;

[60] https://www.cmcc.it/

[61] https://www.euro-cordex.net/index.php.en

- increase of recovery of animal wastes for biogas production.

According to available data, emissions slowly declined in the period 2015-2020 and show further slightly decreases from 2020 onward. The overall trend represents the contribution of different rate of reductions for all the underlying sectors.

5.2.6.1 Projections of emissions from industrial processes

Emission projections for industrial processes rely on the same main assumptions on GVA and physical production used for the calculation of final energy consumption of the industrial sector. Emission factors for processes have been considered constant for the whole time series assuming that no new processes and additional measures will be implemented.

Projections for Aluminium production and Fluorochemical Production have been derived from information communicated directly from industry on the basis of the present situation: for what concern Aluminium production, if at first there was a plan to restart, actually there are no perspectives of a reopening of the plant in Portovesme that has stopped the production in 2012. Regarding the production of HCFC22 used as the input for the TFM (tetrafluoroethylene monomer) that has been then used to produce different fluoropolymers and fluoroelastomers, the Company Solvay has communicated that the production if HCFC22 will remain almost constant.

About semiconductor manufacturing, projections have been derived from agreements subscribed by the European Semiconductor Industry Association. The Italian semiconductor industry has predicted a 30% reduction of PFC emissions in 2025 compared to 2010 emissions. In 2040 a further 5% reduction is expected. PFC emissions reduction technologies that are applied in factory operations include: manufacturing process optimisation (reducing the amount of PFCs that are used and emitted), using alternative process PFC chemistries with lower global warming potential where possible, and installing abatement equipment systems.

For SF_6 used in magnesium and aluminium foundries and for solvent and F-gases substitutes for ozone depleting substances and other product use, projections are based on the achievement of the objectives established by the European Regulation n. 517/2014 on F-gases (F-gases Regulation), and by the Kigali Amendment. In Table 5.14 F-gases projections up to 2050 by sector are reported.

For solvents, future trends have been estimated extrapolating most recent data and considering the implementation of 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 5.2.14 – F-gases emissions by sector (MtCO2 eq.)

	2005	2010	2015	2020	2025	2030	2035	2040	2050
Chemical industry	1.572	1.302	1.553	0.418	1.479	1.479	1.479	1.479	1.479
Metal industry	0.293	0.118	0.010	0.005	0.006	0.006	0.006	0.006	0.006
Electronics industry	0.303	0.207	0.247	0.217	0.179	0.181	0.183	0.185	0.192
Product Uses as Substitutes for ODS	7.588	12.042	15.382	15.861	12.967	9.687	6.670	4.899	2.953
Other Product Manufacture and Use	0.412	0.347	0.425	0.216	0.260	0.244	0.229	0.218	0.218
Total	10.168	14.016	17.617	16.717	14.891	11.597	8.567	6.787	4.848

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).

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 projections up to 2050 are reported in

Table **5.2.15**. The decrease of industrial processes emissions is connected to the decreasing use of substitutes of ozone depleting substances, the other emissions being almost stable (around 1.5 $MtCO_2$ eq. increase after 2020).

Table 5.2.15 – Emission scenario by sector from industrial processes and solvent use (MtCO2 eq.)

	2005	2010	2015	2020	2025	2030	2035	2040	2050
Industrial Processes	47.2	37.0	33.2	31.0	29.7	26.4	23.5	21.8	21.1

Source: ISPRA

5.2.6.2 Projections of emissions from the agriculture sector

GHG emission figures from the agriculture sector are updated and improved thanks to different national research studies[62]. 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[63].

Between 1990 and 2020, GHG emissions from the agriculture sector have decreased by 11.4%. Emission trends are due to the reduction in activity data such as the number of animals, the cultivated surface and crop production and use of nitrogen fertilizers, and the changes in manure management systems, mainly linked to Common Agricultural Policy (CAP) measures[64].

Emission projections are estimated with the same model used for the preparation of the national emission inventory. To estimate the number of different animal categories, a model has been developed by ENEA[65], which every year estimates emission scenarios for air pollutants using specific models[66].

For the use of fertilizers, ENEA assumptions are based on the European Fertilizer Producers Association (Fertilizers Europe) forecast until 2030. From 2030 onwards, the value has been varied according to the projections of the utilised agricultural area. For estimates of agricultural land and production, see the next section Projections of emissions from the LULUCF sector. In Table 5.2.16, the assumptions adopted for synthetic fertilizers consumption and application of manure to agricultural soils are shown.

A decrease of 16% of the major N input to agricultural soils has been estimated in 2020 with respect to 2005 due to a 26% reduction in the consumption of synthetic fertilizers (accounting for 38% of total nitrogen inputs in 2005) and an 1% increase of the application of manure to agricultural soils (accounting

[62] NIR 2022, Chapter 5. Italian Greenhouse Gas Inventory 1990-2020 - National Inventory Report 2022 https://www.isprambiente.gov.it/it/pubblicazioni/rapporti/italian-greenhouse-gas-inventory-1990-2020-national-inventory-report-2022

[63] ibidem

[64] Rural Development Plans (RDPs) from Italy are available at URL: https://ec.europa.eu/agriculture/rural-development-2014-2020/country-files/it_en

[65] ENEA, 2006. Valutazione del potenziale di riduzione delle emissioni di ammoniaca. Rapporto Finale. ENEA UTS- PROT, Unità Inquinamento Atmosferico. Settembre 2006.

[66] D'Elia, I., Peschi, E., 2016. How National integrated air quality models can be used in defining environmental policies: the revision of the NEC directive. ENEA Technical Report, RT/2016/30/ENEA. https://iris.enea.it/retrieve/dd11e37c-d7b8-5d97-e053-d805fe0a6f04/RT-2016-30-ENEA.pdf; D'Elia, I., Piersanti, A., Briganti, G., Cappelletti, A., Ciancarella, L., Peschi, E., 2018. Evaluation of mitigation measures for air quality in Italy in 2020 and 2030. Atmospheric Pollution Research, 9, 977-988.

for 22% of total nitrogen inputs in 2005).

Table 5.2.16 – Assumptions used for estimating GHG emission projections from synthetic fertilizers consumption and N input from application of manure

Major N input to agricultural soils (kt nitrogen*)	2015	2020	2025	2030	2035	2040	2050
N input from application of synthetic fertilizers	517.9	577.5	485.6	481.9	473.7	469.9	461.1
N input from application of manure	461.3	469.2	459.8	466.7	450.8	453.3	436.4
Total consumption of N fertilizers	**979**	**1047**	**945**	**949**	**925**	**923**	**898**

* Nitrogen content in synthetic and organic fertilizers

Source: ISPRA

In Table 5.2.17, assumptions for the main animal categories (cattle, swine, sheep and poultry) are shown. The CAP 2014-2020 has conditioned herd sizes over the years, for example with the milk quota reform; we will see in the future how the new CAP 2023-2027[67] will contribute to changes in the agricultural sector.

Table 5.2.17 – Assumptions used for GHG emissions projections with respect to the number of animals

Animal category (kheads)	2015	2020	2025	2030	2035	2040	2050
Dairy cattle	1826	1638	1771	1765	1603	1598	1472
Non-dairy cattle	3955	4355	3708	3696	3515	3503	3206
Swine	7149	7034	6920	6769	6565	6546	6270
Sheep	8675	8543	8767	8975	9268	9409	9660
Poultry	177392	178907	178892	179726	180457	181789	185566

Source: ISPRA

In Table 5.2.18, GHG emission projections are shown. A slightly downward trend is observed from 2025 onwards. In 2030, emissions from the sector are reduced by 18% compared to 2005 and in 2050 by 23%. In 2030 and 2050, the largest reductions are in the manure management and agricultural soil categories, which account for about 20% and 30% of annual emissions, respectively. The manure management category decreases by 29% and 35% and the agricultural soils category falls by 32% and 34% in the years 2030 and 2050 compared to 2005.

Table 5.2.18 – Emissions for the agriculture sector (MtCO2 eq.)

	2005	2010	2015	2019	2020	2025	2030	2035	2040	2050
Agriculture	34.2	31.6	31.2	31.4	32.7	28.2	28.0	27.1	27.2	26.4

Source: ISPRA

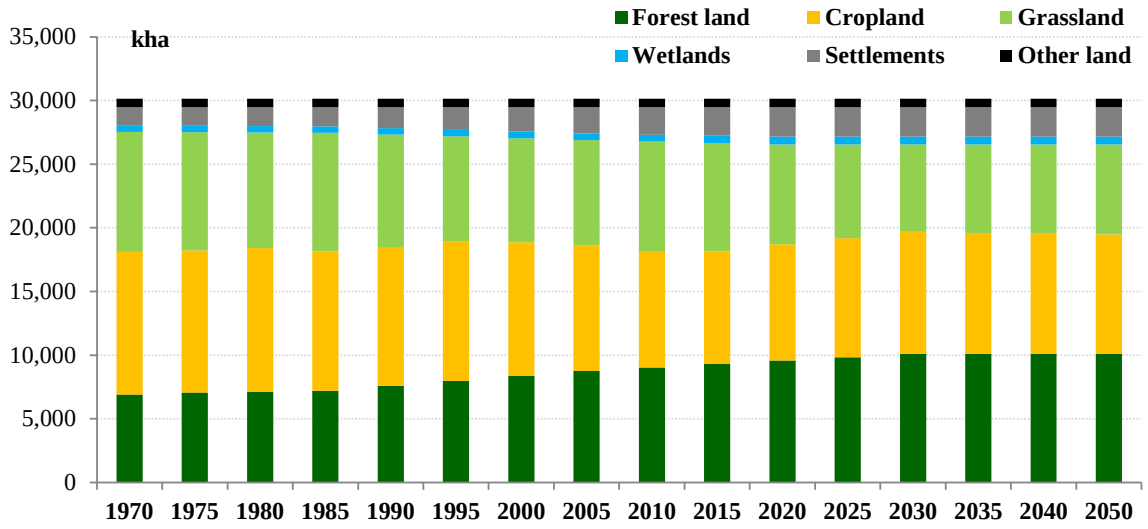
[67] The European Commission provided for the application of the new common agricultural policy (CAP) from January 1, 2023.

5.2.6.3 *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, cropland and grassland constitute the key variables to project emissions by sources and removals by sinks. Compliant to the requirements set out by Regulation (EU) 2018/841[68], the GHG emissions and removals have been estimated and projected considering the different land transitions among the six land use categories as occurring in Italy (e.g., forest land to settlements, cropland to grassland, cropland to wetlands, etc.). The land use and land use changes have been projected to 2050, as shown in Figure 5.14, on the bases of historical trends and considering:

- for agricultural areas, a growing trend is assumed until 2040 and, thereafter, a stabilization[69]; the trend is determined by the increase in cereal areas and by the decrease of woody and industrial crops;
- for the grazing land[70], a decrease is foreseen, consequent to the reduction of grazing animals;
- in line with the goal of limiting land consumption, the settlements area is assessed to not expand compared to current levels while the forest area grows until 2030 and then remains constant.

Figure 5.14 - Trends of area for the land use categories



Source: ISPRA

Consistently with the National Forestry Accounting Plan[71], an increase of harvesting activities has been assumed, up to a maximum of 40-45% of the annual increment, starting from the current estimated use

[68] Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework (LULUCF Regulation), and amending Regulation (EU) 525/2013 and Decision 529/2013/EU

[69] To project the activity data, the percentage change rates resulting from the FAO scenarios for Italy were used, applied to the historical series, for the macro-categories wood crops, cereals, industrial crops and other (legumes, vegetables, tubers), included in the cropland category. The projections of agricultural areas were developed starting from the FAO scenarios (FAO Global Agriculture Perspectives System (GAPS) in FAO. 2018. The future of food and agriculture - Alternative pathways to 2050 Rome; FAO Global Perspectives Studies. Data for 1961–2011 from FAO, 2016a; data for 2030 and 2050 from Alexandratos and Bruinsma, 2012), elaborated for Italy with the GAPS model (Global Agriculture Perspectives System) and calibrated with FAOSTAT data (FAOSTAT Food Balance Sheets: http://www.fao.org/faostat/en/#data/FBS/report) for the period 2011-2013; the estimates for the period 2030-2050 are were carried out with data produced by Alexandratos, N. and J. Bruinsma 2012 (World agriculture towards 2030/2050: the 2012 revision. ESA Working paper No. 12-03. Rome, FAO).

[70] The estimates are based on the 2012-2017 average of the head / hectare ratio (head consistency (LU) on total grazing land.

[71] National Forestry Accounting Plan (NFAP) Italy:
https://www.minambiente.it/sites/default/files/archivio/allegati/clima/nfap_final_resubmission_2019_clean.pdf

of 33% (RAF[72], 2019). Furthermore, the projections of activity data for cropland and grassland categories consider the different management practices[73]; additional information on management practices and estimation process are available in the *Italian Progress report on LULUCF action under the art. 10(2) of Decision 529/2019*[74] and in the National Inventory Report 2022[75].

The GHG emissions and removals, reported in Table 5.2.19, have been estimated by multiplying the projected areas, under each land use subcategory (i.e. land remaining land and land converted to other land use), by and Implied Carbon Stock Factor (ICSF), deduced from the historical data of emissions and removals and land use areas (1990-2019).

Table 5.2.19 – Emissions for LULUCF categories (MtCO2 eq.)

	2005	2015	2020	2025	2030	2035	2040	2050
LULUCF	**-35.24**	**-43.09**	**-32.40**	**-34.34**	**-33.89**	**-30.00**	**-36.67**	**-36.66**
Forest land	-34.54	-39.22	-30.12	-34.88	-36.18	-37.29	-37.22	-37.09
Cropland	-1.89	0.58	-0.01	2.09	3.63	5.35	5.28	5.31
Grassland	-6.13	-9.40	-7.21	-4.77	-3.78	0.29	-5.57	-4.48
Wetlands	0.01	0.13	0.03	0.14	0.14	0.14	0.14	0.14
Settlements	7.80	4.74	5.57	4.26	4.02	3.78	3.50	3.35
Other Land	NO	NO	NO	0.00	0.00	0.00	0.00	0.00
Harvested wood products	-0.50	0.09	-0.67	-1.17	-1.71	-2.25	-2.79	-3.87

Source: ISPRA

5.2.6.4 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.

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 production, waste fluxes have been analysed on the basis of the following waste management options: separate collection, recycling, landfilling, incineration, mechanical biological treatments, anaerobic digestion and composting.

Focusing on recycling and other options, national circumstances are quite in line with the European average, as reported in

Table 5.2.20. Waste production in 2020 is almost equal to the European average while waste management is slightly lower; among the waste management technologies, energy recovery is lower than the European

[72] RAF Italia 2017-2018 - Rapporto nazionale sullo stato delle foreste e del settore forestale in Italia (2019), Rete Rurale Nazionale (RRN 2014-2020), Compagnia delle Foreste, Arezzo, ISBN 9788898850341.
[73] The following management practices have been considered: *organic farming, sustainable agriculture, conservation practices, set-aside, ordinary agriculture, natural grazing land, managed grazing land, organic grazing land.*
[74] Italian Progress report on LULUCF action under the art. 10(2) of Decision 529/2013/EU: http://www.sinanet.isprambiente.it/it/sia-ispra/serie-storiche-emissioni/italy-progress-report-on-lulucf-article-10-2-of-dec-529-update-2020/view
[75] http://emissioni.sina.isprambiente.it/inventario-nazionale/

average due to the historical difficulty of the population to accept the plants while composting is above average also because the industrial sector in Italy is well developed (ISPRA, 2022).

Table 5.2.20 – The waste cycle in Italy and Europe in 2020

	Waste produced (kg/inh.)	Waste managed (kg/inh.)	Percentage of urban waste treated				
			Recycling	Energy recovery	Composting and anaerobic digestion	Incineration	Landfills
UE 27	517	509	31%	26%	18%	0%	24%
Italy	487	443	30%	21%	26%	1%	22%

Source: ISPRA

The extremely accentuated difference between the different areas of the country is slowly smoothing out, with southern Italy also exceeding 50% of separate waste collection with respect to the waste produced. Compared to 2019, in 2020 the percentage of the regions of southern Italy grew by 3.0 points, that of the central regions by 1.4 points and that of the northern regions by 1.2 points. 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) being equal to 54.4[76]% in 2020 and for the future targets set by the most recent directive 2018/851 / EU (55% by 2025, 60% by 2030 and 65% by 2035).

Table 5.2.21 – Emissions for the waste sector (MtCO2 eq.)

	2005	2010	2015	2020	2025	2030	2035	2040	2050
Waste sector	21.9	20.4	18.5	18.6	14.6	12.2	10.8	9.6	7.8

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. Thanks to the efforts made by the government in cooperation with local authorities, the amount of biodegradable waste disposed into landfills has fallen sharply in recent years and is totally complying with the target of landfill directive (D.lgs. 36/2003) resulting in 59 kg_{waste}/inh.*year in 2020, below the target set by legislation for 2018 (81 kg_{waste}/inh.*year). It is assumed that the share of landfill gas collected will reach 60% in 2030.

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

[76] calculated according to method 2 indicated by Directive 2008/98 / EC

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. According to these projections a 48% reduction can be expected in 2040 with respect to 2020 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.

5.3 WAM Scenario

The WAM scenario was elaborated with the same main assumptions and base year adopted for WM scenario and considering the policies and targets set up in the NECP.

The national efficiency target to be achieved in 2030 is set to -0.8% per year of final energy consumption, while the renewable share target is set to 30% of final energy consumption in 2030.

The plan also provides a list of planned PaMs aiming to reach the targets as intense modal swift in passenger transport, 6 million BEV and PHEV fleet, a target share of at least 55% in 2030 of energy from renewable sources in gross electricity consumption, strong increase in the renovation rate in the civil sector, etc.

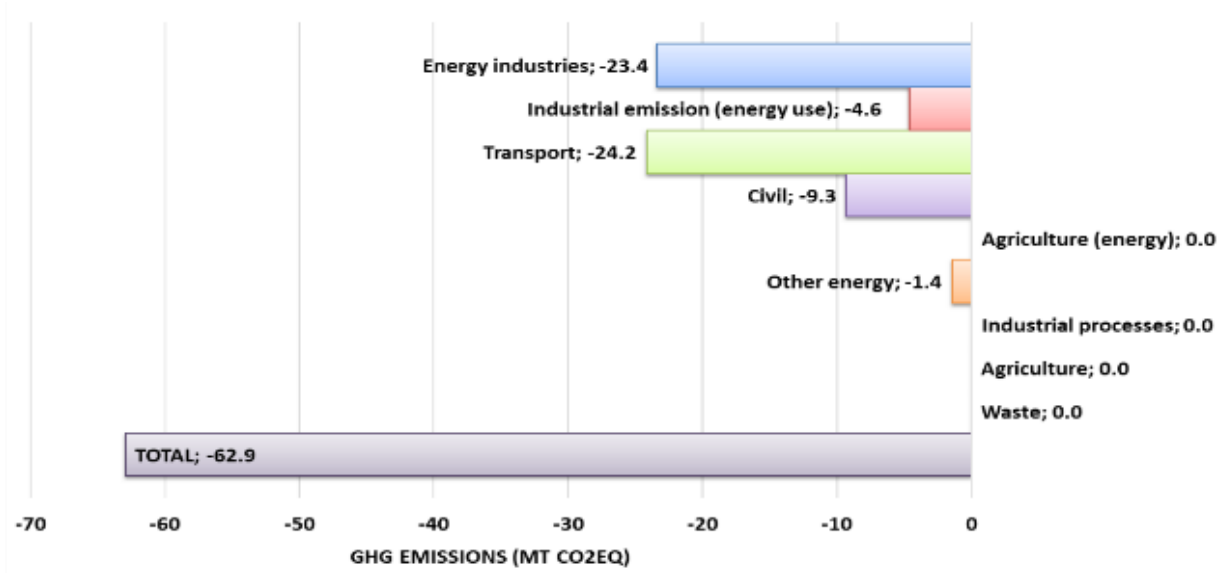
Figure 5.15 shows the differences between WAM and WM scenario at 2030 for each sector.

Table 5.3.1 – WAM Scenario's GHG emissions, disaggregated by source of emission sector (MtCO2 eq.)

	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040	2050
FROM ENERGY USES, of which:	**425.3**	**437.9**	**459.6**	**487.6**	**428.9**	**358.8**	**298.9**	**269.5**	**236.7**	**207.9**	**190.8**	**171.1**
Energy industries	137.6	140.6	144.9	159.9	137.5	106.1	81.8	63.4	52.3	52.8	52.7	50.7
Industry	92.3	90.3	96.4	92.4	70.2	55.6	45.9	47.3	44.4	41.8	40.3	38.8
Transport	102.2	114.3	123.8	128.3	115.5	106.1	85.4	81.6	71.1	53.2	43.6	30.9
Residential and Commercial	69.8	69.2	73.6	86.7	88.0	74.8	71.3	61.9	54.7	46.2	43.5	41.3
Agriculture (energy use)	9.1	9.6	8.9	9.3	8.1	7.7	7.9	8.4	8.1	8.5	5.5	5.0
Other	14.3	13.9	12.0	11.1	9.6	8.5	6.6	6.9	6.1	5.4	5.1	4.4
FROM OTHER SOURCES, *of* which:	**94.6**	**95.9**	**97.7**	**103.3**	**88.9**	**83.0**	**82.3**	**72.6**	**66.7**	**61.4**	**58.6**	**55.2**
Industrial Processes + F-gas	40.4	38.3	39.1	47.2	37.0	33.2	31.0	29.7	26.4	23.5	21.8	21.1
Agriculture	36.9	37.6	36.7	34.2	31.6	31.2	32.7	28.2	28.0	27.1	27.2	26.4
Waste	17.3	20.0	21.9	21.9	20.4	18.5	18.6	14.6	12.2	10.8	9.6	7.8
TOTAL	**519.9**	**533.9**	**557.3**	**590.9**	**517.8**	**441.8**	**381.2**	**342.0**	**303.3**	**269.3**	**249.3**	**226.3**

Source: ISPRA

Figure 5.15 - WAM – WM GHG emissions (Mt CO2 eq.) difference, year 2030



The more noticeable differences can be seen in the energy industries and in the transport sectors. For transport this outcome is due to the effects of the following planned measures:

- increase of electric vehicle fleet from near zero in 2015 to about 6 million in 2030;
- modal optimization: car sharing, carpooling and shared taxi initiatives for passenger transport;
- infrastructures: extension and modernization of the local railway network;
- alternative fuels: development of LNG in the maritime transport and heavy goods vehicle sector.

Table 5.3.2 – WAM Scenario's, transport demand for passengers and freights

				2015	2020	2025	2030	2035	2040	2050
WAM	Passenger	Road	billion pass-km	820.2	670.7	752.2	847.5	826.8	806.6	767.9
		Rail	billion pass-km	59.5	31.7	48.5	74.2	76.6	79.0	84.1
		Domestic aviation	Number of Landing and Take-Off cycle (LTO)	380.6	121.0	383.2	434.1	471.5	512.2	567.8
		International aviation	Number of Landing and Take-Off cycle (LTO)	325.4	115.7	366.3	416.3	457.6	497.6	558.2
	Freight	Road	billion ton-km	124.9	144.5	149.8	168.4	169.6	170.3	171.9
		Rail	billion ton-km	20.8	20.5	25.2	30.9	30.7	30.5	30.1

Domestic navigation (inland waterways and national maritime)	billion ton-km	51.2	44.6	59.8	61.1	61.8	62.6	65.2

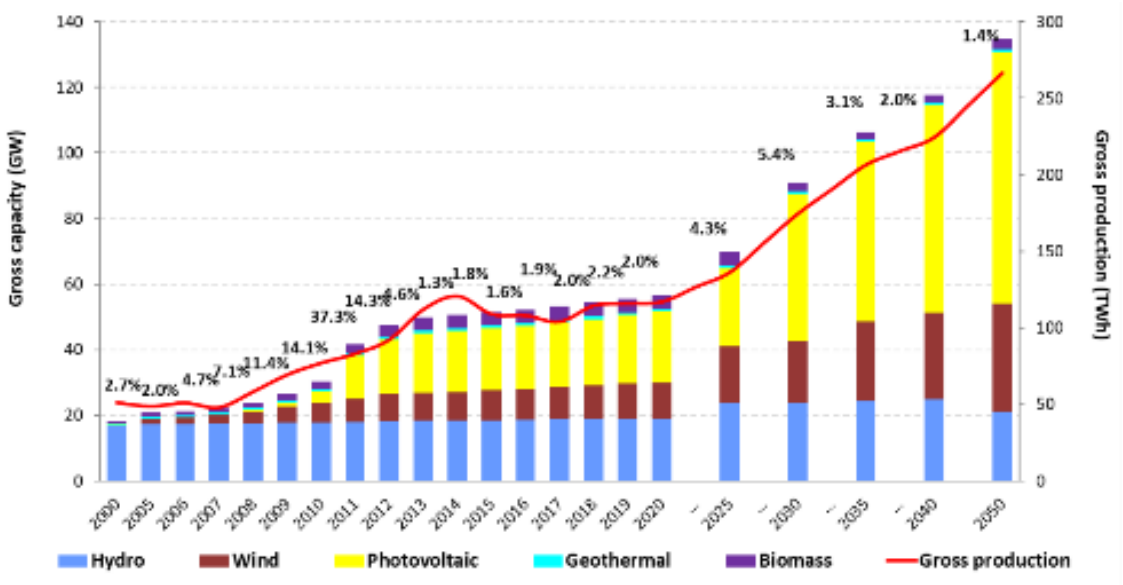
The modal split remains substantially unchanged up to 2020 for passengers, whereas a significant increase in railway / ship goods transport is expected in the future. From 2020 to 2030, an increase of passenger-km in railway and public transport is foreseen.

For the civil sector the emission reduction is due to:

- the increase of rate of renovation, the deep renovation rate in the WAM scenario in equal to 0.8%;
- electrification oh the heating system with a penetration of heat pumps both in the domestic and service sector.

For energy industries the main role is played by power sector with the planned target of 55% share of energy from renewable sources in gross electricity consumption in 2030. Such target would be achieved boosting wind and photovoltaic power capacity as showed in Figure 5.16. The increasing trend of new installation will go on after 2030. As for wind capacity a share of off-shore plants is planned too, about 2 GW in 2040.

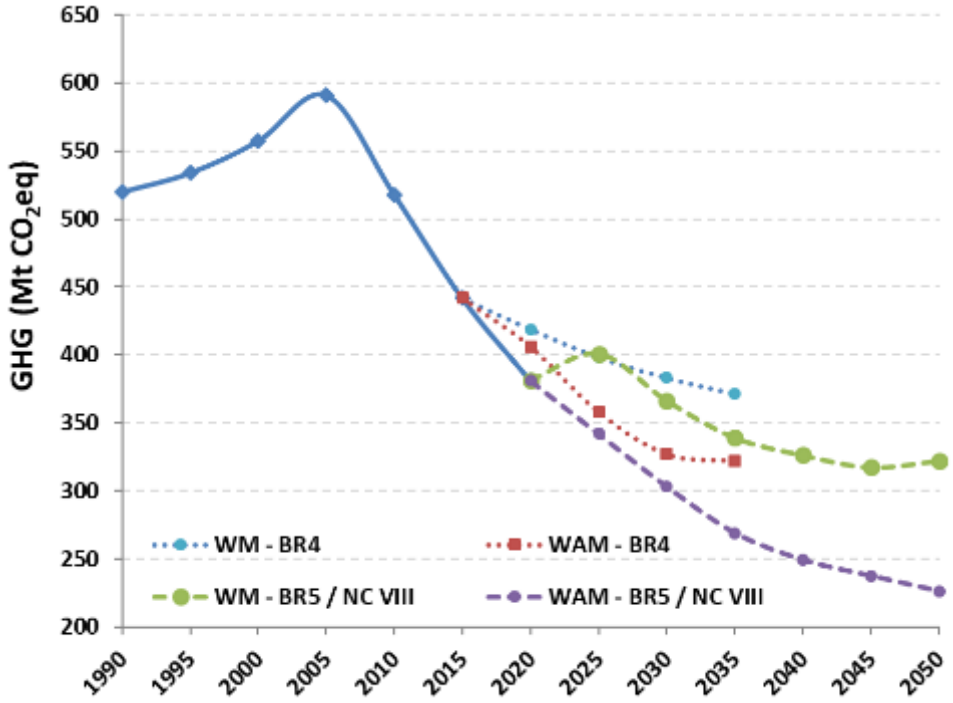
Figure 5.16 – Renewable contribution to gross electricity production in WAM scenario. The percentage represents the annual average power rate.



Further description of the effects of PaMs is provided in Chapter 4.

As can be seen in Figure 5.17 the additional measures allow further reduction of GHG emissions starting from 2025. The WAM projected emissions for 2040 are 23.6% below the level of WM scenario due to a decrease of energy related emissions for all sectors except agriculture. At the moment, no measures are planned for no energy sectors. The total impact of additional measures determines a reduction of GHG emissions of -34.6% in 2040 with reference to 2020 level to be compared with -14.4% for WM scenario.

Figure 5.17 – Actual and projected GHG emissions (Mt CO2 eq.)



Source: ISPRA

5.4 Projection results and emissions targets

Table 5.24 summarizes the GHG emissions in both WM and WAM scenarios up to 2050. Targets for Effort sharing, covering the period 2013-2030, are also reported (see paragraphs 4.1.2 and 4.1.3).

Targets up to 2020 have been achieved, while according to the WM scenario there is a sizeable distance from targets set to for the period 2021-2030. At present, final target for 2030 is set to -33% compared to 2005 level as reported in Commission Implementing Decision (EU) 2020/2126 of 16 December 2020. On November 8, 2022, the Council and the European Parliament reached an interim political agreement on stricter emission reduction targets for Member States under the Effort Sharing regulation. Pending formal adoption, the provisional agreement endorses an EU-wide GHG emission reduction target of 40% by 2030 compared to 2005 levels. For Italy, the target corresponds to a 43.7% reduction, to be achieved through a progressive annual reduction set by year-specific maximum allowances from 2021 to 2030. The new allowances have not been defined yet.

A LULUCF target for Italy equal to -35.8 $MtCO_2eq$ have also been included in the revision of EU Regulation 841/2018, currently under negotiation.

Table 5.4.1 – National GHGs emission scenarios and targets (Mt CO2 eq.) under EU legislation

	1990	2005	2020	2025	2030	2035	2040	2050
National emissions without LULUCF WM	519.9	590.9	381.2	400.6	366.3	339.1	326.3	322.1
National emissions without LULUCF WAM				342.0	303.3	269.3	249.3	226.3
Effort Sharing emissions WM			254.0	273.4	240.8	210.5	198.2	188.9
Effort Sharing emissions WAM				231.3	205.2	172.9	154.2	134.3
Effort Sharing targets[1]			291.0	254.6	226.9			
Distance from Effort Sharing targets WM			-37.0	18.8	13.9			
Distance from Effort Sharing targets WAM				-23.3	-21.7			
LULUCF emissions and removals (WM/WAM)[2]	-3.6	-35.2	-32.4	-34.3	-33.9	-30.0	-36.7	-36.7

1 Target up to 2020 by the Effort Sharing Decisions (ESD) 406/2009/EC, 2030 target set up according to Effort Sharing Regulation (ESR) 2018/842. NF3 emissions are included into the ESR target for the post-2020 period.

2 No policies are in place for the LULUCF sector; therefore, for the LULUCF sector, WM and WAM scenarios coincide

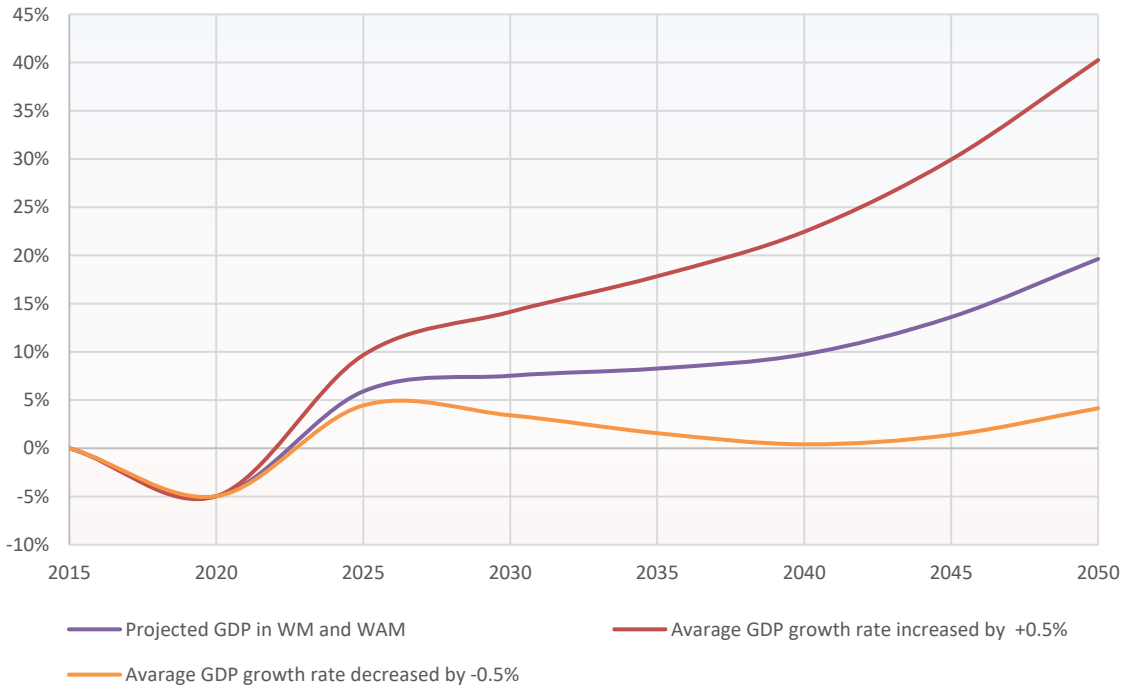
Source: ISPRA

5.5 Sensitivity analysis

5.5.1 Sensitivity to GDP

In order to test the robustness of the assumptions and to assess the variation in the results obtained as the input parameters changed, a sensitivity analysis was carried out for both the WM and WAM scenarios. The global events related to the ongoing pandemic during the implementation of the scenarios had very substantial effects on the main drivers determining emissions. New assumptions about the development of world, European, and national economies emerged during 2020 and part of 2021. To test the behavior of the system under different assumptions of economic development, therefore, it was chosen to produce alternative scenarios characterized by annual GDP growth rates with excess and shortfall of 0.5% per year compared to the projection used for WM and WAM scenarios (Figure 5.18).

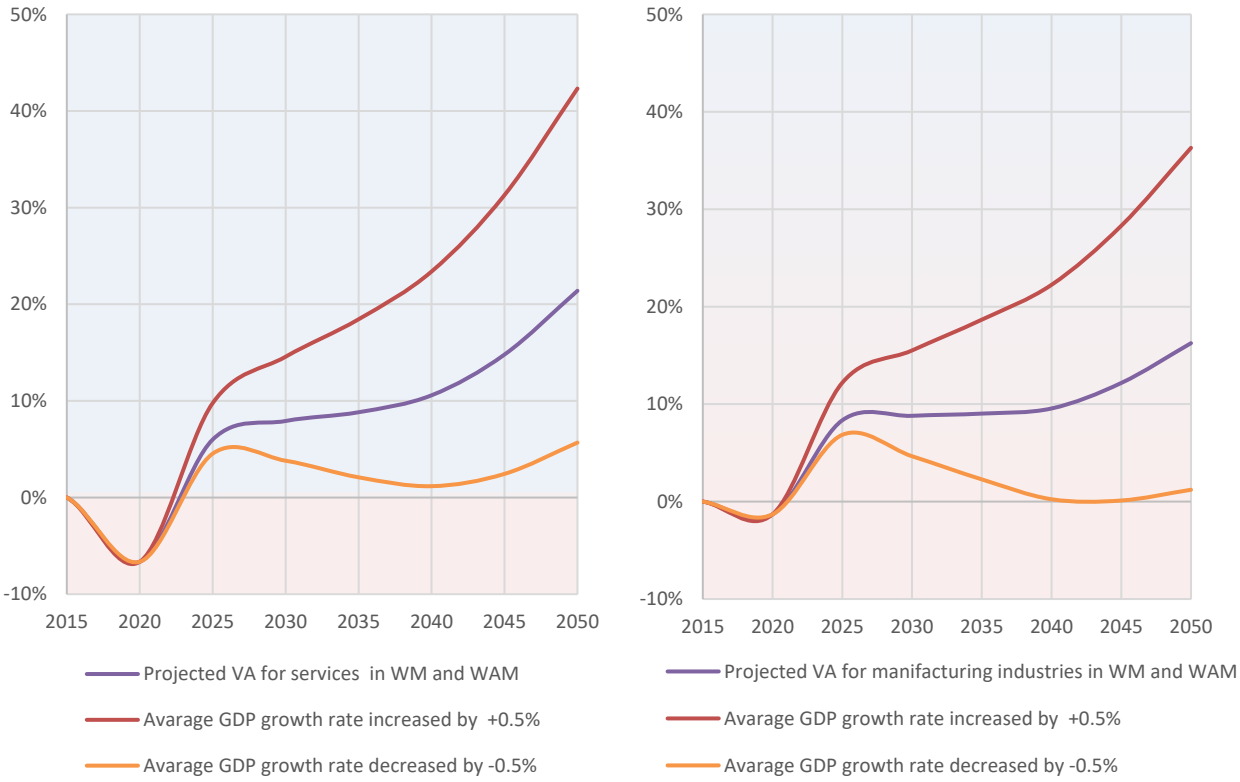
Figure 5.18 - GDP changes compared to 2015 used in the sensitivity analysis



In the modeling system used for the emission projections calculation, GDP trends are directly related to the level of industrial, services, and freight transport activities and indirectly related to electric generation and more generally to energy transformation processes such as refineries and coke ovens.

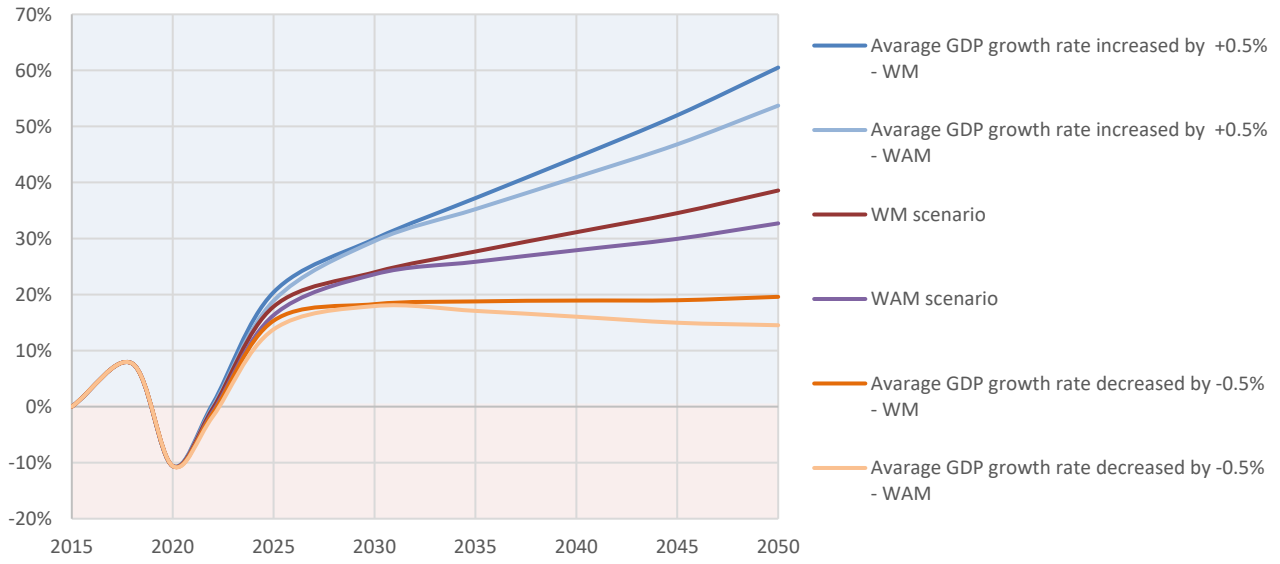
Therefore, two alternative datasets consistent with different economic development hypotheses for the period 2020-2050 were produced: two different trends in industrial value-added and associated physical outputs, two different economic development hypotheses for the tertiary sector, and four freight transport demand curves.

Figure 5.19 – VA for services (left) and manufacturing industries for sensitivity analysis: changes compared to 2015



As shown in Figure 5.20, for the transport sector, the number of cases under analysis doubles, since in the WAM scenario the expected demand trend curves change according to policies aimed at rationalizing demand and encouraging intermodality.

Figure 5.20 - Projected trends for freight transportation demand for sensitivity analysis: changes compared to 2015



Changes of the above parameters has a greater impact on emissions from combustion processes carried out on stationary equipment, such as boilers, or mobile equipment, such as the combustion engines of road vehicles. For this reason, for the sole purpose of making it easier to compare the results obtained under the different assumptions, it was decided to use the CO_2 emissions produced by these processes in the different scenarios as an indicator of the level of activity.

The following graphs and related comments summarize the main results obtained about CO_2 emissions.

Figure 5.21 and Figure 5.22 show, as one would logically expect, that higher GDP growth corresponds to higher emissions and lower GDP growth corresponds to lower emissions, and that these differences are amplified as the time horizon is extended. In general, the changes are rather small; in fact, the percentage change in total CO_2 emissions from the central scenario is always lower than the changes in GDP.

On closer reading, however, other useful elements emerge. The distribution of effects is not uniform across sectors and is not symmetrical; also, the magnitude of changes in different sectors changes unevenly over time. In general, for all sectors except manufacturing industries, in the WM scenario, the contraction that occurs when the GDP growth rate is lower is greater than the increase observed when the GDP growth rate is increased. In the WAM scenario, the situation is similar, although the system seems to be more sensitive to increasing GDP growth rates. Indeed, in this scenario, in addition to manufacturing industries, energy industries and transport also see rather large increases in their emissions and activity levels. Broadly speaking, we can observe that higher GDP growth than in the central scenario corresponds in the WM scenario to moderate growth in activity levels, while lower GDP growth corresponds to a greater contraction in activity levels. It also emerges that in the medium term (2030) the energy industries would experience a greater contraction in the case of lower-than-expected GDP growth, while in the long term (2050) it would be the manufacturing industries that would be most affected in terms of both higher and lower growth. Thus, in the WM scenario, the activity level of the manufacturing sector appears to be the most sensitive to changes in the overall economic situation. The behavior of the WAM scenario differs from that of the WM especially over the long-term horizon, particularly for the energy, civil, and transportation industries in case of higher GDP growth. On the other hand, manufacturing industries are more sensitive to lower economic growth rates.

Figure 5.21 – Relative change of sectoral CO2 emissions from combustion in comparison with WM and WAM scenarios: year 2030

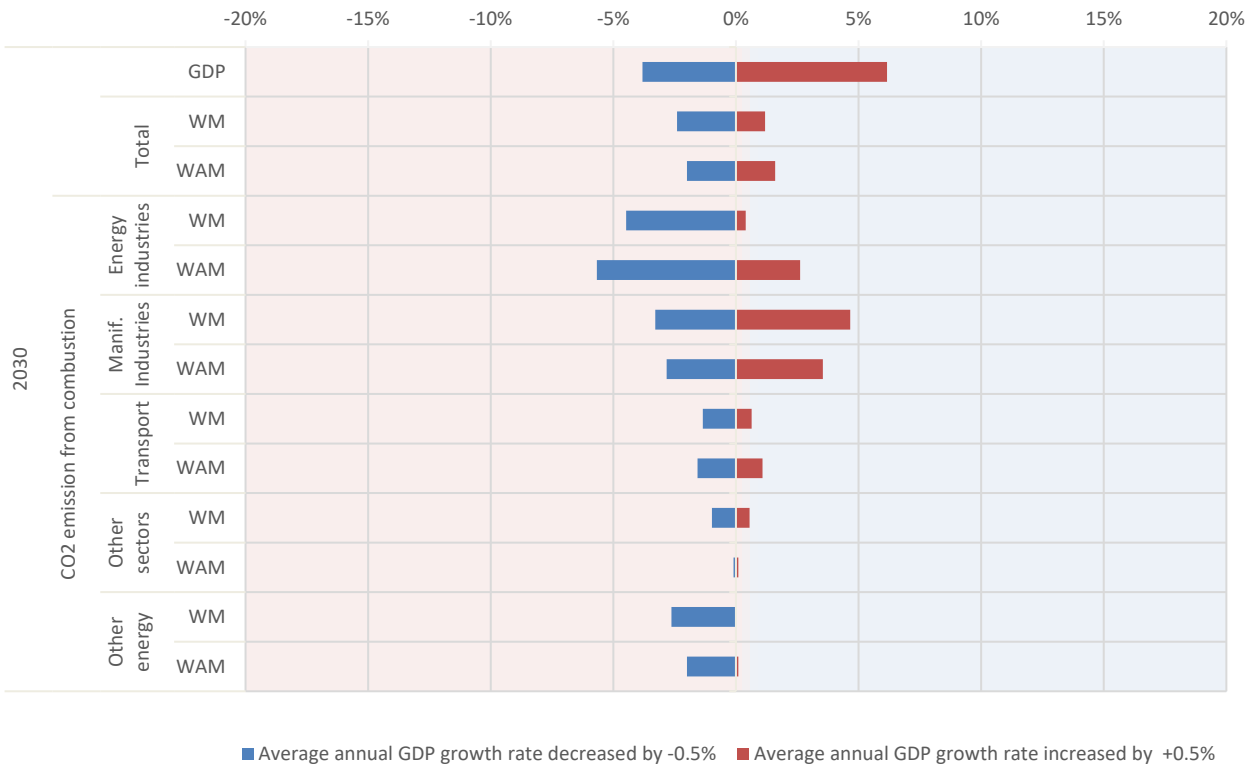
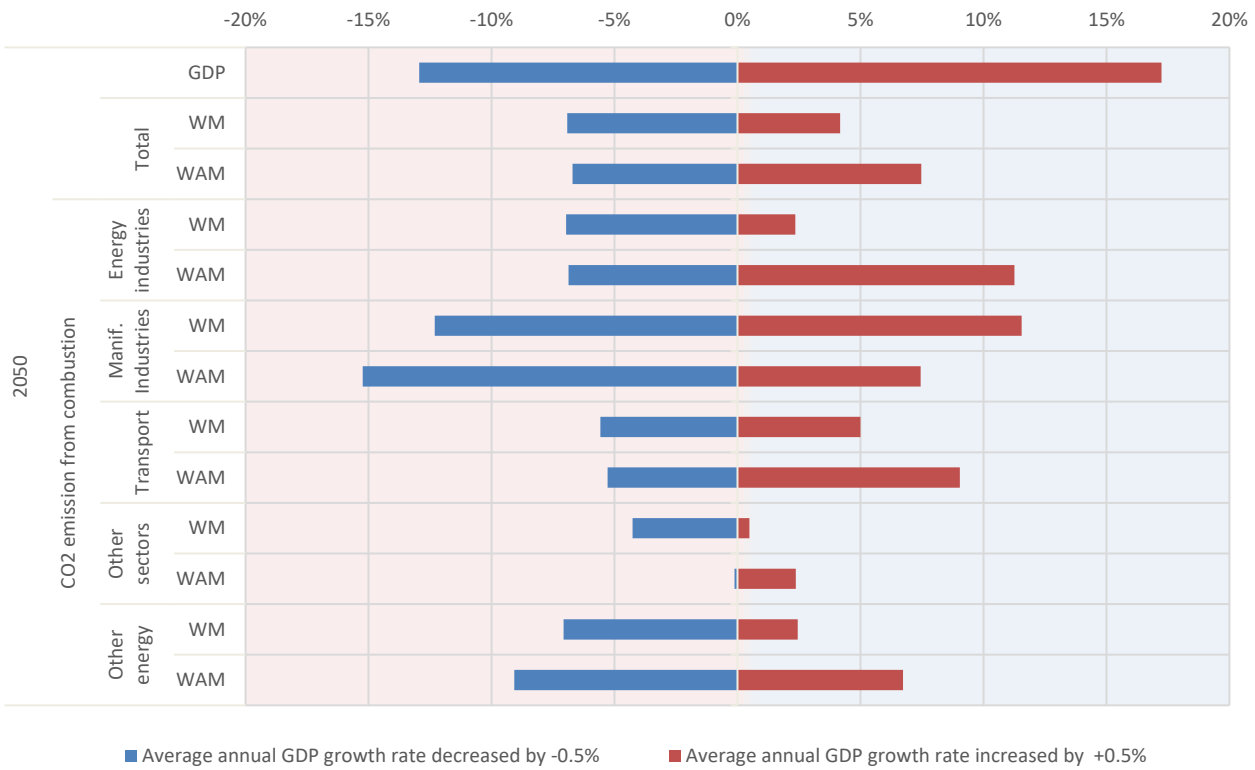


Figure 5.22 – Relative change of sectoral CO2 emissions from combustion in comparison with WM and WAM scenarios: year 2050



5.5.2 Sensitivity to price of CO2 emission allowances on the European ETS market in ETS

During the course of scenario development, it became evident that, due to the economic dynamics triggered by the pandemic, CO_2 emission allowances in the ETS market were experiencing much higher growth than projected, reaching levels as early as 2021 previously expected only for the post-2030 period. It was therefore deemed useful to also investigate the effects produced by different trends in the price of CO_2 emission allowances on the European ETS market through sensitivity analysis concerning this parameter, in addition to sensitivity to GDP.

CO_2 emission allowance price is one of the parameters with the greatest uncertainty in the projections, and it is particularly important because it directly impacts the production costs of electricity and, to some extent, industrial production. Considering the ubiquity of the electricity carrier and the assumptions of further growth in consumption due to the progressive electrification of energy end uses (see, for example, the strong penetration of electric cars in the WAM scenario), it was deemed important to test the reaction of the modeling system to the assumed changes in this parameter. Even though, as reported in paragraph 5.2.1, CO_2 price projections are identical in both WM and WAM scenario, the analysis focused mainly on the results of the scenario with additional policies, since in this framework the electrification of processes is more significant in all sectors. In addition, in the WAM scenario, renewable energy sources have a greater possibility of penetration into the energy system and are thus better able to replace, where required by rising costs, the energy sources responsible for CO_2 emissions subject to ETS.

In the sensitivity analysis, it has been supposed that once the allowance prices went up, they would always stay above the assumptions adopted for WM and WAM scenarios, but with different increase rates. Over the period 2015 - 2030 for the high price increase scenario, an average annual rate of 19.2% was assumed, for the low increase scenario 17.4%, and for the very low increase scenario 15.2%. In the WM and WAM scenarios, the increase rate for the same period is about 9.5%. If, on the other hand, the entire period of analysis, from 2015 to 2050, is considered, the average annual increase rate of the allowance price is 8.4%, 7.7%, and 7.6%, respectively, compared with a rate of 7.3% in both WM and WAM scenarios. Alternative assumptions on the evolution of the price of CO_2 allowances considered are shown in Figure 5.23 and Figure 5.24.

Figure 5.23 - Hypothetical increase of the price of CO2 emission allowances in the ETS market: change from 2015

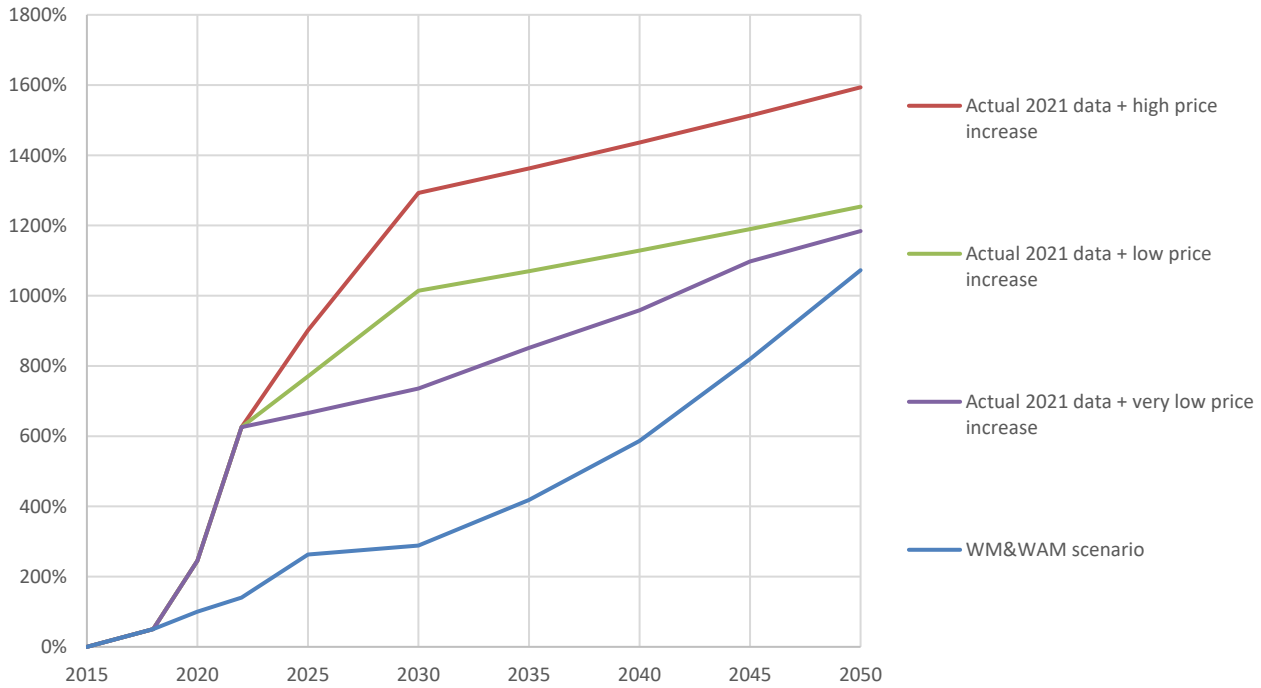
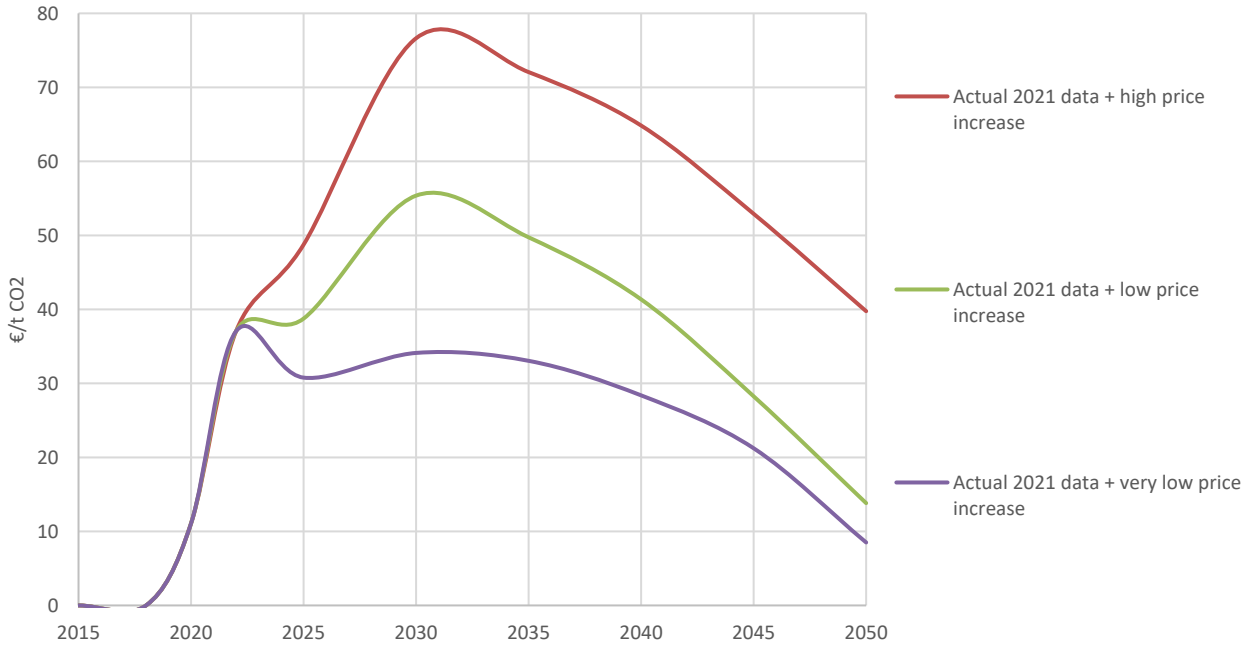
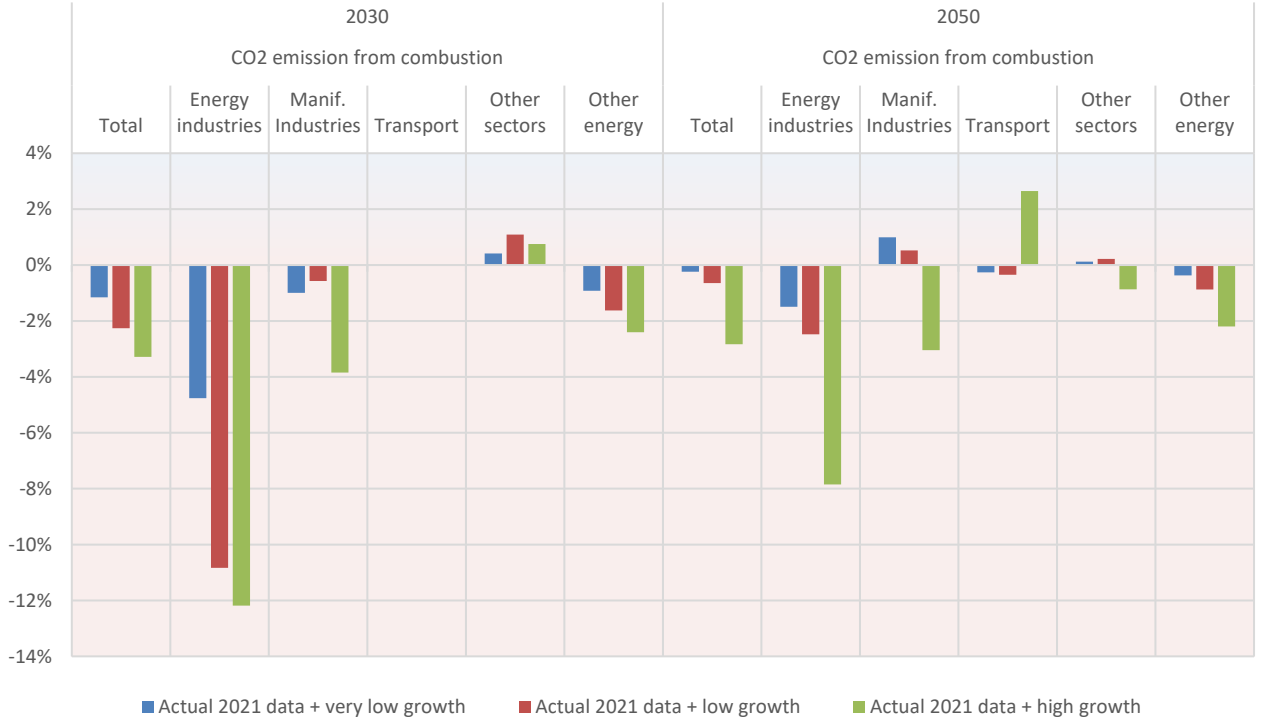


Figure 5.24 – Gap between the emission allowances price in the WM/WAM scenarios and in the three increasing scenarios (€/t CO2).



Again, to easily compare the results obtained and consider the sectors most involved, CO2 emissions from combustion were chosen as indicator (Figure 5.25).

Figure 5.25 - Relative change of sectoral CO2 emissions from combustion in comparison with WAM scenario for three carbon price increasing trends.



As shown in the Figure 5.25, the largest differences are found in the medium term when the differences in allowance prices are the largest. At the 2050 horizon, however, all assumptions made predict a significant increase in costs compared to the base year.

Again, however, upon closer analysis, elements emerge that should be given due consideration when designing policies to reduce consumption and emissions. While in general, when looking at total CO_2 emissions from combustion, it appears that a higher price of allowances corresponds to lower emissions, at the level of individual sectors the situation is more nuanced. The energy industries sector, being the one most directly affected by the ETS, shows the most significant reductions due fundamentally to a different set-up of the electricity generation system where renewables are becoming more and more affordable. The other sectors, particularly transport and civil, where existing policies and targets are pushing for greater electrification, show less obvious trends. Where the increase in the cost of ETS allowances only indirectly translates into an increase in cost of electricity for final consumers, the effect of policies is slowed, and traditional combustion systems, whether stationary plants or internal combustion engines, see their activity levels prolonged over time. The indication that can be drawn from this is that in the event of continued high CO_2 prices it will likely be necessary to adopt policies targeting those energy end-use sectors that, among other things, have the greatest impact in terms of air pollution and air quality.

5.6 Comparisons with previous National Communications

Figure 5.26 shows GHG emission projections for each National Communication (NC) since the second one, in order to compare projected emissions with different sets of measures. Projections from WM scenarios have been considered. For the 6th NC and the present one, projections from WAM scenarios are also reported. In the various NC similar approaches were used to perform scenario and emission projections.

The comparison of projections occurred along the examined period need to consider for each projection basic parameters such as base year and projection time horizon which are summarized in table 5.25.

Figure 5.26 – GHG emissions trend in the past and present NCs since the second one. Dotted lines are the projected emissions in the relating NC.

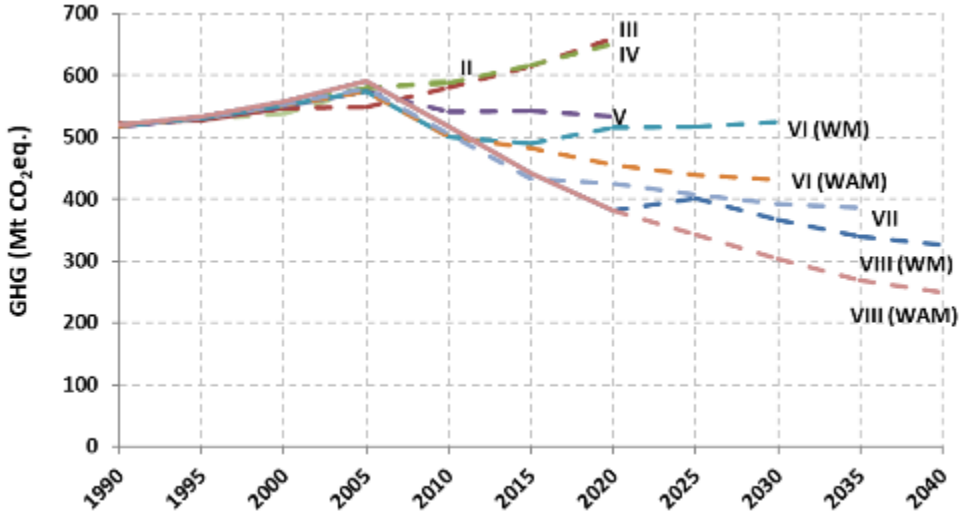


Table 5.6.1 – Basic parameters for each NC's projections

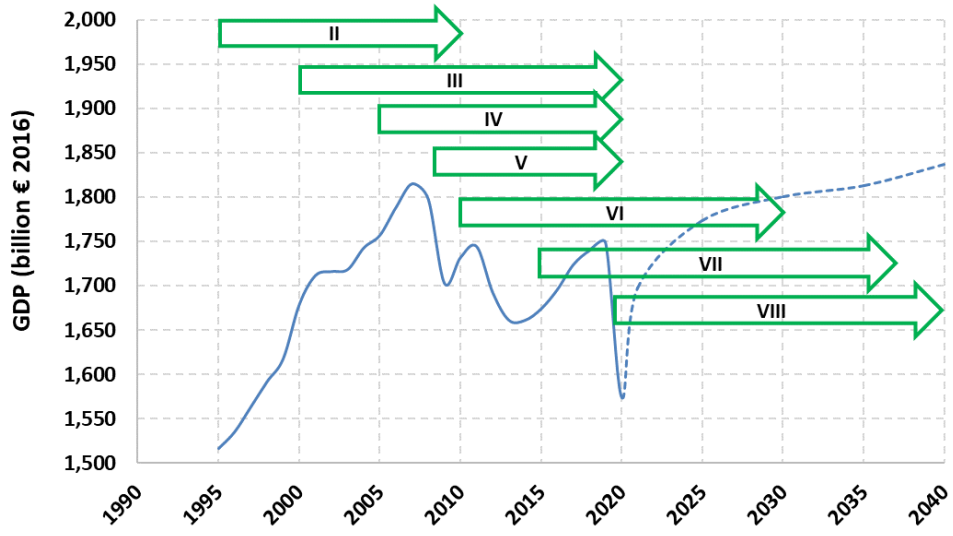
NC	Historycal or preliminary data up to	Projection base year	Projection horizon
II	1996	1995	2010
III	2000	2000	2020
IV	2005	2005	2020
V	2008	2007	2020
VI	2012	2010	2030
VII	2016	2015	2035
VIII	2020	2019	2040

Projected GHG emissions for 2010, with a coefficient of variation (ratio of the standard deviation to the mean) of 1.1%, had remained quite stable between the 2nd and 4th NCs; instead, since the 5th NC 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 NC, 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). The emissions projections furtherly decline with the 7th NC when the effect of economic crisis were even more evident. 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 differences in historical GHGs emissions between the various NCs.

A clearer understanding around the projections change among NCs emerges by overlapping the GDP trend and the time span between base year and projection time horizon for each NC. Figure 5.27 shows that unpredictable economic events have occurred in such time periods and how they have affected the GHG emissions. The impact on GHG emissions occurred after the submission of a NC could be taken into account only in the next NC, whose projections were affected by further unpredictable economic downturns.

Figure 5.27 – GDP trend from 1995 to 2020 and projection up to 2040 (dotted line). The arrow for each NC goes from projection base year to time horizon.



Along with GDP, which is in some way an exogenous parameter, the implementation of new politics and measures has also dragged down the projections pattern from a NC to the next one. Since 1995 the European and National targets have become more and more ambitious and the legislation for their implementation represents a powerful driver to reduce emissions. In this regard it is worth noting the parallel trend of the emissions projections in the WAM scenario of the 6th NC and WM scenario in the 7th one, when the additional measures of the previous NC were implemented in the next one. The lower base level recorded for the 7th NC is likely due to the economy effect, while the trend is driven by the implemented measures.

5.7 Preliminary analysis of most recent policies and measures at national level

Article 2, paragraph 9 of Law No. 39 of April 7, 2011, on the reshaping of instruments and the budget cycle, requires that a document, prepared by the Minister of the Environment and Protection of Land and Sea on the status of implementation of commitments to reduce greenhouse gas emissions, consistent with Italy's international obligations at European and international level, shall be submitted annually as an annex to the Economic and Financial Document (Documento di economia e finanza – DEF).

Compared to the WM and WAM scenarios described in the previous paragraphs, the analysis realized in 2022 fully include the effects of the pandemic from COVID-19, thanks to the availability of consolidated data, which allow quantifying the effects in terms of emissions on the different sectors. The final 2020 data have been used to update the projections of the main macroeconomic parameters. A "reference scenario" has been calculated to show how the emissions should evolve up to 2030, considering the policies and measures included in the "National Recovery and Resilience Plan" (NRRP) adopted in July 2021 as well as the effects of the pandemic.

In the transport sector, NRRP foresees investments related to sustainable mobility, renewal of bus and train fleets with zero-emission vehicles, and expansion of the electric charging infrastructure network. In terms of personal mobility, by 2026, most measures are concentrated in cycling and walking and rail transport, with increases in kilometers of bicycle lanes and rail infrastructure. By 2026, the effect of the NRRP measures results in a 5% increase in demand for rail transport and a 9% increase in bicycle-pedestrian transport, with a reduction in passengers mainly relative to private cars but, to a lesser extent, also buses. The NRRP also envisages the installation of 21,355 new charging infrastructures by 2026, technologically diversifying the current endowment with superfast charging infrastructures, which is necessary to stimulate electric mobility on long distance. This number is very important compared to the current endowment of charging infrastructure and the current number of electric cars on the road. As for the renewal of the public transport fleet, the measures converge in the entry into service by 2026 of about 3,000 zero-emission buses and 150 hydrogen-powered trains to replace diesel-powered ones. As far as the transport sector is concerned, the measures in the NRRP contribute to the path toward the existing 2030 targets.

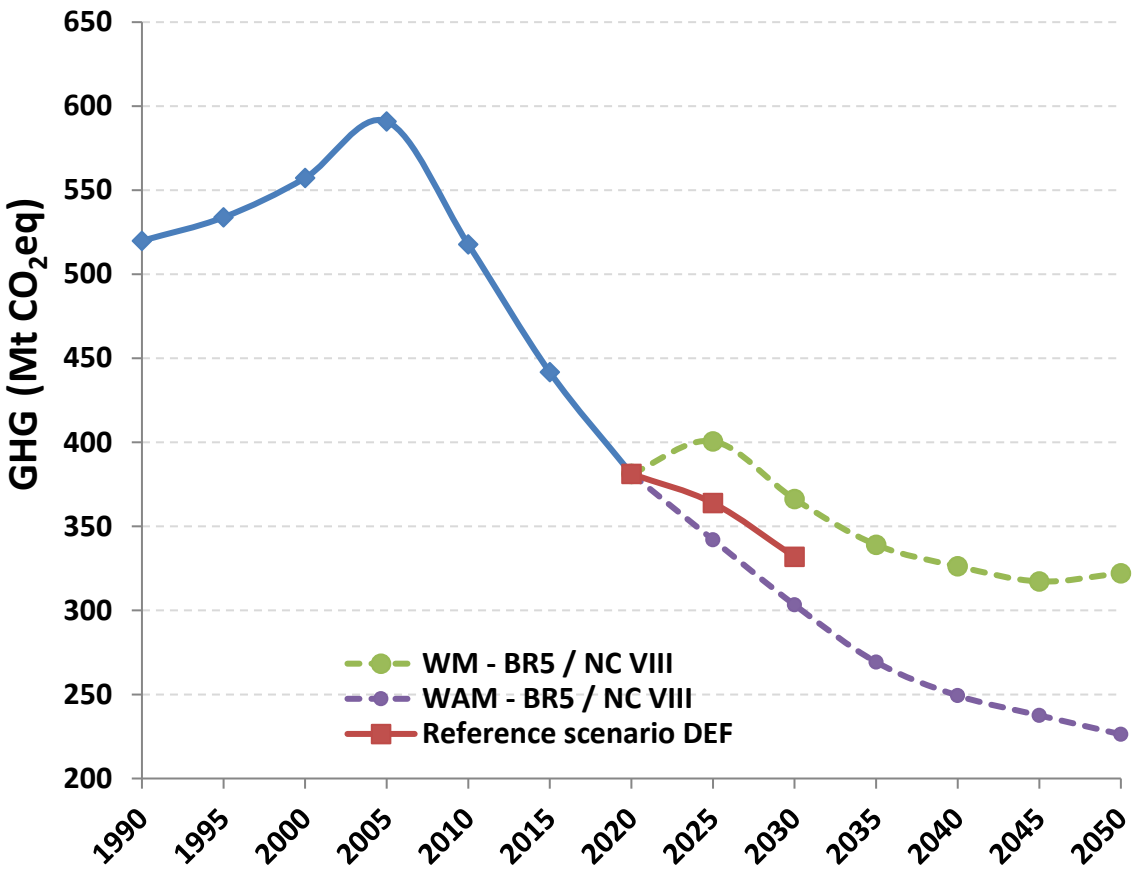
As far as the civil sector is concerned, the measures identified by the NRRP mainly focus on building efficiency measures, both in the residential and tertiary sectors. The most important measure is the so-called 110% Superbonus, however, for the sake of completeness, the effects of the various measures related to the upgrading of cinemas, theaters, museums, schools and buildings pertaining to the Ministry of Justice were also analyzed. The resources made available and the effect of all these measures together can be quantified as a reduction of about 1% of the sector's emissions, compared to what would occur without these interventions. Given the current emission levels, as well as the historically observed inertia in this sector, the emission reduction trend may not yet be sufficient to achieve the 2030 targets established for Italy at EU level in the Effort Sharing (-33% GHG emissions compared to 2005 levels from road and domestic maritime transport, buildings, agriculture, waste and small industries, cfr Table 4.1.2 – ESR 2020-2030 targets for Italy).

NRRP measures are very effective in the renewable energy sector. In this area, the funded interventions and the expected effects of the enabling reforms will bring significant increases for photovoltaic, wind, and biomethane production. In particular, wind and photovoltaic production would result in a clear reduction in emissions produced by the energy industries sector, quantifiable at about 10 $MtCO_2eq$ by 2030. According to the NRRP, a production of about 2.3 billion cubic meters per year of biomethane should be achieved

starting in 2026. The release for consumption or distribution of such biomethane into the network, offsetting an equal reduction in consumption of natural gas of fossil origin, will result in a further reduction in emissions. Looking at the data, it is clear that the investments and reforms related to renewable sources contained in the NRRP, allow for a very significant reduction in emissions from the ETS sectors; the expected values for 2025 and 2030 of this "reference scenario" are in line with those of the WAM scenario described in paragraph 5.3. For the effort sharing sectors the "reference scenario", thanks both to the changed economic situation and to the adoption of the measures envisaged in the NRRP, is only partially in line with the current reduction target for Effort Sharing, but the adoption of additional policies is still necessary, particularly for buildings and transport. The mere increase of renewables in the electricity generation mix does, certainly, result in emission reductions, however a greater electrification of road transport and building is necessary.

In Figure 5.28, a comparison between WM and WAM scenario with the reference scenario calculated for the DEF is reported.

Figure 5.28 – Comparison between WM, WAM and reference scenarios



6 VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES [77]

6.1 Climate modelling, projections and scenarios

Italy is located in an area identified as particularly vulnerable to climate change[78]: as a matter of fact, the Mediterranean region is considered to be a hotspot of climate change impacts[79].

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 [80] [81]. 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[82] , 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[83] has been established, to provide a global coordination of regional climate downscaling for improved climate change adaptation policy and impact assessment.

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 1989–200884 against the E-

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[78] Giorgi F. (2006). Climate change Hot-spots. Geophysical Research Letters 33: L08707. doi: 10.1029/2006GL025734

[79] IPCC (2014a). 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 Universitt Press, Cambridge, United Kingdom and New York, NY, USA, 1132 pp.

[80] Brunetti et al. (2006). Temperature and precipitation variability in Italy in the last two Centuries from homogenized instrumental time series. Int. J. Climatol.

[81] 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

[82] Kottek et al. (2006). World Map of the Köppen-Geiger climate classification updated. Meteorologische Zeitschrift 15(3):259-263

[83] 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.

[84] 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

OBS dataset[85]. 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[86]: 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 MASE, Italian Ministry of University and Research, and of Economy and Finance) in order to assess the effects of increasing resolution on the quality of results[87] [88]. 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[89]. 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 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

[85] 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.

[86] 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

[87] 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

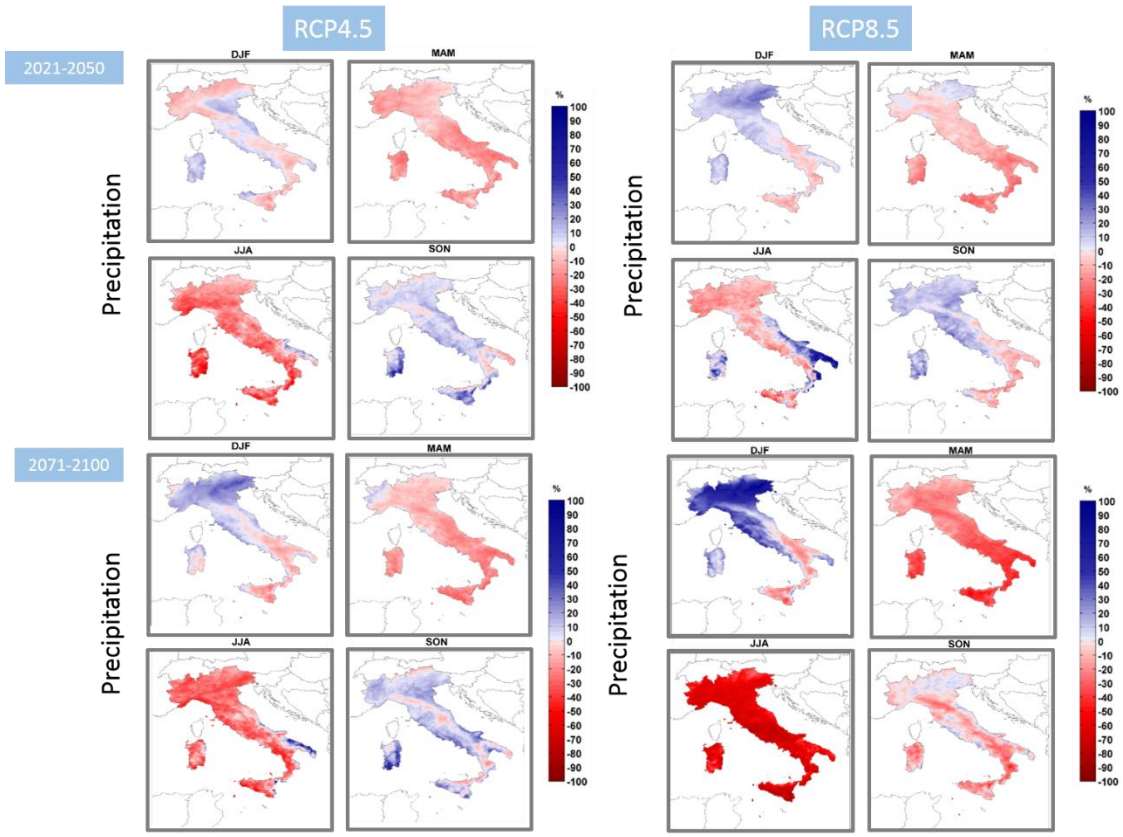
[88] Zollo et al. (2016). Extreme temperature and precipitation events over Italy: assessment of high resolution simulations with COSMO-CLM and future scenarios. International Journal of Climatology, 36(2), 987-1004. doi:10.1002/joc.4401

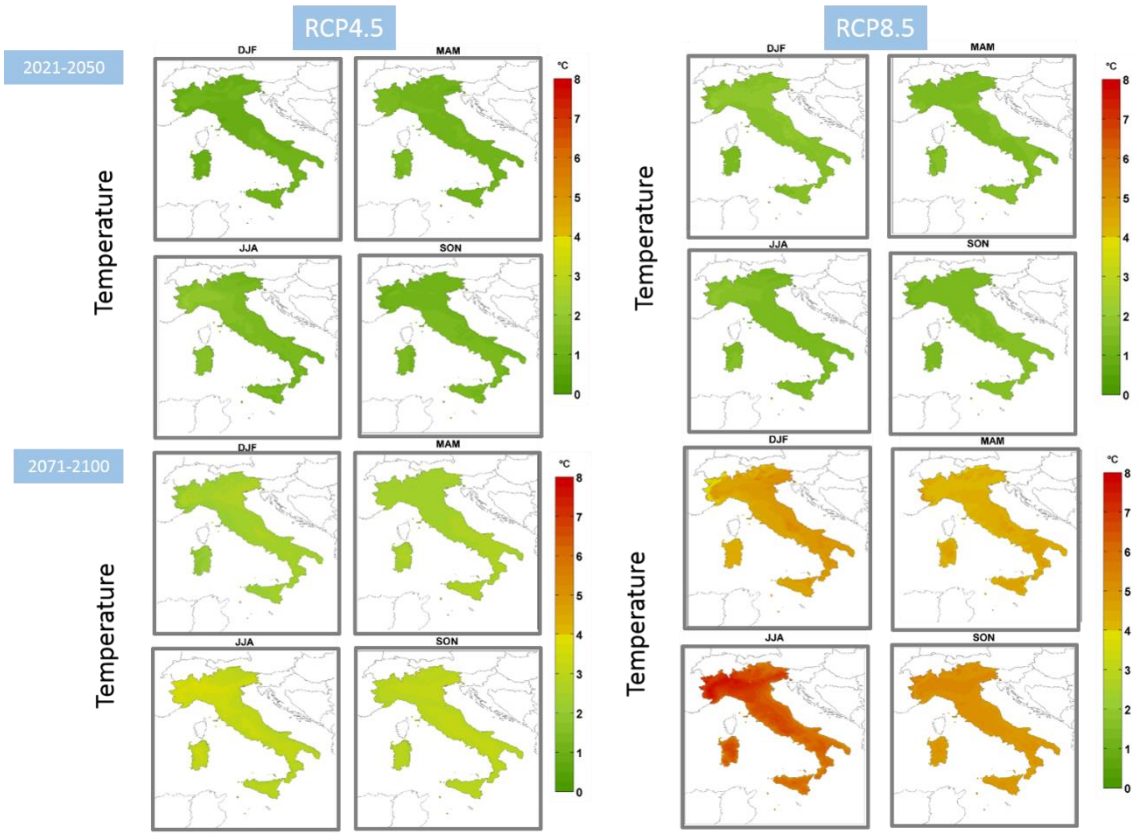
[89] Jacob et al. (2014). EURO-CORDEX: new high-resolution climate change projections for European impact research. Reg. Environ. Change 14: 563–578, doi: 10.1007/s10113-013-0499-2.

diminish over south Italy, while in summer a general reduction is observed (with exception of Apulia where, however, autumn precipitations 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

As reported in the VII National Communication Italy is located in the so-called "Mediterranean hot spot", an area identified as particularly vulnerable to climate change. Italy is notoriously prone to natural hazards and climate change is expected to increase climate-related hazards over the next decades. This, combined with the economic, social and environmental pressures, makes Italy one of the most vulnerable countries in Europe. 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. In the table below the climate change potential impacts and the future scenario are reported according to eighteen sectors plus the Po river basin envisaged in the NAS.

Sector	Potential Impact	Future Scenario
Water resources (quality and quantity)	Reduction in water availability and quality and increase 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[90,91].	All these pressures will reduce the capability to rigenerate reservoirs, thus increasing the competition among the different water uses (civil, industrial and agricultural), especially in summer and in southern regions.
Desertification, land degradation	Regions with "higher sensitive areas" compared to the national average (30%) are: Basilicata, Marche,	The gradual worsening of desertification trends, already observed in the whole country, can

[90] Portoghese I. et al. (2009). "Impatti sul ciclo idrologico e risorse idriche". In Castellari S. and Artale V. (2009). Bononia University Press.

[91] Funari E. et al. (2007). "3.1 Water". In Menne B. and Wolf T., 2007. Rome, WHO-APAT.

Sector	Potential Impact	Future Scenario
and drought	Molise, Sicilia, Sardegna, Puglia e Emilia-Romagna[92]. 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[93] and to the consequent decreasing ground levels. Water erosion already affects 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[94].	be accelerated by climate change as it increases the actions of erosion, salinization, loss of organic matter and drying up of soil[95].
Hydrogreological risk	An analysis of flood risk[96] 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.	In Italy about 94% of the municipalities is actually affected by landslide, flooding and coastal erosion risk. It is estimated that about more than 8 million people (12,5% of the national population) is potentially exposed to high risk and buildings potentially involved are more than 2 million. This critical situation is likely to be exacerbated due to future climate trends[97].
Terrestrial ecosystems	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, the upward migration of shrubs species, the rise of arboreal species, the variation of floristic composition, extension and pattern of spatial distribution of plant communities and finally the acceleration of the impacts of climate change on dynamism and species colonization processes.	(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)[98].

[92] 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.

[93] INEA (2011). Valutazione del rischio di salinizzazione dei suoli e di intrusione marina nelle aree costiere delle regioni meridionali in relazione agli usi irrigui.

[94] 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.

[95] 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.

[96] Trigila et al. (2015). Dissesto idrogeologico in Italia: Pericolosità e indicatori di rischio, Report No 233/2015, ISPRA, Rome, Italy.

[97] 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.

[98] Cecchi L. et al. (2007). "3.3 Urban environments and socioeconomic sectors". In Menne B. and Wolf T., 2007. Rome, WHO-APAT.

Sector	Potential Impact	Future Scenario
Marine ecosystem	Reduction of species with an affinity for cold-water conditions. In the Adriatic, over the last 20 years, the number of thermophilous species has increased significantly and several rare species are becoming abundant. The increasing development of marine mucilage might favor the spreading of pathogenic bacteria[99].	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%.
Freshwater and transition ecosystems	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[100]. 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[101].
Health	(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 and deaths, from floods, heavy precipitation and fires events; (iv) increased respiratory diseases and allergic disorders; (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[102].	Increase in injuries, morbidity and deaths due to climate-related events (heat waves, flooding, heavy precipitation, fire events)
Forestry	Changes in growth rates and productivity, 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.	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[103].
Agriculture	The productive capacity of agricultural crops in the Mediterranean region is strongly conditioned by the	Climate change is expected to affect the livestock by increasing the risk of

[99] 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.

[100] MASE (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: MASE.

[101] Menne B. et al. (2009). "6. Conclusions". In Menne B. and Wolf T., 2007. Rome, WHO-APAT.

[102] UNFCCC (2013). VI National Communication.

[103] UNFCCC (2013). VI National Communication.

Sector	Potential Impact	Future Scenario
	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	heat stress and to reduce the quality of agricultural products, especially for the 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.
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. The most vulnerable areas in Italy are located in the North-East and along the Adriatic coast.	The increasing attention is focusing on the possible effects on the molluscs production
Fishery	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 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; (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 .
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%. 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[104].	The increase in energy demand for cooling in summertime could exceed the decreasing energy demand for heating in winter. Summer cooling needs might increase up to 50% Italy by 2080. 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

[104] Gaudioso D. and Masullo A. (2009). "Impatti dei cambiamenti climatici sul settore energetico". In Castellari S. and Artale V. (2009). Bononia University Press.

Sector	Potential Impact	Future Scenario
		and form plants based on renewable sources. 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.
Coastal zones	Costal erosion phenomena. 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. The rate of coastal erosion varies between 13% in Friuli Venezia Giulia and 91% in Molise. 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.	(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[105].
Tourism	Climate change impacts projections on the tourist sector show a decrease in the italian attractivity as an international destination which will mean a decrease in tourist flows. Those impacts will vary across regions: the most likely vulnerable regions are, in descending order, Sicily, Lazio, Tuscany and Umbria.	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 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[106]. According to several studies, in the coming decades a snow cover will 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.
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,	

[105] 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.

[106] UNFCCC (2013). VI National Communication.

Sector	Potential Impact	Future Scenario
	droughts[107] [108]. 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).	
Cultural heritage	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 CO_2 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 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[109] [110].
Infrastructure and transport	Over the last 20 years at least 20 NaTech events (events in which a natural disaster triggers one 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[111].
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
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	Due to climate variations and to the reduction of the area and the volume of the alpine glaciers, large

[107] EEA (2012a). "Urban adaptation to climate change in Europe - Challenges and opportunities for cities". EEA Report No 2/2012. Copenhagen: EEA.

[108] EEA (2016). "Urban adaptation to climate change in Europe 2016. Transforming cities in a changing climate". EEA Report No 12/2016. Copenhagen: EEA.

[109] 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.

[110] Bonazza et al (2009). Climate change impact: mapping thermal stress on Carrara marble in Europe. Science of the Total Environment 407, 4506-4512.

[111] MASE (2015). Strategia Nazionale di Adattamento ai Cambiamenti climatici. Roma: MASE.

Sector	Potential Impact	Future Scenario
	is extremely vulnerable to changes induced by climate change. 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.	variations of water outflows will likely occur and will be only partially compensated by the existing artificial hydraulic works.

During the 2021 an update of the risk analisys has been developed by the Euro-Mediterranean Center on Climate Change (CMCC) [112]. The analisys results are reported in the "Communication of adaptation of Italy" submitted to the United Nations Framework Convention on Climate Change in december 2021. In the table below the analized sectors and the most relevant update are reported.

Sector	Update on potential impact
Water resources	Prolonged periods of drought, extreme events as well as changes in rainfall patterns, constitute risks to the quality and availability of water resources in Italy. These risks are most evident in the summer months and in semi-arid areas. Analysis carried out by CMCC on the influence of climate change on water availability in Italy focus on the district and on the river basin level and, highlight a reduction in both quantity and quality of water resources. In the coming decades, the increase in average temperature, evapotranspiration and low rainfall will contribute to a 40% decrease in flow by 2080. A further reduction of 10-15% is also expected because of anthropogenic activities, such as increased water withdrawals. Strong competition for water resources between sectors - such as households, agriculture, industry, energy, tourism - is expected to be exacerbated by the impacts of climate change, and will affect both water quality and quantity, especially during the summer season. Furthermore droughts, and the consequent reduction in flow rates, together with overexploitation of water resources, make watercourses and coastal land reserves more exposed to the action of sea level rise, with consequent saltwater intrusion and increased salinity in the freshwater reserve
Hydrogeological risks	Due to the conformation of the territory and its geographical location in Europe, Italy is an area strongly affected by geological, hydrological, and hydraulic instability phenomena, which represent a significant threat both in terms of expected damages and safety. The increase in localised precipitation phenomena plays an important role in aggravating the risk of geo-hydrological instability throughout all the peninsula. In this context, anthropogenic factors - such as soil consumption and sealing or occupation of river areas - combined with climate change hazards play a significant role in exacerbating risks. The most affected areas in relation to this hazard are (and will be) on the Alps and

[112] https://www.cmcc.it/it/analisi-del-rischio-i-cambiamenti-climatici-in-italia

	on Apennines, both in terms of magnitude and seasonality of disturbances. Moreover, the expected rise in intense rainfall contributes to a further increase in the hydraulic risk for small basins, and amplifies the risk associated with surface landslides in areas with more permeable soils (such as urban areas).
Agriculture sector	The risk posed by climate change to the agricultural sector in Italy is significant for both plant and animal production. Higher atmospheric concentrations of CO_2 can promote photosynthetic activity and water use efficiency of crops, but at the same time can negatively affect the nutritional quality of products, reduce the protein content of cereals and the concentrations of iron and zinc, with significant consequences on nutritional values. The assessment of climate risk for irrigated agriculture due to climate change is strongly linked to the specific crop needs and climatic conditions of each geographical area. Specifically, the Regions that will be most negatively affected are the Southern Regions (e.g., Sicily, Sardinia, and Apulia), while some Central and Northern Regions could be positively affected. Regarding the negative impacts of climate change on the livestock, climate change will have repercussions on health, production, and reproduction. Increasing rising temperatures will subject the livestock to heat stress events (amplified in term of magnitude and frequency), with significant consequences for productivity in this sector.
Forest fires	Italy accounts for about 19% of the total number of fires and approximately 23% of the area affected. In the future, due to the exacerbation of climatic conditions, the fire risk is expected to increase by more than 20% and the fire season is expected to lengthen by between 20 and 40 days in the coming years. This phenomena could induce an increase in burnt areas of between 21% and 43%, depending on the emission scenario considered.
Urban areas	Urbanised areas are considered a climate 'hot spot' because of the complex system that characterises them, but also for the number of citizens that populates them. In Italy, urban centres host 56% of the population. In 2019, there were 29 more days of intense heat than in the period 1961- 1990, and climate projections predict an increase in these phenomena, especially regarding extreme weather phenomena, such as heat waves or floods. In this context, the most fragile segments of the population (children, the elderly, and people with disabilities) are the first victims in the urban context and are most at risk. The expected intensification of extreme weather phenomena, especially heat waves (and urban heat island phenomenon) and intense precipitation over the coming decades, is one of the main amplifiers of climate risks in cities.
Health	Due to temperature increases, there is a significant real risk of a re-emergence of previously endemic agents, such as tick-borne encephalitis, Lyme disease, Mediterranean spotted fever, and West Nile fever. The health sector could be also affected in the short term by the arrival of communicable tropical diseases, such as dengue, chikungunya, Zika, Crimean-Congo fever or Rift Valley fever, and diseases occurring in animals,

	including bluetongue and oily skin disease. In addition, in the international context, Italy has the highest heat-related effects on daily mortality considering overall summer temperatures. However, there is heterogeneity among Italian territories. Overall, Italy is also strongly characterized by population movements: there are about 5 million resident immigrants in Italy, representing about 8.4% of the total resident population. Of this total, there are about 150,000 refugees, most of whom are economic migrants moving from areas affected by drought and desertification.

Since 2018 the National System for Environmental Protection set up a national Working Group on "Impacts, vulnerability and adaptation to climate change" with the objective to define a set of climate change impact indicators. The first report has published in June 2021[113] providing a first picture on climate change impacts at national and regional level. Thirteen sectors have been analized (see **Errore. L'origine riferimento non è stata trovata.**) and thirty-three potential impacts have been identified. A subset of 20 national indicators and 30 regional case studies have been elaborated. These indicators belong to various vulnerable sectors according with the NAS and for each one the report specifies climate factors, frequency of data collection, temporal and spatial coverage, and limitations, as well as overall future trends. The indicators have heterogeneous characteristics in terms of data, consistency and length of the historical series.

Table 2- Sector covered by the study

SECTORS	SIGLA
Water resources	Ri
Soil	St
Terrestrial ecosystems	Et
Marine ecosystem	Em
Alpine and Appennine environment	Aa
Coastal areas	Zc
Health	Sa
Forestry	Fo
Agriculture	Ag
Fishing	Pe
Energy	En
Urban Areas	Iu
Culture heritage	Pc

The table below summarizes the most relevant information about the impact indicators elaborated.

[113] https://www.snpambiente.it/2021/06/30/rapporto-sugli-indicatori-di-impatto-dei-cambiamenti-climatici-edizione-2021/

SECTOR AFFECTED	POTENTIAL IMPACT	SCENARIO	INDICATOR	TREND	
Ri	Hydrological cycle modification		Runoff index (National coverage)		Growing trend but not statistically significant
Ri	Hydrological cycle modification		Annual number of water flow above the threshold (Liguria)		Undefined trend
Ri	Hydrological cycle modification		Duration curve of the flow (Liguria)		Undefined trend
Ri	Change in the availability of renewable water resources		Internal flow (National coverage)		Decreasing trend but not statistically significant
Ri	Variation in the availability of groundwater resources		Groundwater level (National coverage)		Growing trend but not statistically significant
Ri	Variation of territory subjected to unusual wet or dry conditions		Percentage of land subjected to unusual wet or dry conditions (Sardegna)		Undefined trend
St	Variation of soil water erosion		Soil water erosion (National coverage)		Undefined trend
St	Modification of frequency and spatial distribution of landslides		Landslide events (National coverage)		Undefined trend
St	Variation in the erosive capacity of precipitation		R-factor average annual erosivity of precipitation (Veneto)		Growing trend statistically significant
St	Space-time variation of soil water content		Soil humidity (Calabria)		Undefined trend
Et	Worsening of the conservation status of migratory birds		Date variation index of spring migration (National coverage)		Stable trend
Et	Worsening of the physical condition of birds during spring migration		Consistency index of fat accumulations during spring migration (National coverage)		Stable trend
Et	Life cycle modification		Variation of the phenological calendars of plant species (Emilia-Romagna)		Undefined trend
Et	Increased risk of drought in natural environments		Breathable deficit in natural environments (Friuli Venezia Giulia)		Growing trend statistically significant
Em	Alteration of the characteristics and chemical-physical processes		Sea Surface Temperature (National coverage)		Growing trend

SECTOR AFFECTED	POTENTIAL IMPACT	SCENARIO	INDICATOR	TREND	
Em	Alteration of the characteristics and chemical-physical processes (heat exchanges)		Sea Surface Temperature (Calabria)		Undefined trend
Em	Alteration of the characteristics and chemical-physical processes (heat exchanges)		Sea Surface Temperature (Friuli Venezia Giulia)		Undefined trend
Em	Alteration of the characteristics and chemical-physical processes (heat exchanges)		Sea Surface Temperature (Liguria)		Undefined trend
Em	Alteration of the characteristics and chemical-physical processes (evaporation, supply of fresh water)		Sea Surface Salinity (Calabria)		Undefined trend
Em	Alteration of the characteristics and chemical-physical processes (evaporation, supply of fresh water)		Sea Surface Salinity (Friuli Venezia Giulia)		Decreasing trend statistically significant
Em	Alteration of the characteristics and chemical-physical processes (evaporation, supply of fresh water)		Sea Surface Salinity (Liguria)		Undefined trend
Em	Alteration of ecological communities and marine food webs		Estimation of planktonic biomass through induced fluorescence (Chlorophyll a) (Friuli Venezia Giulia)		Undefined trend
Aa	Glacial mass variation		Glacier mass balance (National coverage)		Decreasing trend statistically significant
Aa	Glacial mass variation		Glacier mass balance (Valle d'Aosta, Lombardia)		Decreasing trend statistically significant
Aa	Permafrost degradation		Permafrost thermal state (Valle d'Aosta, Piemonte)		Growing trend statistically significant
Zc	Variation in the frequency of rough sea conditions		Frequency of rough sea conditions (National coverage)		Stable trend
Zc	Variazione del livello medio del mare Average sea level change		Average sea level (National coverage)		Growing trend

SECTOR AFFECTED	POTENTIAL IMPACT	SCENARIO	INDICATOR	TREND	
Zc	Average sea level change		Venice average sea level (Venezia)		Growing trend
Zc	Geomorphological changes in coastal areas		Geomorphological variations of the coast (National coverage)		Growing trend (Timeseries discontinuos)
Zc	Short-term pollution in bathing water		Number of short-term pollution events (National coverage)		Growing trend (Timeseries <10 years)
Zc	Microalgal blooms in marine-coastal waters		Ostreopsis ovata concentration (National coverage)		Growing trend (Timeseries <10 years)
Zc	Loss of biodiversity of the coralligenous habitat		Status of coralligenous habitat (Sicilia)		Undefined trend
Sa	Mosquitos density variation (*Aedes albopictus*)		Average density of *Aedes albopictus* trend (Emilia-Romagna)		Undefined trend
Sa	Mosquitos density variation (*Culex Pipiens*)		*Culex Pipiens* monthly regional average (Emilia-Romagna)		Undefined trend
Sa	Summer mortality due to heat waves		Summer mortality (Piemonte)		Decreasing trend
Fo	Variation in frequency, intensity and potential of forest fires		Forest fires (National coverage)		Undefined trend
Fo			Forest fires (Lombardia)		Undefined trend
Fo			Meteorological index of fire danger (Proxy) - (Piemonte)		Growing trend but not statistically significant
Ag	Increased risk of agricultural drought		Transpiration deficit (Emilia-Romagna)		Growing trend statistically significant
Pe	Target species of fisheries: change in distribution range		Average temperature of commercial catches (National coverage)		Growing trend statistically significant
En	Hydroelectric power generation variation		Gross hydroelectric energy production (National coverage)		Growing trend
En	Change in energy consumption		Gradient of natural gas consumption for heating (National coverage)		Undefined trend
En	Change in energy consumption		Cooling degree days (Proxy) (Piemonte)		Growing trend

SECTOR AFFECTED	POTENTIAL IMPACT	SCENARIO	INDICATOR	TREND	
					
En	Change in energy consumption		Heating degree days (Proxy) (Piemonte)		Decreasing trend
En	Change in energy consumption		Consumption of electricity in July (Lombardia)		Growing trend
En	Change in energy consumption		Natural gas consumption in buildings (Lombardia)		Decreasing trend
Iu	Flooding in urban areas		Number of flooding (National coverage)		Undefined trend
Pc	Degradation of stone materials		Surface recession (National coverage)		Undefined trend

For some indicators a clear and significant trend has been identified:

- Glaciers Mass balance (national coverage)
- Average temperature of commercial catches – Fishing (national coverage);
- Factor R annual average erosivity of precipitation (Veneto region);
- Sea Surface Salinity (Friuli Venezia Giulia region);
- Glaciers Mass balance (Valle d'Aosta, Lombardia regions);
- Thermal state of the permafrost (Valle d'Aosta, Piemonte regions);
- Transpiration deficit (Emilia-Romagna region);
- Transpiration deficit into natural environments (Friuli Venezia Giulia region).

The indicators listed above have a long time series data and it is important to highlight how the phenomena observed through these indicators present a mostly high cause-effect relationship with climate change. The indicators related to the mountain enviroment have the most concern. The impacts observed are the contraction of glaciers's mass balance and the permafrost degradation due to heating (+0.15°C every 10 years and a completly degradation by 2040). The trend of incators related to socio-ecomonic sectors as average temperature of commercial catches, transpiration deficit and also ones with indirect connections (factor R annual average erosivity of precipitation, transpiration deficit into natural environments, sea surface salinity) show that phenomena of species distribution, increase in agricultural drought and water stress of natural vegetation are already in progress.

The indicators showing trends in progress, although not yet statistically significant, already seem to be consistent with the expected future scenario. Only after the continuous observation and monitoring of the phenomena, the statistical and validation of data the current evidence can be confirmed.

6.3 Domestic adaptation policies and strategies

Since 2015 the Ministry of the Environment has been working on the implementation of the National Adaptation Strategy (NAS) through the development of a National Adaptation Plan (NAP).

The NAP is aimed at supporting national, regional and local institutions in the definition of adaptation measures, in relation to the critical issues that most characterize them and promoting a general coherence at national level.

The NAP will provide institutional guidance to national and local authorities, for the integration of adaptation measures within policy processes and spatial planning.

In 2020 the draft NAP was submitted to Strategic Environmental Assessment (SEA). In March 2021 the first phase of the evaluation was completed and the responsible Directorate for the NAP received comments and recommendations from the Competent Authority.

As a result of the reorganization of the current Ministry, the responsibilities for climate change adaptation were assigned to the General Directorate for Sustainable Land Use and Water Resources (DG USSRI).

The Ministry is currently working on revising draft NAP and preparing of environmental report in which the likely significant effects on the environement of implementing the Plan, and reasonable alternatives considering the objectives and the geographical scope of the Plan, are identified, described and evaluated.

For this purpose, in July 2022, a technical working group consisting of representatives from DG USSRI, National System for Environmental Protection and Research (ISPRA) and other participants was established by a director's decree.

In November 2022, the structure and objectives of the proposed Plan were shared with the Italian Regions at a special meeting.

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 is currently taking into consideration the need for a Monitoring, Reporting and Evaluation of adaptation, which will be then defined within the NAP framework.

The activity of the National System for Environmental Protection set up a national Working Group on “Impacts, vulnerability and adaptation to climate change”, described in section 6.2, is 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

In June 2018, the former Ministry of Environment started the activities of the line 5 of the CReIAMO PA project "Capacity biulding for climate change adaptation" (financed on EU funds). The activity is aimed at spreading information at regional and local level and strengthening technical and administrative capacity.

In June 2020, guidelines for Italian Regions and Municipalities were produced. At present, the activity is concerned with supporting regional and local governments in using the contents of the above-mentioned documents for the establishment of their adaptation strategies, plans and measures, in line with national planning.

As a result, the number of administrations that have started capacity building activities has increased over the past three years. The dialogue with scientists and stakeholders is also carried on under the CReIAMO PA Project, through several initiatives such as conferences, workshops and schools.

In October 2022, the former Ministry of Environment, in collaboration with ISPRA, has published the National Adaptation Platform, which intends to foster the exchange of information between the Central Administration, Local Authorities and all stakeholders on the issue of climate change adaptation. At the moment it represents the main information tool in Italy on this topic. The general purpose is to inform, raise awareness and make data and operational tools available to all citizens, to promote and support Local Authorities in decision-making and planning processes on the subject of adaptation to climate change, as well as to provide the information contained in the National Plan for Adaptation to Climate Change. The

Platform, in particular, aims to facilitate access to and sharing of data and information on observed and future climate changes impacts and vulnerabilities of regions, natural systems, socio-economic sectors, institutional levels working on the issue, adaptation strategies and plans at different administrative levels and possible adaptation actions. This is a first version that will be enriched and updated periodically with data and information from different sources.

In June 2021, a funding Programme for urban adaptation was launched. This Programme is aimed at increasing the resilience of cities to the risks of climate change, in particular to heat waves, extreme rainfall and drought phenomena. This is the first initiative to set these objectives at the national level, for now intended for municipalities with a population over 60.000 inhabitants. In particular, the Programme allocates around 80 million euro for the implementation of mainly green and blue actions, but also, to a lesser extent, grey actions. In addition, the Programme includes a series of adaptive capacity building measures. By June 2022, 80 municipalities were eligible for funding.

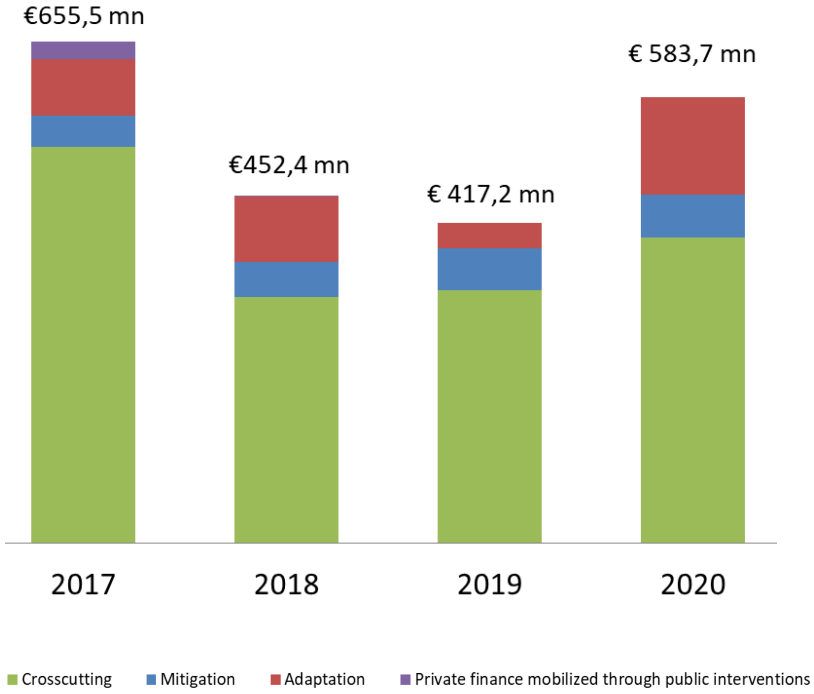
7 FINANCIAL, TECHNOLOGICAL AND CAPACITY-BUILDING SUPPORT[114]

7.1 Provision of financial, technological and capacity-building support to Parties not included in Annex I to the Convention

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 2017-2020 increased substantially compared to the levels of previous years (2013-2016), while improving the quality and transparency of our reporting.

Total climate finance for the period 2017-2020 amounts to more than 2 billion euro (2.108.831.654 euro, corresponding to 2.406.698.114 USD). This represents more than double (a 107% increase) the support provided and mobilized for climate action in non-Annex I countries from the 1.16 billion USD provided in the period 2013-2016.

Figure 7.1 – Italian international climate finance by climate theme and private finance mobilized through public interventions, 2017-2020 (million euro)



Source: Italian Ministry of Environment and Energy Security (MASE)

While in the biennium 2019-2020 Italy reports only public support provided to non-Annex I Parties, with no component related to private finance mobilized through public interventions, for the biennium 2017-2018 the private mobilized component amounts to 23.9 million euro. Thus, total public climate specific support[115] for the period 2017-2020 amounts to 2.08 billion euro (2,084,899,215 euro, corresponding to 2.38 billion USD (2,379,702,547 USD).

During the reporting period 2017-2020, Italy put its best effort to follow up on the commitments made at the UNFCCC 21st Conference of the Parties and in the context of the Convention and the Paris Agreement

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[115] Excluding private finance mobilized through public interventions.

decisions, increasing its financial, technology transfer and capacity building support to non-Annex I countries. In 2015, Italy committed to mobilize 4 billion USD in the period 2015-2020, as contribution towards the collective goal of developed countries to provide 100 billion dollars a year by 2020 and until 2025. Between 2015 and 2020, Italy provided and mobilized 3.17 billion USD (2.8 billion euro) of which only 60 million USD of private finance mobilized. The demonstrated effort towards reaching our goal encourages all the Italian climate finance actors to do more, and more quickly, to contribute to the achievement of the goals of the Paris Agreement by non-Annex I countries.

Italy is aware of the importance of grants to support non-Annex I countries in implementing the objectives of the Convention and the Paris Agreement. Between 2017 and 2020, the average use of grants as financial instrument has been 83.2% (80% in 2017-18 and 86.3% in 2019-20). However, Italy did not commit to the use of specific instruments in extending its climate finance. In fact, the choice of financial instruments should be tailored to the needs at activity and country level, and depends on a range of factors, such as the climate objective (mitigation and adaptation projects present different needs of grant resources), the level of income of the recipient country, the vulnerability of the beneficiary, the main purpose of the project (mainstreaming climate action in development projects vs climate-specific funding), the robustness of the enabling environment, the level of development of financial markets and ease of access to debt resources.

Most of the Italian public climate specific support is classified as Official Development Assistance (ODA), as defined by the Development Assistance Committee of the Organization for Economic Cooperation and Development (OECD-DAC)[116], through financial instruments of grants and concessional loans. Italy also extends climate specific non-export credit Other Official Flows, which however constitutes less than 1% of the total over the period 2017-2020, through financial instruments of loans and equities.

Table 7.1 – Italian international climate finance by type of finance and financial instrument, 2017-2020 (euro)

2017-2020			
ODA	2.059.759.655,05 €	*Grants*	1.719.982.875,31 €
		Loans	339.776.779,74 €
		Equities	0
OOF	25.139.560,00 €	*Grants*	0
		Loans	3.089.560,00 €
		Equities	22.050.000,00 €

Source: Italian Ministry of Environment and Energy Security (MASE)

[116] Official development assistance flows are defined as those flows to countries and territories on the DAC List of ODA Recipients and to multilateral development institutions which are:

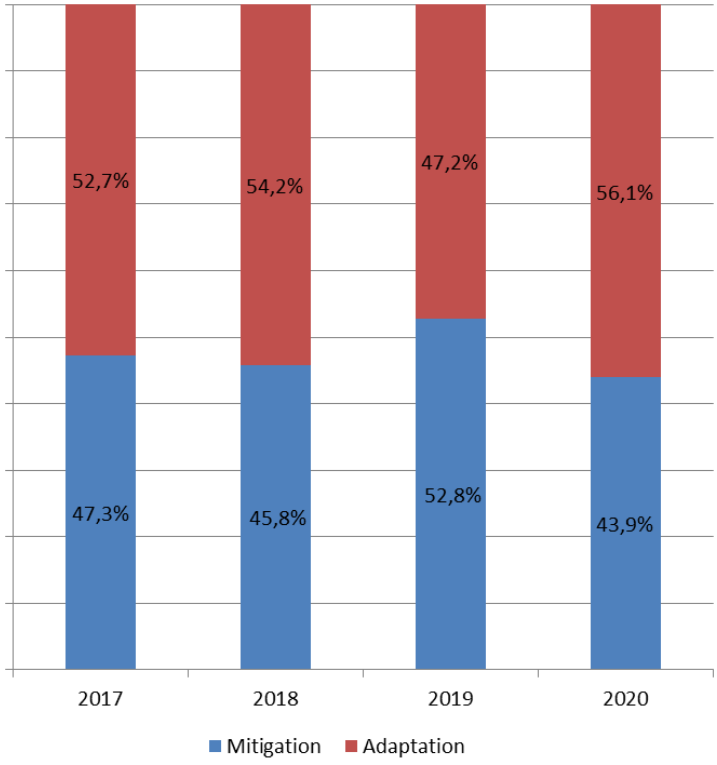
i. provided by official agencies, including state and local governments, or by their executive agencies; and
ii. each transaction of which:
   - is administered with the promotion of the economic development and welfare of developing countries as its main objective; and
   - is concessional in character. In DAC statistics, this implies a grant element of at least:
     - 45 per cent in the case of bilateral loans to the official sector of LDCs and other LICs (calculated at a rate of discount of 9 per cent).
     - 15 per cent in the case of bilateral loans to the official sector of LMICs (calculated at a rate of discount of 7 per cent).
     - 10 per cent in the case of bilateral loans to the official sector of UMICs (calculated at a rate of discount of 6 per cent).
     - 10 per cent in the case of loans to multilateral institutions (calculated at a rate of discount of 5 per cent for global institutions and multilateral development banks, and 6 per cent for other organisations, including sub-regional organisations).

Loans whose terms are not consistent with the IMF Debt Limits Policy and/or the World Bank's Non-Concessional Borrowing Policy are not reportable as ODA. From https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/officialdevelopmentassistancedefinitionandcoverage.htm

7.2 Support provided for mitigation and adaptation activities

In the provision of public financial resources, Italy aims to strike a fair balance between support to mitigation and adaptation activities in non-Annex I countries over time. The adaptation component in 2017-2020 stays stable at 53% of the total public climate specific support with respect to the previous reporting period 2013-2016 (considering cross-cutting activities equally allocated between the two objectives). Italy thus maintains at least 50/50 allocation between mitigation and adaptation support advocated by several non-Annex I countries, and with a peak in favour of adaptation of 56% in 2020. However, Italy did not commit to a fixed share of allocation of climate finance to either mitigation or adaptation, as it would potentially undermine the necessary consideration of needs and priorities of partner countries. Thus, Italy considers to allocate a fair balance of funds between mitigation and adaptation considering the needs and priorities of recipient countries.

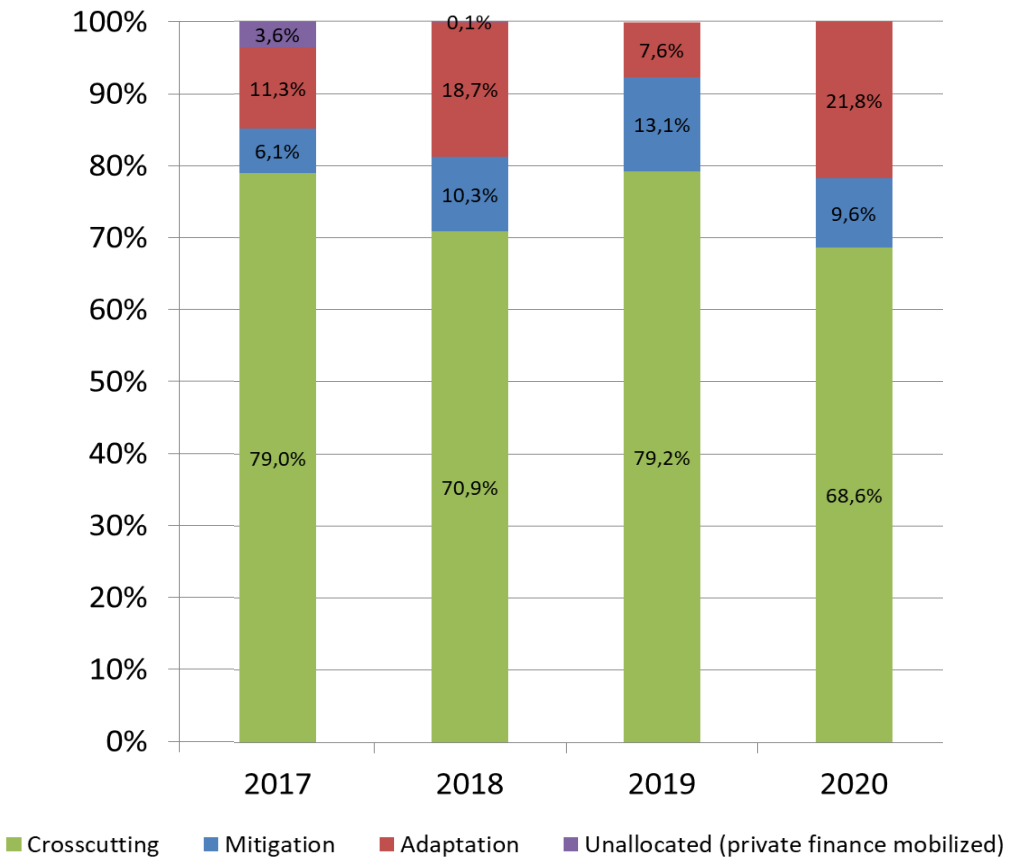
Figure 7.2 – Italian public climate finance by climate theme, 2017-2020 (percentages)



Source: Italian Ministry of Environment and Energy Security (MASE)

Italy classifies a significant share of its support provided to non-Annex I countries as cross-cutting: on average, the 74% of international climate finance is categorized as cross-cutting between 2017 and 2020. Italy considers as cross-cutting every activity addressing both mitigation and adaptation, as well as those activities in which mitigation and adaptation components are mainstreamed into projects in a range of sectors, especially agriculture. Italy considers key to address climate action in synergy with other objectives: this maximizes impact on the ground, especially when it comes to adaptation actions, which necessarily (and increasingly) should be embedded into infrastructure, agriculture and other sectors on the ground. Moreover, most of the multilateral inflow contributions (apart from the specific funds such as the Adaptation Fund) are categorized as cross-cutting.

Figure 7.3 – Italian international climate finance by climate theme, 2017-2020 (percentages)

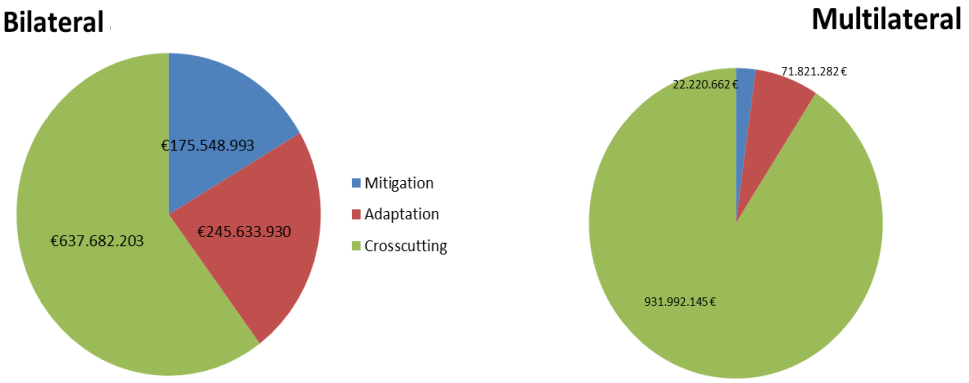


Source: Italian Ministry of Environment and Energy Security (MASE)

Italy provides public climate specific support to non-Annex I countries through both **bilateral** (including multi-bilateral) and **multilateral** channels[117]. The main entities extending support are central administrations, in particular the Ministry of Economy and Finance (MEF), providing exclusively funding through multilateral channels; the Ministry of Foreign Affairs and Development Co-operation (MAECI), providing mainly funding through bilateral channels; the Italian Ministry of Environment and Energy Security (MASE, former Ministry of Environment, Land and Sea), providing support both through bilateral and multi-bilateral channels, as well as multilateral funding to the Green Climate Fund; the Italian Development Cooperation Agency (AICS), and the Italian National Development Bank (Cassa Depositi e Prestiti). However, bilateral flows also include contributions from Local administrations (regions and municipalities), considering all kind of implementing agencies (f.i. Universities, NGOs and religious organizations).

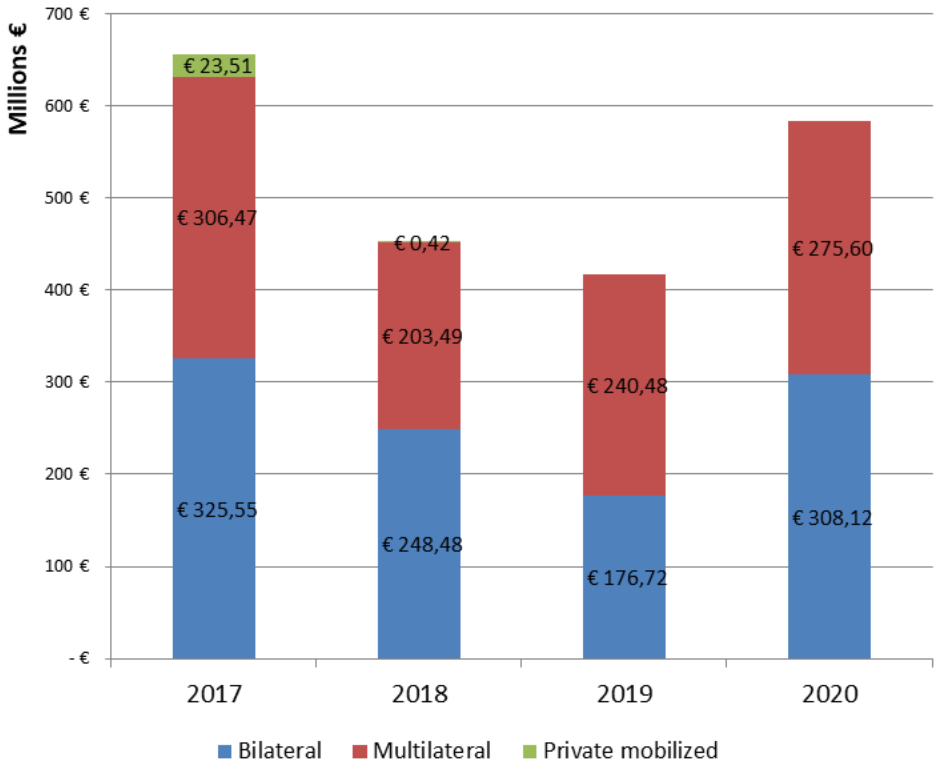
[117] For the relevant definitions and methodologies, see paragraph 7.3.

Figure 7.4 – Italian bilateral and multilateral public climate finance by climate theme, 2017 to 2020 (euro)



Source: Italian Ministry of Environment and Energy Security (MASE)

Figure 7.5 – Italian international climate finance by channel of delivery, 2017-2020 (million euro)



Source: Italian Ministry of Environment and Energy Security (MASE)

Private Finance Mobilized through public interventions

For the years 2015 to 2018, Italy undertook a pilot study to estimate the amounts of private finance mobilized through public interventions for climate related purposes, finalized in the year 2020.

According to the available data, the pilot study estimates public finance at a project/operation level, and does not take into account other forms of public support such as technical assistance for policy development. In the period 2015-2018, Italian public sector leveraged private finance through grants, direct investments in companies and project finance. The data collection and the application of methodologies agreed in the context of the OECD is still at its early stage for Italy, thus is does not cover all finance mobilized through public interventions.

Excluding climate-related export credits and investments from publicly-controlled enterprises, the total estimate of Italian public climate finance that directly mobilize private investments in developing countries between 2015 and 2018 is 31,661,.220 USD. This amount directly mobilized 60,874,543 USD of private climate finance. For the biennium 2017-2018, the amount mobilized reached 26,995,567 USD.

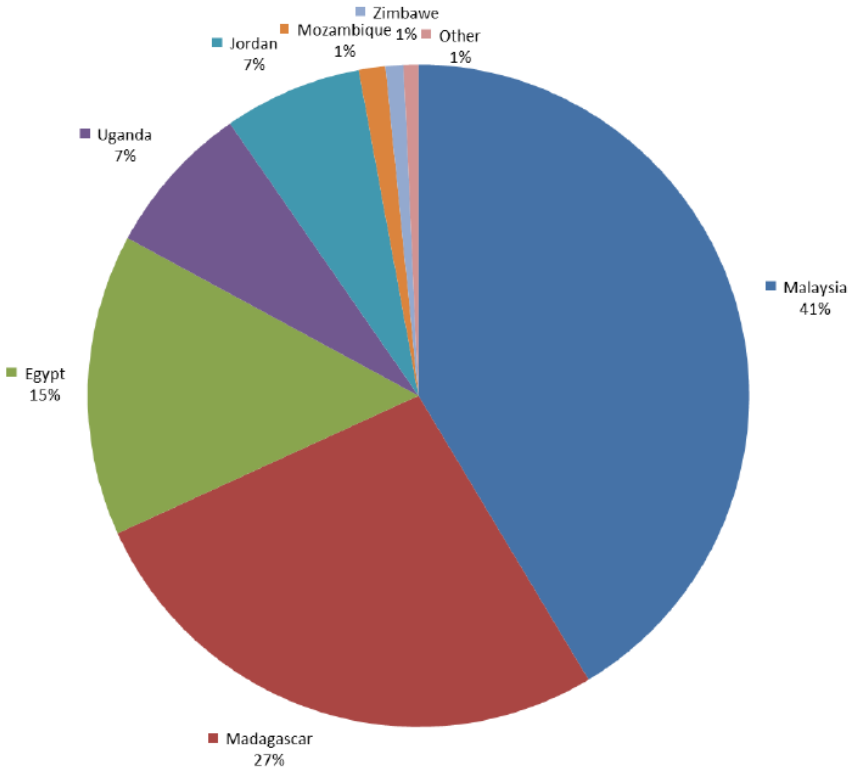
Table 7.2 – Italian private climate finance mobilized through public interventions by financial instrument, 2015-2018 (USD)

Italian private mobilized finance by financial instrument					
Financial instrument	2015	2016	2017	2018	Total (2015-2018)
Project Finance	29.280.000	4.170.000	8.950.000		42.400.000
Direct Investments in companies			16.280.000		16.280.000
Grants		428.976	1.265.720	499.847	2.194.543
Total	29.280.000	4.598.976	26.495.720	499.847	60.874.543

Source: Pilot study on private finance mobilized by Italy for climate change mitigation and adaptation in developing countries, CMCC, 2020

Concerning the **geographical distribution** of funds, the majority of climate private finance according to OECD DAC methodology is mobilized in Africa and Asia. The geographical distribution of other private climate-relevant financial amounts, such as export credits and state-owned enterprises' investments, is significantly different from the official Italian climate finance. While the latter is concentrated in African countries and Malaysia, the other climate investments are more widely distributed and they mainly target African and especially South American countries. The graph below shows the distribution of private climate finance mobilized per country.

Figure 7.6 – Geographical distribution of private climate finance mobilized by Italy, 2015-2018 (percentages)



Source: Pilot study on private finance mobilized by Italy for climate change mitigation and adaptation in developing countries, CMCC, 2020

For the sake of completeness and transparency, the table below provides an overview of other publicly mobilized private climate-relevant amounts currently out of the scope of the official OECD DAC methodology. These financial flows reflect the specific Italian cases of publicly-controlled enterprises, and export credits issued by the public Export Credit Agency or the National Development Bank.

Table 7.3 – Other sources of Italian private climate finance, 2015-2018 (USD)

Other climate finance sources	
SACE's export credits	2.672.776.934
Of which	
Buyer's credit	*2.556.238.379*
Supplier's credit	*116.538.555*
SACE's export credit reported under CDP	350.000.000
Enel Climate-related investments	8.919.150.000
Of which:	
Involving SACE	*339.272.000*
Involving foreign public institutions	*306.809.000*
Enel's direct investment (without involvement of public institutions)	*8.273.069.000*
Total (excluding ENEL's investments involving public institutions)	11.941.926.934

Source: Pilot study on private finance mobilized by Italy for climate change mitigation and adaptation in developing countries, CMCC, 2020

The process of data collection implied a careful evaluation of the climate-relevance for the activities of each entity involved. Their information systems mainly did not consider the same categories as the OECD Rio Markers, employed by central and local administrations; therefore, dedicated interviews with entities were organized to evaluate the data available and find common criteria/categories for the climate-relevance assessment. In some cases, it was necessary to adopt a conservative approach and limiting the boundaries of data collection (for instance, restricting the analysis to the operations in the renewable energy sector). A second step was a further in-depth assessment of climate-relevance only on the retained projects. It was carried out in collaboration with each actor, analyzing all the relevant operations case by case.

The pilot study represented a first attempt to set a permanent data collection system, with the aim of defining a consistent path for future adjustments. From 2019, the OECD DAC CRS data collection system allows for the systematic reporting of amounts of private finance mobilized, not only for climate purposes but for all development finance. Thus, reporting countries under the OECD have now the tool to systematically collect this information. For this reason, the MASE did not collect data from 2019 onwards through the pilot study dedicated to private finance mobilized through public interventions for climate action. However, for Italy the systematic collection of these amounts remains challenging for a range of reasons, one of them being the difficulties in creating institutional capacities in centralized and decentralized entities in the application of complex methodologies as those related to estimation of private finance mobilized. Italy will put additional effort in improving its data collection and institutional capacity in view of providing a more complete reporting under the future Biennial Transparency Reports.

7.3 National approach to the tracking of the provision of financial, technological and capacity-building support to non-Annex I Parties

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 OECD DAC Rio Markers and the Aid to Environment marker for bilateral and multi-bilateral figures, and imputes a climate relevant share to multilateral contributions (inflows);
- 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 for multilateral flows as mutually exclusive: the figures reported as core-general are 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 OECD DAC or the DFIs themselves;
- most part of the Italian public development cooperation is in form of public grants through official agencies. Thus, most 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 Italian Ministry of Environment and Energy Security (MASE) and the Ministry of Foreign Affairs and Development Co-operation (MAECI) and applied to climate finance reporting since 2017 flows - which increases comparability over time.

Italy refers to the OECD DAC list of ODA recipients to define the **beneficiaries** of climate finance. Italy systematically excludes from its total climate finance the support provided to Annex I countries, namely Belarus, Ukraine and Turkey.

Public financial support provided through bilateral channels includes both purely bilateral and multi-bilateral flows. The relevant definitions of **bilateral and multi-bilateral** flows is the one agreed under the OECD DAC Creditor Reporting System[118].

For bilateral and multi-bilateral contributions, Rio Markers assess the climate specific share of the projects.

[118] See the updated Converged Statistical Reporting Directives and relevant addenda at https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/data-collection-and-resources-for-data-reporters.htm

In particular, where the Rio Marker value 1 ("significant") is attached to the project/activity, the 40% of the total value of the project is reported as climate specific; where the Rio Marker value 2 ("principal") marker is attached to the project/activity, the 100% of the total value of the project is reported as climate specific. 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. Moreover, where the Disaster Risk Reduction marker is present, and the project description and the sector are relevant, projects are analyzed individually and evaluated for their climate component and, when relevant, either a 100% or a 40% of the value of the project is reported. In particular, relevant projects are considered when addressing agriculture, forestry and fishery, water, energy and general environmental protection sectors, also referring to the OECD DAC Rio Markers for Climate Handbook.

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 purely **multilateral flows**, the nature and the purpose of the fund is considered, even though they mostly fall into the cross-cutting category. For those multilateral flows whose figures fall into the core-general column only, and the project description does not report a clear mitigation or adaptation purpose, or the nature of the fund is not clearly relevant for both (cross-cutting), the category is left blank.

For multilateral support, the climate specific column reports the total amount of the inflow contribution to the multilateral institution/DFI multiplied by the imputed multilateral share. The shares applied are provided and updated by the OECD for all the institutions but UNDP and the World Food Programme (WFP), which are taken from institutional reports of year 2017 and not updated for the entire period, as data were not available. The **core-general** column reports:

- total contribution towards a multilateral institution/fund/DFI in case it is not possible to identify the climate-specific component of the contribution (i.e. missing imputed multilateral share, or organization with a climate-relevant portfolio which does not provide an indication on the climate relevance of its outflows); or

- non-climate relevant part of the contribution towards the organization in case the climate specific component is reported.

The core-general figures are not included in the total climate finance.

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).

Italy reports as climate finance the type of flows classified as Official Development Assistance (**ODA**) and Other Official Flows (**OOF**) to non-Annex I countries. The financial instruments included in the reporting are grants, (concessional) loans and equities. Relevant definitions are those of the OECD DAC Creditor Reporting System.

As for the **sectoral** classification, for bilateral support Italy refers to the five-digit purpose codes introduced by the OECD Development Assistance Committee for reporting to the Creditor Reporting System (DAC CRS)[119]. The column "Sector" has been populated according to the following categorization, on the basis of the sub-sector codes reported in the "sub-sector" column in the OECD DAC CRS:

- 23xxx > Energy

- 21xxx > Transport

- 32xxx >Industry

- 311xx > Agriculture

[119] Further information on these codes is available under http://www.oecd.org/development/financing-sustainable-development/development-finance-standards/purposecodessectorclassification.htm

- 312xx > Forestry

- 14xxx > Water and sanitation

- 43xxx > Cross-cutting (Multisector)

- Other > all sectors as mentioned in the brackets. The five-digit sector codes as under the OECD DAC CRS are used.

- 99xxx > Not applicable (non-sector allocable)

In case sub-sector codes are reported as multiple in the OECD DAC CRS, the sector categorization has been assigned according to the sector which is first reported, while the amount reported is weighted by the percentage of the climate relevant sector.

Projects and activities involving **technology transfer** and **capacity building** components, as well as the identification of support focused on transferring technologies relevant to climate action and on building capacities in non-Annex I beneficiary Parties, are tracked on a case-by-case basis. Projects and activities are identified as relevant to both aspects by dedicated experts in the MASE, who analyze the database, the descriptions of the projects and investigate further relevant information to ensure the relevance of the technology transfer and capacity building components, before reporting the activities in the respective tables.

Italy reported on **private finance mobilized through public interventions** from the year 2015 to the year 2018, through a pilot study for tracking mobilized private finance through public interventions. The study applied methodologies have been developed by the Research Collaborative on Tracking Private Climate Finance[120] and agreed by the Development Assistance Committee of the Organization for Economic Co-operation and Development (OECD-DAC)[121]. The organization worked to harmonize methodologies for reporting on amounts mobilised from the private sector through official development finance interventions, defining them instrument by instrument. In the Italian context, those methodologies are applied in accordance with the principles of transparency, accuracy and reliability and adopting a conservative approach in cases of uncertainty. In order to avoid double counting, the attribution of private finance mobilized are considered pro-rata especially when more than one public donor is involved in the financing of a project.

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 2017 - 2020 came from:

- the Italian Ministry of Environment and Energy Security (MASE) funds according to law June 1, 2002, n°120;
- the Italian Ministry for Foreign Affairs and Development Co-operation (MAECI) funds for development cooperation;
- the Italian Ministry of Economy of Finance (MEF) 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) and the Adaptation Fund (AF).

[120] OECD's Research Collaborative on Tracking Private Climate Finance. The Research Collaborative is a network of governments, research institutions and international financial institutions aiming to coordinate research priorities in the field of private climate finance.

[121] For detailed information on methodologies, see OECD DAC CRS Directives, Annex 6 https://one.oecd.org/document/DCD/DAC/STAT(2018)9/ADD1/FINAL/en/pdf

The Italian Climate Fund

Most significantly, in 2021 (through Law No. 234/2021) the Italian Climate Fund has been established with the purpose to finance interventions in favour of mitigation and adaptation action in countries that are recipients of official development assistance identified by the Development Assistance Committee of the Organization for Economic Cooperation and Development (OECD-DAC). The Fund's interventions are carried out, in accordance with the aims and guiding principles of Law No. 125 of August 11, 2014, and the guidelines of Italy's foreign policy. As announced by the Italian government in 2021 at the G20 Summit and COP26, the Fund is endowed with 840 million euros per year for each of the years 2022 to 2026, and aims at mobilizing 1.4 billion per year for 5 years in climate finance to developing countries. Therefore, the Italian Climate Fund will be a significant national public instrument for contributing to the achievement of Italy's commitments on climate finance in favour of developing countries

7.4 Italian cooperation for mitigation and adaptation action in non-Annex I countries

Since 2015, Italian Development Cooperation has undergone an important legislative reform, leading to a new institutional framework designed to make it more effective and consistent. Under the new system, the Ministry of Foreign Affairs and International Cooperation gives guidance for the definition of cooperation policies, while the Italian Development Cooperation Agency, established following the reform, is in charge of implementing policies. In addition, a permanent inter-ministerial "table" for coordinating support in the field of climate change (priorities, actions, countries etc.) has been set up. Finally, the law also confirmed and expands the role of the Italian National Development Bank "Cassa Depositi e Prestiti Spa" (CDP), with new innovative Public Private Partnership mechanisms.

In this context, the Italian development cooperation aims at effectively mainstreaming environmental and climate considerations into its activities. The commitment to tackle climate change and related support to developing countries is strongly expressed in Decree nr.30 (DLGS n.30 13/03/2013), which defines the criteria for the allocation of the proceeds from auctioning of greenhouse gas emission allowances. In particular, it is 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 have been allocated by the Italian Ministry of Environment and Energy Security (MASE) starting from 2015, representing additional public climate financial resources to developing country Parties.

The role of the Ministry of Foreign Affairs and Development Co-operation (MAECI)

An integrated approach to environment and development has been adopted in development cooperation run by the Ministry of Foreign Affairs and International Cooperation (MAECI), mainstreaming climate consideration into the traditional development cooperation 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 pursuing the objectives of the 2030 Agenda for Sustainable Development.

Target mainstreaming sectors are mainly: agriculture, food security, smart cities, biodiversity conservation, access to water, renewable 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, circular economy and waste. Geographical distribution reflects not only mitigation and adaptation needs, but also the need to address destabilization patterns in areas where environmental fragility overlaps socio-economic and/or governance weakness.

The role of the Italian Ministry of Environment and Energy Security (MASE) in environmental cooperation

At the same time, in the wake of Italian Law n. 125 of 11 August 2014 on international development cooperation, the former Italian Ministry for the Environment, Land and Sea (now Italian Ministry of Environment and Energy Security, MASE)) gradually shifted its method of operation towards a more systemic approach. Its priorities were directly connected to strengthening the financial support commitments in line with the objectives of the Paris Agreement. It also established a closer collaboration and coordination with the Italian Ministry of Foreign Affairs and International Cooperation (MAECI) and the local diplomatic representations. The overall aim was to promote a more structured and efficient system of planning, management, and control, enhancing synergies between the interventions carried out by different Italian institutions. This new model was meant to replace the former grant-logic with a collaboration-between-equals approach, taking into account the strategic implications on the Italian national system, possibilities to activate economies of scale, and the careful evaluation on the concrete, efficient and effective use of public contributions, also in terms of environmental impact.

In particular, MASE's cooperation strategies defined jointly with MAECI, indicated among the priorities the support to Small Islands Developing States (SIDS) to implement climate adaptation strategies and to African countries in the forestry and energy sectors. The main scope of MASE's cooperation continued thus to be supporting mitigation and adaptation initiatives instrumental for the implementation of countries' Nationally Determined Contributions (NDCs) and National Climate Change Adaptation Strategies (NAPs). The promotion of renewable energy and energy efficiency, as in NC7, remained priority areas of action. Facilitating access to climate finance, providing capacity building, and promoting technology transfer were among the preferred types of activities.

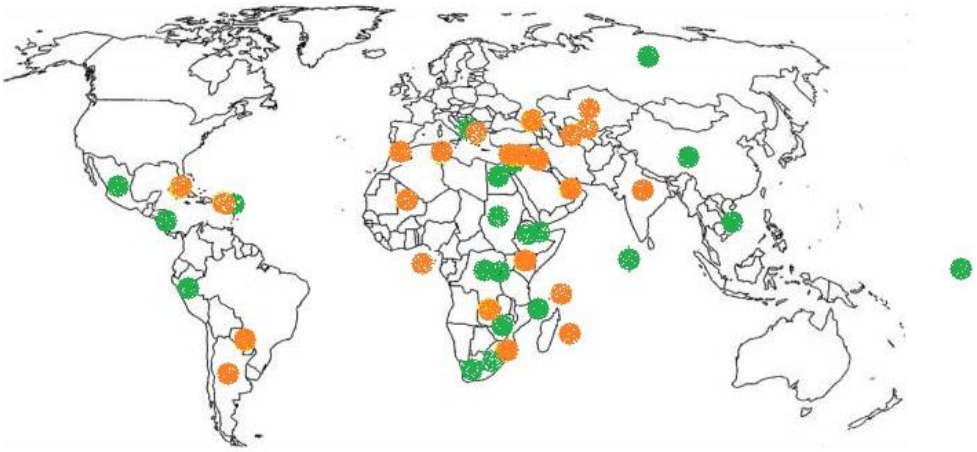
At the same time, expanded its areas of action to sustainable development, which took shape in the Action of Address and Planning for International Environmental Cooperation 2020-2022, adopted on 7th August 2020. Starting from 2020, the areas of action of the new Memoranda of Understandings (MoUs) were expanded to sustainable development, aiming at the promotion of the objectives of the UN Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (UNCBD) and the Convention to Combat Desertification (UNCCD), as well as the 2030 Agenda for Sustainable Development. In particular, seven Sustainable Development Goals (SDGs), in line with MASE's mandate, have been identified as priority in cooperation initiatives:

- improve water resource management and protect and restore water-related ecosystems (SDG 6),
- promote access to sustainable, renewable and efficient energy (SDG 7),
- encourage sustainable consumption and production patterns (SDG 12),
- strengthen and coordinate the efforts to combat global climate change and address its adverse effects (SDG 13),
- promote sustainably use the oceans, seas and marine resources (SDG 14),
- protect, restore and enhance sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, land degradation and biodiversity loss (SDG 15),
- enhance international support for implementing effective and targeted capacity building in developing countries to support national plans to implement all sustainable development goals (SDG 17).

This process translated in terms of multilateral cooperation, in strengthening the support of Italy primarily to energy programs, as energy access and access to finance.

In terms of bilateral cooperation, the geographic range of MASE's cooperation was doubled between 2017 and 2019. As many as 23 new bilateral Memoranda of Understanding (MoUs) were signed with developing countries: Arab Emirates, Argentina, Cuba, Dominican Republic, Eswatini, Georgia, India, Jordan, Kazakhstan, Kenya, Kurdistan, Lebanon, Mali, Mauritius, Paraguay, Sao Tome and Principe, Serbia, Seychelles, Tunisia, Turkmenistan, Uzbekistan, Vietnam, and Zambia. In total, considering also agreements with regional groups such as Pacific SIDS and Caribbean Community (CARICOM) countries, the number of MoUs in force reached 52.

Figure 7.7 – Bilateral cooperation of the Italian Ministry of Environment and Energy Security (MASE), 2017-2020



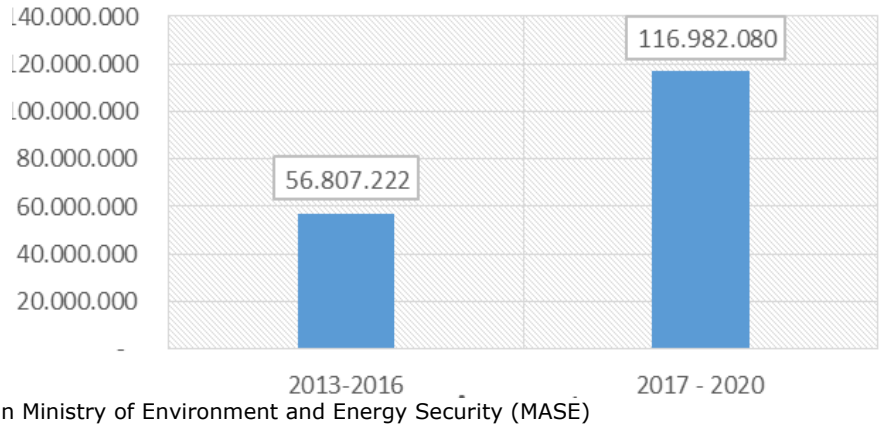
- Countries with agreements signed before 2017: Albania, Botswana, CARICOM countries, China, Costa Rica, Democratic Republic of the Congo, Djibouti, Egypt, Ethiopia, Lesotho, Maldives, Mexico, Montenegro, Morocco, Peru, PSIDS, Russian Federation, Rwanda, South Africa, Sudan, Palestine, PSIDS, Union of the Comoros.
- Countries with new agreements signed between 2017 and 2020: Arab Emirates, Argentina, Cuba, Dominican Republic, Eswatini, Georgia, India, Jordan, Kazakhstan, Kenya, Kurdistan, Lebanon, Mali, Mauritius, Paraguay, Sao Tome and Principe, Serbia, Seychelles, Tunisia, Turkmenistan, Uzbekistan, Vietnam, and Zambia.

Source: Italian Ministry of Environment and Energy Security (MASE)

In February 2020, following to the spread of the Covid-19 pandemic, MASE's cooperation activities have come to a temporary halt. Specific initiatives such as capacity building and training have been postponed and technical missions have been cancelled due to lockdowns both in Italy and in the partner countries. Readjustments of Work Plans and shift to virtual modality and remote working have subsequently allowed a partial resumption of some activities, however the consequences of the pandemic have had a high impact on the overall cooperation.

As showed in Figure 7, in the reporting period the financial resources committed to bilateral cooperation almost doubled. From 2017 to 2020 Italy committed € 116,982,080 to bilateral cooperation (+ 105% compared to the financial resources committed from 2013 to 2016).

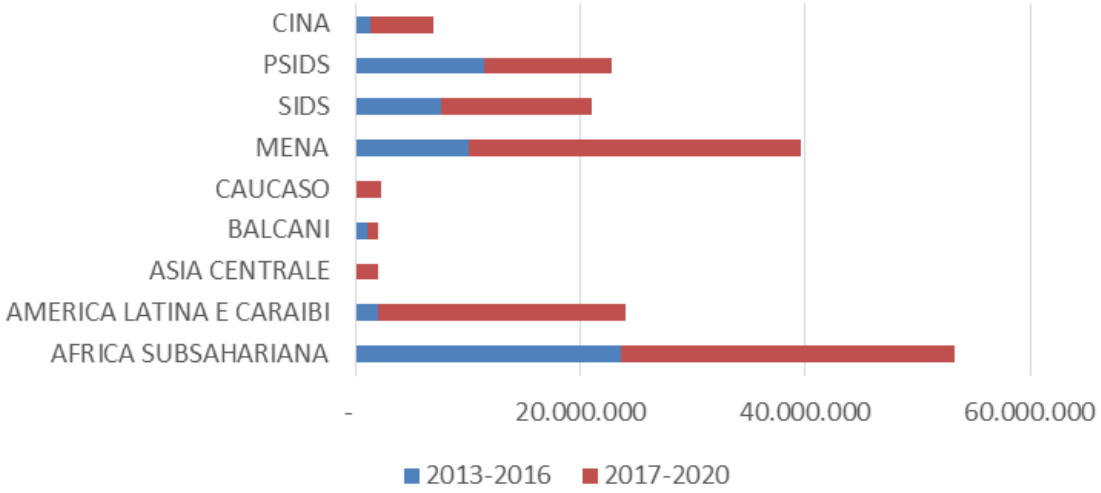
Figure 7.8 – Public climate finance committed by the Italian Ministry of Environment and Energy Security (MASE), 2013-2016 vs 2017-2020 (euro)



Source: Italian Ministry of Environment and Energy Security (MASE)

As highlighted in Figure 8, the funds provided by the environmental cooperation of MASE were focused mainly on three geographical areas: Sub-Saharan Countries, North Africa/Middle East area (MENA) and Small Island Development States (SIDS/PSIDS).

Figure 7.9 – Geographic distribution of climate finance committed by the Italian Ministry of Environment and Energy Security (MASE), 2013-2016 vs 2017-2020 (euro)



Source: Italian Ministry of Environment and Energy Security (MASE)

7.5 Delivery mechanisms, allocation channels and programmes

Multilateral Cooperation on climate change

Between 2017 and 2020, the Italian multilateral environmental activities were carried out through several organizations or programmes, such as: the World Bank Group (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 was expected to be met by International Financial Institutions (IFIs) and other multilateral initiatives. At COP21 in Paris, six 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 their support for climate change mitigation and adaptation by providing policy, advisory, financial, and technical support in favour of countries politically committed to a transition towards a lower carbon and more climate resilient future.

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. It is also a donor and provides concessional and grant resources to multilateral development funds (African Development Fund, Asian Development Fund, International Development Association, International Fund for Agricultural Development, Special Development Fund) through replenishment cycles. In this capacity, the MEF oversees progress towards those targets in the governing bodies of the institutions. Italy's climate finance figure includes multilateral flows, based on inflows to multilateral institutions, calculated as a percentage of the Italian annual contribution to multilateral development banks and funds weighted for the share of climate-related outflows and targets. In 2020, approximately 35 per cent of the MEF contribution to these institutions may be imputed to climate finance.

Furthermore, with the aim of pooling financial resources to support environmental cooperation projects and initiatives, MASE and **Cassa Depositi e Prestiti**, the Italian development bank, established in 2018 a common platform, called the "Climate & Sustainable Development Italian Platform". The platform provides numerous tools for financial support, aimed preferably at micro, small and medium-sized enterprises: from loans to guarantees that cover the risk of the project, to capital investments and non-repayable investments. It also offers the possibility of attracting additional financing in blending and through other local, national, European, international or multilateral financial institutions.

Regarding its participation to the **World Bank Group,** MASE has been involved in various trust funds with the aim of promoting sustainable development in developing countries, increasing renewable energy and strengthening global awareness on environmental issues and climate change.

Between 2017 and 2020, MASE continued with the International Finance Corporation its longstanding support to the Energy Access Program. In 2017, through the Program it promoted the use of solar energy for both domestic and small commercial applications (agricultural solar irrigation, as well as innovative uses of emerging storage technology). In 2018, in view of supporting Sub-Saharan Africa in the effort to achieve universal energy access, it contributed to programs for the scaling-up of off-grid energy solutions through Public-Private Partnerships.

Later, in 2019 MASE approved and financed the following new programs:

- *Global energy access through solar market development in off-grid and bad grid sectors,* to promote the sustainable growth of the off-grid solar market through the development of the off-grid lighting market in rural, urban and peri-urban areas that do not have access to electricity.
- *Off-grid energy PPP program in Sub-Saharan Africa*, to support public-private partnerships in sub-Saharan Africa in order to create favourable environments for private investment in renewable energy and to foster private sector participation in the design and supply of off-grid and mini-grid renewable energy.
- *Renewable Energy Market development in Africa*, to promote the renewable energy market and support companies and governments to facilitate investments in clean technologies.

In addition, at the end of 2017, the Italian Ministry of Environment and Energy Security (MASE)launched with the World Bank the AGREED program (Africa's Green and Climate Resilient Development), with the aim of supporting African countries in their commitment to green growth and adaptation to climate change.

The governments of the beneficiary countries are supported in identifying possible financing and in the preparation of projects and programs through technical assistance and capacity building activities to allow the achievement of their own climate change mitigation and adaptation objectives (Nationally Determined Contributions).

The agreement was amended in 2019 to expand the scope of application from Africa to the whole world and to add a component on the promotion of renewable energy in Africa. Through the energy component, the Ministry promoted renewable energy, energy efficiency and the participation of the private sector.

The MASE 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 (C4C) network was launched in 2013 and a global platform was created to promote climate change awareness raising activities. Connect4Climate (C4C) 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 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 high profile and mass public outreach events 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.

The **Green Climate Fund (GCF)** is the 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 2020 the Fund's portfolio consisted of 159 public and private sector funding proposals, which request a total GCF funding of USD 7.3 billion to support projects and programmes totaling USD 23.4 billion, when taking co-financing into account.

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 considering the most vulnerable developing countries, including LDCs, SIDS and African States.

Italy is a strong supporter of GCF, as the key multilateral vehicle for helping developing countries adapt to climate change and follow low-carbon development pathways. In 2014, at the GCF donor conference, Italy pledged to contribute to the first capitalization of the Fund with 250 million euro, which have been disbursed by the MASE through the period 2015-2020. Additionally, at the High-Level Pledging Conference of the Green Climate Fund's First Replenishment (GCF-1) convened on 24 and 25 October 2019 in Paris, Italy pledged further 300 million euro to contribute to the GCF resource mobilization for the 2020-2023 period, which are disbursed by MASE in line with the provision of the 2019 Budget Law n. 196/2019 (art. 1, para 96).

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. The MEF contributed to the Sixth and Seventh Replenishment of the GEF with the same amount of 92 million euros for each replenishment, representing a share of around 3.3% of total pledges. GEF-6 covers the period July 2014 – June 2018, GEF-7 covers the period July 2018– June 2022.

Since 2015, Italy is a contributor to the **Adaptation Fund (AF)** through MASE. 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 51 million € (61.2 USD million) to the AF. These contributions helped the Fund to assist vulnerable communities' efforts in developing countries to adapt to climate change and surpassing its fundraising targets. Furthermore, MASE 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.

In the reporting period, MASE continued supporting the **FAO International Alliance on Climate-Smart Agriculture (IACSA Project)** that contributes to SDG 15.3 by strengthening the resilience of local communities to climate change and desertification through mechanisms that incentivise investment in the rehabilitation of degraded land in some regions of the Sahel. The contribution aims to support the dialogue on "market mechanisms" and Article 6 development activities under the UNFCCC. Also, it contributes explicitly to the GACSA (Global Alliance on Climate Smart Agriculture) and its enlargement, supporting the Knowledge Action Group and the GACSA Facilitation Unit (Secretariat).

Between 2017 and 2019, the project developed a series of knowledge products at the global level and in the country pilot projects. Furthermore, it organized events, teleconferences and webinars and produced videos and training courses, including seven e-learning courses, in collaboration with FAO's e-learning academy. For the generation of the knowledge products, IACSA included many partners from within and outside FAO. Through successfully supporting the creation and operations of GACSA and knowledge management on CSA, the IACSA project has been of crucial importance for international coordination and collaboration on CSA.

The **EU–Central Asia Platform on Environment and Water Cooperation (WGECC),** established in 2009, with Italy as the lead country, is the reference framework for the cooperation between EU and

Central Asian countries in the field of environment, water, and climate change.

The Platform is a framework for implementing the EU–CA Cooperation on water and environment, based on the EU Strategy for Central Asia agreed with the CA countries. The priorities for the Platform were first agreed upon at the third EU–Central Asia High-Level Conference in Rome in 2009 and subsequently confirmed at the High-Level Conferences in Bishkek (2013), Milan (2015), and Tashkent (2019).

In 2017, the annual meeting of the EU-Central Asia Working Group on Environment and Climate Change took place in Astana (Kazakhstan), at the premises of the Italian Pavilion at the Expo. During the meeting, the parties initiated a discussion on key directions and joint actions for the further strengthening of CA regional organisations active in water, environment and climate change.

The Platform has been implemented through the Working Group on Environment and Climate Change (WGECC), chaired by the Italian Ministry of Ecological Transition, since its establishment in 2009.

The objective of WGECC is to enable and facilitate the policy dialogue between the EU and CA countries and within the CA region to enhance cooperation, as well as to support progress on environmental and climate change issues. The WGECC meetings define common priorities for exchange and sharing experiences.

In May 2019, the European Commission and the High Representative of the Union for Foreign Affairs and Security Policy issued the Joint Communication on a new EU Strategy on Central Asia entitled "The EU and Central Asia: New Opportunities for a stronger partnership". Adopted by the Council of the European Union on 17 June 2019, the Strategy defines three interconnected priorities on Resilience, Prosperity and Working together and has specific objectives on "Enhancing Environmental, Climate and Water Resilience".

Italy is a party and a donor of the **Initiative Climate Action Transparency (ICAT)**, working at the country, regional, and global levels on both immediate and long-term needs of developing countries, highlighting the direct and indirect impact of climate action on their development trajectories and in particular providing capacity building in view of the implementation of the enhanced transparency framework under the Paris Agreement.

In December 2020, the Donor Steering Committee (DSC) of ICAT approved an extension of ICAT until 2026 and a revised strategy (ICAT 2.0). Donors committed additional funding to the Initiative, including a contribution by Italy of 5 million Euro for the period 2021-2026.

In 2020-2022, despite the challenges posed by the COVID-19 pandemic, the implementation of the country' work plan has continued in most of the countries, and most of the counterparts showed commitment to achieving the project outcomes. Work plans were finalized, and work was initiated for the first phase in nine countries: Antigua & Barbuda, Botswana, Chad, Chile, Cuba, Fiji, Liberia, Nigeria and Zimbabwe. In the countries where the work plans and budgets were already completed, implementation progressed. Introductory and scoping discussions with Eswatini on a work plan advanced.

In two countries, the Dominican Republic and Ghana, work plans and budgets were developed and agreed upon for the second phase of deepened engagement and work initiated. Another work plan for a second phase was developed for India.

The adaptation work covers the inclusion and expansion of support to adaptation-focused transparency arrangements under the Paris Agreement. Work under the second phase was a continuation of the activities and the results achieved in the initial phase of adaptation, which aimed at scoping the relevant sectors, focus areas, and cross-cutting issues based on the specific needs of Bangladesh, Dominican Republic, India, Kenya and South Africa. ICAT collaborated with five implementing partners with recognized expertise in climate action transparency: Greenhouse Gas Management Institute (GHGMI), the Italian Environmental Protection and Research Institute (ISPRA), New Climate Institute (NCI), World Resources Institute (WRI) and the UNEP-DTU Partnership (UDP).

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.

Italy supports the functioning and activities of the **Global Bioenergy Partnership (GBEP)** since 2006 through a Memorandum of Understanding with the FAO. The Partnership focuses its activities on three strategic areas: Sustainable Development, Climate Change, and Food and Energy Security.

In 2020, the Implementation Guide for the Global Bioenergy Partnership Sustainability Indicators for Bioenergy was developed to complement and enhance the first edition of The Global Bioenergy Partnership Sustainability Indicators for Bioenergy, published in 2011. It includes guidance that is based on the implementation of the GBEP Sustainability Indicators in fourteen countries, spanning four continents. Based on the lessons learnt from this implementation of the GBEP Sustainability Indicators (GSI) at the national and local levels, guidance has been provided on methodological and practical issues that were not addressed in the original report. This includes both cross-cutting issues that concern the implementation of the set of GSIs (Section 1) as well as methodological guidance for each of the 24 GSIs (Section 2). This Guide is to be used by practitioners, in conjunction with the first edition of The Global Bioenergy Partnership Sustainability Indicators for Bioenergy, to ensure effective and successful implementation of the GSIs in their country.

In April 2019, MASE agreed to provide a contribution to **UNCCD** for the realization of the Project "*Creating lands of opportunity: Transforming livelihoods through landscape restoration in the Sahel*". The initiative aims at strengthening the resilience of communities in Burkina Faso, Ghana and Niger to climate change and desertification through the rehabilitation of degraded lands, while creating income-generating activities. Among the expected results, there is the restoration of estimated 20.000 hectares of degraded lands and 300.000 beneficiaries from the social impacts of new sustainable sources of income.

On 1 April 2019, MASE signed an Agreement for a Trust Fund with the **UN Organization for Industrial Development (UNIDO)**, aimed at realizing the project "*Fostering international partnerships between companies and/or institutions operating in the energy and environment sectors*". The project aims at supporting the commercialization and scale-up of sustainable energy and environmental technologies and projects in Small and Medium-sized Enterprises (SMEs) in 7 partner countries in Africa, Asia and Latin America, through capacity-building and facilitation of access to finance. It operates through two main interrelated approaches. On the one side, UNIDO provides technical assistance to SMEs to identify and develop high-impact innovations and investment projects in SMEs in the sustainable energy and environment sector, on the other side, it facilitates investment, commercialization and trade opportunities through international partnerships and collaboration.

Regional cooperation

- African Development Bank (AFDB)

The outcomes of the 21st 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 worked 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.

The Italian Ministry of Ecological Transition supports the SEFA with a total contribution of 7.4 million euro. The Fund provides catalytic finance to unlock private sector investments in renewable energy and energy efficiency. SEFA offers technical assistance and concessional finance instruments to remove market barriers, build a more robust pipeline of projects and improve the risk-return profile of individual investments. The Fund's overarching goal is to contribute to universal access to affordable, reliable, sustainable, and modern energy services for all in Africa. SEFA was transformed at the end of 2019 into a larger and more catalytic platform operating across three strategic priorities - green mini-grids, green baseload and energy efficiency – to accelerate the clean energy transition in Africa. The "new" SEFA has an expanded toolbox from technical assistance grants to concessional project finance, designed to support the African Development Bank in pushing new boundaries in the renewable energy space.

The Italian Ministry for the Ecological Transition made support the Africa Climate Change Fund (ACCF) with

a total contribution of 4.7 million Euro.

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.

The Italian commitment has triggered the conversion of the ACCF to a multi-donor trust fund and allowed to launch the second call for proposals to strengthen access to climate finance and pilot a variety of innovative adaptation approaches in line with African countries' nationally determined contributions (NDCs) and national adaptation plans (NAPs).

- Inter-American Development Bank

In 2017 MASE signed an Agreement to join the Sustainable Energy Facility for the Easter Caribbean Expanded (SEF-Expanded) project, managed by the Caribbean Development Bank (CDB) and co-financed by the Green Climate Fund (GCF) and by IDB, which intends to reduce financial, technical and institutional obstacles to the development of geothermal energy in the five eastern Caribbean countries with the greatest potential: Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

Bilateral cooperation with non-Annex I countries

The following sub-paragraphs describe the some relevant initiatives.

- Cooperation in the Asian region

MASE started the Sino-Italian Cooperation Program for Environmental Protection (SICP) with the People's Republic of **China** nearly twenty years ago. In 2018, the climate policy responsibility shifted from the National Development and Reform Commission (NDRC) to the newly Ministry of Ecology and Environment (MEE) that assumed responsibility for leading and coordinating China's international climate negotiations efforts and coordinating domestic climate policy among ministries.

In the timeframe 2017–2020, the Sino-Italian Center for Sustainability (SICES), supported by MASE and the University of Tongji (Tongji), was established. The Center aims at enhancing the collaboration between Italian Research centers and Chinese Research center on Greener Cities, to promote research and capacity building in Climate Change Adaptation/Mitigation, Energy Efficiency/Renewable Energy, Resource Efficiency/Circular Economy sectors.

Over the same period, under the MoU between MASE and the People's Government of Beijing Municipality signed in 2017, 4 projects were approved:

- Technical Arrangement on Beijing Electromagnetic Radiation Monitoring Network
- Low-nitrogen gas-fired boiler pilot Project
- It aims at promoting low nitrogen gas-fired boilers, based on the scientific analysis of monitoring data and operating data
- Particular Matters Monitoring Project
- It aims at enhancing Beijing Municipality's capacity for air quality monitoring and pollution monitoring and control in particular on fine particles (PM2.5)
- Tongzhou Water Environment Evaluation and Strategy (TWEES)
- It aims at optimizing water environment management strategies of Tongzhou District based on the practices and experiences of EU and Italy

In addition, in 2018 the Sino Italian Capacity Building for environmental protection (SICAB) started, for a duration of two years with a total budget of €2,567,508. Between 2019 and 2020, the advanced training course provided an in-depth overview of climate change and related global and European policy framework, introducing the main scientific instruments and methods currently available for the production of high-resolution climate scenarios. Over 600 participants from all the provinces of China took part in the training program, with 24 courses (in Italy and China). The table below summarizes the recipient institutions of the trainings and the content of the courses.

Table 7.4 - Recipient institutions of the trainings and content of training courses of the Sino Italian Capacity Building for environmental protection (SICAB) program, 2018-2019

Recipient Institution	Content of the training	Period	Place
Beijing Municipality Bureau of Environment and Ecology	Environmental Pollution Control	2018	Italy
Ministry of Industry and Information technology	Energy Efficiency in Industry	2018	Italy
Shanghai Municipality – Bureau of Environment and Ecology	Air quality control and urban wastes disposal	2018	Italy
Ministry of Science and Technology	Innovative Science Parks and research / industry collaborations	2018	China
Ministry of Environment and Ecology	Radioactive waste and nuclear plants decommissioning	2018	China
Ministry of Science and Technology	Innovative Science Parks and research / industry collaborations	2018	Italy
Ministry of Environment and Ecology	Radioactive waste and nuclear plants decommissioning	2018	Italy
Ministry of Industry and Information technology	Energy Efficiency in Industry	2018	Italy
Ministry of Environment and Ecology (FECO)	Environmental Protection and Sustainable Development in Emission Permits Management	2018	Italy
Ministry of Environment and Ecology (DCC)	Climate scenarios, adaptation and mitigation policies,	2018	Italy
Beijing Municipality Bureau of Environment and Ecology	Environmental management and climate change	2019	Italy
Shanghai Municipality – Bureau of Environment and Ecology	Soil and groundwater pollution and climate change	2019	Italy
Ministry of Environment and Ecology (DCC)	Climate Scenarios, Adaptation, and Mitigation Policies	2019	China
Ministry of Environment and Ecology (FECO)	Soil and groundwater pollution and control	2019	China
Ministry of Industry and Information technology	Industrial Energy Efficiency Capacity Building and Experiences Exchanges	2019	China
Ministry of Environment and Ecology	Nuclear waste management	2019	Italy
Ministry of Environment and Ecology (DCC)	Climate scenarios, adaption and mitigation policies	2019	Italy
Ministry of Environment and Ecology (FECO)	Environmental protection and sustainable development in soil and groundwater pollution prevention and control	2019	Italy
Ministry of Environment and Ecology	Nuclear Waste Management	2019	China
Beijing Municipality – Bureau of Environment and Ecology	Environmental Management and Climate Change	2019	China
Shanghai Municipality – Bureau of Environment and Ecology	Smart city and sustainable mobility	2019	China
Ministry of Science and Technology	Science, technology, innovation and green growth	2019	China
Ministry of Industry and Information Technology	Energy Efficiency in Industry	2019	Italy
Ministry of Science and Technology	Science, Technology, Innovation and Green Growth	2019	Italy

Source: Italian Ministry of Environment and Energy Security (MASE)

- Cooperation in the Mediterranean region

During the reporting period, in the Mediterranean region MASE continued supporting the environmental cooperation in the framework of previous Agreements. It also signed 2 new MoUs with Tunisia, specifically with the Ministry of Energy, Mines and Renewable Energy (now Ministry of Industry and SMEs - MIPME), in February 2017, and with the Ministry of Agriculture, Water Resources and Fisheries in May 2018.

Under the MoU with the Palestinian Quality Authority (EQA), the project Proposed Technical Assistance for the" Revision and updating of the National Biodiversity Strategy of Palestine and related Action Plan and preparing the Sixth National Report" was approved on 31/12/2018). Due to the state of emergency of

virus pandemic the process has been interrupted and the project restarted on December 2020. The project aims at the protection and conservation of biodiversity and protected areas of Palestine, through the updating of the National Biodiversity Strategy and its Action Plan, in addition to the drafting of the Sixth National Biodiversity Report.

MASE continued supporting UNEP's Program Mediterranean Investment Facility, in particular for the project, started in 2016, creating a Strategy and Paving the way for the Deployment of Distributed Renewable Energy Technologies in Egypt. The project aims at increasing energy efficiency, decreasing the use of fossil fuel and promoting renewable energies, also through financial mechanisms to mobilize additional funds.

Through an agreement signed in 2012 with "Agence Marocaine pour l'Efficacité Energétique (AMEE)" MASE continued its support to 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.

- Cooperation on climate change in Central and Eastern Europe, Caucasus Region and Central Asia

In Eastern Europe, MASE continued the cooperation programs active in the region expanding to other areas: Balkans, Caucasus Region, North and Central Asia

In **Montenegro**, once an impasse in the construction of eco-building was resolved in October 2019, negotiations have resumed to undertake the work of the second phase of planned activities through the launch of a new international public tender.

On 29 October 2019, the Memorandum of Understanding with the Serbian Ministry of Agriculture and Environmental Protection was signed in Belgrade. The aim of this Memorandum is to implement the environmental cooperation between Italy and **Serbia** in order to coordinate efforts to combat global climate change and its adverse effects, promoting the transition to a sustainable economy for the protection environmental and natural resources of the Republic of Serbia.

With the entry into the European Union of some of the former Soviet republics, environmental cooperation has become an even more important issue with the Caucasus area and Central Asia, characterized by a particular range of opportunities under different aspects: political, energy, commercial, environmental. The greatest gap to be bridged in the countries of the area is concentrated in strengthening the institutional capacities of local authorities in facing the challenges posed by climate change and sustainable development worldwide, primarily the Paris Agreement. In this regard and with a view to this cooperation, Memoranda of understanding have been signed in the field of climate change vulnerability, risk assessment, adaptation and mitigation (sustainable development), with **Georgia** (15/11/2017), **Kazakhstan** (4/9/2017), **Uzbekistan** (24/01/2019) and **Turkmenistan** (7/11/2019).

Two projects, both entitled "Supporting in Implementing the Technical Arrangement on Sustainable Development Cooperation in the field of Climate Change Adaptation and Mitigation" have been launched with Kazakhstan and Uzbekistan. The projects aim to support Kazakh and Uzbek experts for their participation in international events, including COP25 and COP26, giving them the opportunity to learn about and take part in international negotiations on the topic of climate change.

The cooperation with the **Russian Federation** deserves a separate mention, with which a Memorandum of understanding was signed on 24/10/18. This cooperation will take place on an equal footing, and will represent, by the explicit will of both parties, an opportunity to exchange experiences on policies and technologies aimed at protecting the environment and coping with climate change.

- Scientific cooperation

MASE 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, MASE 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 MASE 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 MASE, 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 MASE 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 MASE and MUR, more specifically MASE 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 MASE financed the project Elements for the elaboration of the National Strategy of Adaptation to Climate Change (SNAC).

The specific SNAC's 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 MASE 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 MASE on matters related to land sector and adaptation in international activities and negotiations.

7.6 Assistance to developing country Parties that are particularly vulnerable to climate change

Bilateral co-operation initiatives from the Ministry of Ecological Transition

- Asia-Pacific

In the Asia-Pacific Region during the reporting period, the MASE signed 1 new MoU with the Ministry of Natural Resources and Environment of **Viet Nam** (5/6/2018), and continued its cooperation under the MoU signed in 2015 with the Ministry of the Environment and Energy of the Republic of **Maldives**. Additionally, it continued supporting, together with other three Donors (Austria, Luxemburg and Spain) the Partnership with **Pacific Small Island Developing States** (Cook Islands, Fiji, Kiribati, Micronesia, Marshall Islands, Nauru, Niue, Solomon Islands, Palau, Papua New Guinea, Samoa, Tonga, Tuvalu and Vanuatu). In 2018, MASE decided to extend the partnership until 2023 with an additional investment of USD15 MLN, to enhance the scope of cooperation activities and to make the Partnership fully instrumental to the implementation of the SAMOA Pathway.

Overall, 26 projects were approved:

The project *Set-up and implementation Geo-Information System for Climate Change Vulnerability, Risk Assessment and Environment monitoring for Vietnam*, aiming at realizing a Geo-Information System to monitor and assess the impacts of and vulnerability to Climate Change in Viet Nam based on remote sensing technology. The initiative includes the development of three case studies: "Saltwater intrusion assessment", "Wetland ecological system monitoring" and "Subsidence monitoring in urbanized areas".

5 projects under the MoU with the Maldives:

- Installation of a water desalination plant on the island of Magoodhoo - Faafu Atoll
- It consists in the realization of a PV powered reverse-osmosis seawater desalinisation plant in Magoodhoo (Faafu Atoll)
- Enhancing weather and climate monitoring and data management capacity of Maldives Meteorological Service for reducing vulnerabilities of climate change in the Maldives
- It aims at strengthening meteorological monitoring, early warning and disaster prevention systems through the installation of 25 PV powered Automatic Weather Stations (AWSs), and the establishment of a Common Alerting Protocol at the Maldives Meteorological Service
- OpERATE - Ocean Energy Resources Assessment for Maldives
- It aims at assessing the energy potential of the 214 marine currents of the Maldivian archipelago, and individuating technological solutions to exploit it
- Enhancing weather and climate monitoring and data management capacity of the Maldives Meteorological Service for reducing vulnerabilities of climate change in the Maldives
- It aims at strengthening national adaptation capacity and building a climate resilient infrastructure
- WAVE4M - Development of a sea state forecasting system for the Maldivian Archipelago
- It aims at developing an operational wave forecast model for the Maldivian Archipelago
- Implementation of an Integrated Meteorological and Climatological Information and Decision Support System at the Maldives Meteorological Service (MMS)
- It aims at strengthening the Maldives meteorological monitoring network, early warning and disaster prevention
- AOSIS Fellowship Programme
- The purpose of the AOSIS Fellowship Programme is to increase the capacity of AOSIS member countries to engage in international negotiations, diplomacy, and international and domestic policy development on climate change, environmental protection, and sustainable development

20 projects under the Partnership with Pacific Small Island Developing States:

KIRIBATI

- Outer Island Fish Center Solar Panel System
- Outer Island Fish Centre Solar Panel System - Phase 2
- Strengthening Phoenix Islands Protected Areas & Creation of Related Marine Protected Areas in Kiribati

- School PV off-grid system for school and village community

MARSHALL ISLANDS

- Building Infrastructure Resilience

MICRONESIA

- Enhancing water security and climate resilient food for the displaced atoll population in YAP
- Support the development of the Federated State of Micronesia's updated nationally determined contribution

NAURU

- Support the development of the Republic of Nauru's updated nationally determined contribution

PALAU

- Increasing Palau's resilience to extreme drought events: taking action for long-term adaptation to the impacts of climate change
- Palau national marine sanctuary education and awareness
- Phase 2 of the PNMS Project: Examining the potential effects of the climate change on the distribution, long-term movement and local fisheries productivity of pelagic and nearshore resources in the PNMS
- Support the development of the Republic of Palau's updated nationally determined contribution

PAPUA NEW GUINEA

- Sustainable water supply end electricity supply project – Feasibility Study

TONGA

- 2019 TONGA Fellowship on the Environment and Ocean (TFEO)
- Strengthening protected area management in the Kingdom of Tonga

TUVALU

- Tuvalu Photovoltaic Electricity Network Integration Project (TPENIP) Phase 2

VANUATU

- Irrigation for a Resilient and Sustainable Agriculture
- Increasing access to safe secure and sustainable water supply in Vanuatu
- A National Marine Spatial Plan for Vanuatu – including a network of Marine Protected Area

■ Sub-Saharan Africa region

Africa has become a top priority in the Italian strategy for development cooperation. In this context, MASE is committed to support national strategies aiming at:

- facing the high climate change vulnerability that often prevents African countries from consolidating their economic growth, and addressing 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, MASE is negotiating or executing several bilateral agreements with many African developing countries. In the reporting period, 4 new MoUs have been signed: with the Ministry of Tourism and Environmental Affairs of the Kingdom of Eswatini (May 2017), with the Ministry for the Environment, Reclamation and Sustainable Development of the Republic of Mali (November 2017), with the Ministry of Energy and Petroleum of Kenya (January 2018), with the Ministry for National Development and Planning of the Republic of Zambia (November 2018). In addition, negotiations to sign new MoUs or renew expiring Agreements were carried on with several other countries: Burkina Faso, Botswana, Rwanda, Lesotho, Mozambique, Cameroon, Chad, Niger, Nigeria, Mauritania.

Over the reporting period, 11 have been approved, listed below.

Ministry of Environment, Nature Conservation and Sustainable Development of the Democratic Republic of Congo:

- *Bukavu Green Community as pioneers of an integral and sustainable development in Democratic Republic of Congo* (November 2017). The project has three main goals: to offer high-level training about renewables to Congolese engineering graduates; to start cooperatives in the solar power sector; to install solar systems serving public buildings in places with limited access to electricity
- *Systèmes décentralisés hors réseau basé sur les sources renouvelables* (January 2019). It aims at promoting access to electricity and drinking water using renewable sources in two territories in the provinces of North Ubangi and Kongo Central.
- *Sustainable Energy Services for Rural DRC* (January 2019). It aims at providing clean, reliable and economical electricity to two villages the island of Idjwi in South Kivu, through the installation of a photovoltaic-hydroelectric hybrid plant.

Ministry of Tourism and Environmental Affairs of the Kingdom of Eswatini:

- *Fossil fuel free and green building of the Raleigh Fitkin Memorial Hospital* (May 2018). The project objective is the energy requalification of the Raleigh Fitkin Memorial Hospital, ensuring its energy self-sufficiency and the reduction of climate-altering emissions.
- *Strengthen Swaziland early warning system and climate services* (May 2018). The project aims at enhancing the national weather forecast and alert system through installation of new meteorological and hydrometric stations; equipment of the Department of Meteorology with advanced forecasting systems; adoption of a Common Alerting Protocol at the national level.

Ministry of Environment, Forest and Climate Change of the Federal Democratic Republic of Ethiopia:

- *Sustainable Water Supply System in Rural Areas of Somali and Afar Regional States of Ethiopia* (November 2017). Project aimed at providing solar-powered water pumping systems in 22 villages in the regional states of Somali and Afar. The diesel engines currently used for pumping water will be replaced.
- *Climate Smart Integrated Rural Development Project in the Pastoralist area of Ethiopia* (May 2018). The project goal is to foster adaptation of rural communities to climate change, in particular to floods and recurrent droughts, through an integrated approach to water, agriculture and natural resources management. The target villages are in Somali and Afar regions.

Ministry of Energy and Meteorology of the Kingdom of Lesotho:

- *Renewable energy potential maps for Lesotho* (April 2017). The project intends to realize a mapping of the energy potential of the major renewable sources in the territory (solar, wind, water), to provide Lesotho with a cartographic tool for proper investment planning.

Ministry of Natural Resources of the Republic of Rwanda:

- *Sustainable urban wetlands development within Kigali City* (May 2018). The project intends to strengthen the competences of Rwandan institutions in planning and management of urban wetlands, waste management and Environmental Impact Assessment processes. The project also contributes to the restoration of 134 hectares of wetlands in urban and peri-urban areas of Kigali.
- Contribution Agreement with the Global Green Growth Institute (GGGI) on Climate Change Vulnerability, Mitigation & Adaptation in Rwanda (April 2019). The objective of the agreement is to support the Rwandan Government in NDCs and green growth strategy implementation through: technical assistance for projects development; the strengthening of private sector engagement and business-to-business exchange; capacity building and knowledge sharing.

Ministry of Environment, Physical Development and Natural Resources of the Republic of Sudan:

- *Solar pumps for sustainable livelihood* (May 2018). Project aimed at promoting water supply for irrigation and access to drinking water in 10 villages of the Nile River State and of North Kordofan, through the introduction of solar-powered water pumping systems not connected to the grid.

- Central and Latin America, including CARICOM area

During the reporting period, MASE continued its environmental cooperation with Central and Latin

American countries. In particular, MASE signed 4 new MoUs with the Ministry of the Environment and Sustainable Development of Argentina (08/05/2017), the Ministry of Science, Technology and Environment of Cuba (14/07/2017), the Ministry of the Environment and Sustainable Development of Paraguay (07/11/2018) and the Ministry of Environment and Natural Resources of the Dominican Republic (15/02/2019).

In the reporting period, 19 projects have been approved, listed below.

Ministry of the Environment and Sustainable Development of Argentina:

- *Strengthening Fire Early Warning and Statistics Systems in Argentina* that aims at improving information management, early warning, and public communications of the Argentine fire management service

Ministry of the Environment of Peru:

- *Support the implementation of Peru's Nationally Determined Contribution (NDC) under UNFCCC* that aims at contributing to the achievement of transformational change by addressing enabling conditions to implement adaptation and mitigation commitments as tools for delivering sustainable and equitable climate-resilient development. It addresses the priority sectors identified in Peru's NDC: agriculture, forests, other land use and land use change (AFOLU), and water resources. It adopts an inclusive approach that incorporates the three levels of government (national, regional, local) as well as participation from academia, civil society, private sector and international cooperation. It also integrates gender and intercultural approaches.

Ministry of Science, Technology and the Environment of Cuba:

- Feasibility study on central coast front of the city of Havana: adaptation proposals for the climate change challenges (Engineering Solution Malecón)

It aims at identifying and proposing, through field research, modelling and technical, economic and environmental feasibility studies, possible engineering solutions to improve Havana coast front's level of protection against current and future climate change risks, especially coastal erosion.

- Strengthening the Cuban Marine Meteorological System (Maritime Surveillance)

It aims at improving the efficacy of the Cuban Marine Meteorological System to address extreme events and the spillage of oil derivatives from ships in the Caribbean Sea, as well as at introducing new hydro-meteorological and environmental services, through the acquisition of high-resolution satellite data and capacity-building.

- Improve national capacities for the introduction and use of innovative and advanced technologies and tools that strengthen vulnerability, risk, adaptation and mitigation assessments of climate change in Cuban marine ecosystems (EcoAtlas)

The project, yet to be started, aims at applying new technologies for habitat mapping to support the monitoring, surveillance and early-warning systems, and at evaluating the sea-energy potential in Cuba.

MoU with **CARICOM States**: 14 projects approved in the reporting period, aiming at developing pilot initiatives to apply the use of renewable energy sources and energy efficiency measures in different sectors: water security and treatment, street lighting, public buildings and transports. The objectives of the projects are to decrease carbon emissions as well as to improve climate change adaptation, resilience and risk preparedness, by providing off-grid power sources for basic services and shelter in case of extreme weather events. In addition, the implementation of the initiatives also aims at strengthening local public awareness on climate-related energy and safety issues, and in various cases capacity-building components for the use and management of renewable energy systems and solar-powered equipment and facilities are foreseen.

In particular:

- 3 projects were approved in 2017, consequently started and currently ongoing:
    - Antigua and Barbuda: installation of PV systems in essential services, i.e. schools and clinics
    - Belize: introduction of sustainable street lighting and construction of a multi-purpose self-contained community centre to be used as shelter in case of extreme weather events

    - Saint Kitts and Nevis: introduction of electric buses rechargeable by a PV system for public school transportation
- 11 projects were approved in 2018, not yet started.

In addition, MASE continued to support the implementation of the remaining 7 projects approved in 2016 under the MoU with CARICOM States.

7.7 Italian cooperation on mitigation and adaptation addresses the needs of non-Annex I Parties

In the reporting period, MASE continued its bilateral cooperation on climate change vulnerability, risk assessment, mitigation and adaptation with countries in Africa, Asia and Pacific, Mediterranean, Latin America and the Caribbean, and Central and Eastern Europe, through a bilateral cooperation governance mechanism which is based on the dialogue between partner countries and a strong ownership component of the beneficiary.

In terms of bilateral cooperation, the expansion and update of its approach facilitated a new phase of negotiation of cooperation agreements which was launched at the end of 2020. The governance mechanism based on the Memoranda of Understanding (MoUs) described in NC7 was confirmed. Through the establishment of a Joint Committee (JC) general direction to the collaboration are provided, as well the approval of work programs and budget, the supervision and support to the cooperation activities - by taking stock and assessing the implementation and progress of approved projects - and, finally, financial decisions over such activities. To complement this approach and ensure that the implemented activities are in line with the expected results, periodical site visits of national experts to monitor and assess activities on the ground continued to be carried out. Indeed, since their standard duration is five years, many MoUs signed in previous years were approaching their expiry date. The new proposed agreements not only expanded the scope of cooperation, but also increased the importance of criteria such as transparency, traceability, efficiency, effectiveness, and ownership of the initiatives promoted, in line with MASE's Actions of Address for the year 2019 and the triennium 2019-2021 and for the for the year 2020 and the triennium 2020-2022.

All financed projects and programs are proposed by the counterparts and reflected priorities and objectives included in the Nationally Determined Contributions (NDCs) and other relevant climate change and development strategies. MASE spread its cooperation activities across all continents and regions: Africa, Middle East and North Africa (MENA), Small Islands Developing States (SIDS), Asia, Central and Eastern Europe, and Central/Latin America, confirming the Sub-Saharan Countries and the SIDS as the priority areas.

7.8 Provision of new and additional resources

Provided that there is no common definition or understanding on what is to be considered "new and additional" resources to be provided, Italy generally considers new and additional all resources that are newly committed and/or disbursed through the different channels and from the different sources that constitutes the diverse landscape of climate finance on an annual basis. Thus, all reported figures are considered new and additional for the period 2017-2020.

In particular, it is to be reminded that environmental challenges are closely interlinked, and climate change is affected, and directly and indirectly affects, all dimensions of our environment, as well as human and ecosystem health. Italy is well aware of this, and in the provision and mobilization of its resources Italy reflects this reality of mutually supportive and synergistic objectives in the environmental realm.

Italy thus actively pursues mainstreaming and integration into the broader support to developing countries for the 2030 Agenda of the objectives of mitigating and adapting to climate change, as well as reducing and managing risks related to climate change and actions to avert, minimize and address loss and damage from the impacts of climate change.

Also taking into account the priorities and needs expressed by developing countries in the dialogue with Italian providers, Italy would consider detrimental as well as meaningless for the effective implementation

of the goals of the Paris Agreement any attempt to discern development and climate finance, especially in the provision and mobilization of support implying the realization of projects on the ground, in particular when it comes to adaptation actions. Italy is aware that what counts is the impact of the actions on the ground, rather than reporting and accounting modalities of climate finance; and impacts can be maximized if resources are pursuing more than one goal, as the 2030 Agenda taught us from 2015 onwards. Italy is undertaking effort to increase levels of development finance, together with improving mainstreaming and integration of climate action in development finance. Considering the above, this ensures no displacement in the provision of climate and development finance, just mutual reinforcements. This vision is what we consider in line with the spirit of the UNFCCC and the Paris Agreement, which also asks all Parties to pursue the consistency of all finance flows with mitigation and adaptation objectives and the provision of climate finance in the context of meaningful mitigation action and transparency on implementation.

7.9 Technology development and transfer

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, contributing to achieve the overall mitigation targets of and adaptation efforts under the Paris Agreement.

Further cooperative action between relevant stakeholders, including local communities and authorities, national planners, the private sector and civil society organizations are essential to accelerate the diffusion of and further innovation in climate technologies across all sectors.

In addition, during the implementation of projects, we believe it is important that the public and private investments should be channeled as much as possible towards low-GHG-emission technologies with the aim of reaching global net-zero-GHG by mid-century.

To actively participate in 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).

Considering 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, MASE 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, MASE 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, MASE 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.

In the following table some technology transfer projects, aimed at transferring both hard and soft technologies, are highlighted as success stories while there are no failure stories to report in the reporting period considered.

As recommended in the previous assessments, the table reports clearly the activities undertaken by the public and by the private sector.

Table 7.5 –Description of selected projects or programmes that promoted practicable steps to facilitate and/or finance the transfer of, or access to, environmentally sound technologies

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 (MASE) and the Lebanese Center for Energy Conservation (LCEC)			
Purpose			
Support to the Lebanese Government to address 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 know-how and technology transfer in line with the European legislation and the phase-down 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	1,976,767.00 € (MASE's funding)	2016-ongoing (until December 2022)
Description			
The project aims to: - Ensure the quality of products on the market, in line with the European legislation and Montreal Protocol's phase-down 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).			
Factors which led to project/programme's success:			
- Collaboration among the Lebanese public administration, private sector and research institutes, including national and international partners. Technical assistance from Italian partners was demonstrated to be of high value. Workshops with industry partners and transfer of know-how between private-sector parties is of key importance to foster partnerships and to raise interest in new technologies.			

- Installers have increased capacity in designing and installing heat-pumps as per international best practices.

Technology transferred

- Vapour compression technologies (e.g. air conditioners and heat pumps) (private).
- Several standards on Heating, Ventilation and Air Conditioning (HVAC) as Lebanese Standards at LIBNOR (the Lebanese Standardization Institute) were identified by POLIMI (Politecnico di Milano) as necessary for the heat-pump market in Lebanon (private).
- The first national test laboratory for vapour compression appliances used in the residential and tertiary Lebanese sectors (DHW production, air conditioning and space heating) consisting of a climatic chamber is designed, constructed and provided by an Italian manufacturer (private).
- A training for optimal installation of heat pump systems and monitoring devices was held with the support of POLIMI team and it gathered around 50 participants (solar water heater installers, ESCOs and Italian suppliers) (private/public-LCEC).
- The online platform to set-up an energy performance monitoring program for 30 sites was finalized with the support of POLIMI (private/public-LCEC).

Impact on greenhouse gas emission/removals (optional):

The promoted and deployed technology will contribute to reduce GHG emissions and increase energy efficiency.

Project / Program title

"HA Project - Maximizing Energy Savings from Energy Efficient Home Appliances" under the technical agreement on sustainable development cooperation between the Italian Ministry for the Environment Land and Sea (MASE) and the Lebanese Center for Energy Conservation (LCEC)

Purpose

Provide assistance to the Lebanese Government on the achievement of the commitments undertaken under the environmental protection umbrella. Specifically, the project aims to carry out a study of the market of household appliances used in Lebanon to subsequently define a national program including financial support for the final users to purchase energy-efficient appliances, promoting and involving Italian companies in the process.

Recipient Country	Sector	Total funding	Years in operation
Lebanon	Energy	1,619,375.00 € (MASE's funding)	2016-ongoing (until december 2022)

Description

The project aims to implement the following activities:

- market analysis aimed at defining the baseline of energy consumption related to the use of household appliances in Lebanon (public-LCEC).
- evaluation analysis of the potential to reduce greenhouse gas emissions and contacts with Italian producers to identify new brands and new technologies (public-LCEC).
- drafting of a discount plan for the purchase of Italian household appliances selected on the basis of specific energy saving criteria (private/public-LCEC).
- involvement of stakeholders and stipulation of agreements with identified resellers (public-LCEC).
- training on energy efficiency and energy saving for importers, suppliers and retailers of household appliances in Lebanon (public-LCEC).

- launch of a national awareness campaign on energy saving, focusing on environmental benefits deriving from the use of energy-efficient appliances (private/public-LCEC).
- development of an online platform for direct access to the project's data (private/public-LCEC).
- valorisation and capitalization of good practices (public-LCEC).

Factors which led to project/programme's success:

- Collaboration among the Lebanese public administration, private sector and research institutes, including national and international partners.
- Promotion of energy saving and efficiency mechanisms, contributing to reduce GHG emissions.

Technology transferred

- Several interviews with selected Italian producers were conducted.
- Several trainings on energy efficiency and energy saving for salespersons were carried out.
- Transfer of knowledge and know-how on energy efficiency and energy labelling of appliances (between Italian manufacturers and local stakeholders).

Impact on greenhouse gas emission/removals (optional):

The ongoing activities will contribute to promote energy saving and efficiency mechanisms, contributing to reduce GHG emissions and improve air quality.

Project / Program title

Outer Island Fish Center Solar Panel System.

Purpose

The main objective is the installation of PV Solar Off Grid systems for fish centers outer islands.

Recipient Country	Sector	Total funding	Years in operation
Kiribati	Energy	780,000.00 € (Phase I); 764,838.00 € (Phase II).	2016 – 2019 (Phase I: 2016-2017 / Phase-II: 2018-2019)

Description

The project has been approved under the umbrella of the Partnership with the Pacific Small Island Developing States and the Memorandum of Understanding between the Italian Ministry of Environment and Energy Security (MASE) 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", signed in New York on 11 May 2007. Today, the Partnership has four donors (Italy, Austria, Luxemburg and Spain) and fourteen Pacific SIDS parties (Cook Islands, Fiji, Kiribati, Micronesia, Marshall Islands, Nauru, Niue, Solomon Islands, Palau, Papua New Guinea, Samoa, Tonga, Tuvalu and Vanuatu).

In 2018 The Italy's PSIDS partnership has been extended until 2023 with an additional investment of 15 million $ to enhance the scope of the activities to be financed under the terms of the MoU governing the Pacific SIDS/Italy and to make the Partnership fully instrumental to the implementation of the Paris Agreement.

The projects agreed by the Joint Committee established under the MoU, both ongoing or concluded, for the period January 2017 – December 2020 are 20 projects, including 5 projects in Kiribati.

In particular, the project "Outer Island Fish Center Solar Panel System", agreed under the Kiribati - Italy Renewable Energy Program (KIIREP), consists of two phases. The phase I of the project (approved in 2016) aimed 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.

The phase II of the project, approved in 2017 and implemented in 2018 and 2019, foreseen activities to install 4 kW Solar off-grid power systems (substituting Diesel fuel) to cover the remaining 10 outer islands all located in the Gilbert Group namely Butaritari, Abaiang, North Tarawa, Maiana, Aranuka, Abemama, Tabiteuea North, Beru, Nikunau and Banaba.

The PV-system replicates the design and specification prepared for the islands covered in the initial titled project of 2016.

Solar power systems have been connected to the chest freezers, ice flakes making machines, computers, lightening and water pumps as well as to other electrical appliances that need to be used in the Fish Centers.

Regarding the roles and responsibilities among the parties involved in the project, the KIIREP Ad hoc Working Committee was the coordinating body and overall management, monitoring and evaluation of the project including financing and accounting (Public). The Ministry of Public Works and Utilities Energy Department was responsible for the designing, procurement, contracting with stakeholders and commissioning of the project and the Ministry of Fisheries, the recipient of the project, was responsible for solar system and the refurbishment of the fish centers existing buildings with the support of the Project Technical Team from the Energy Department, Kiribati Solar Energy and Ministry of Fisheries. Finally, the private sector has provided technologies.

Factors which led to project/programme's success:

- Maximizing the benefits of small fisheries community.
- Sustainable use of marine resources.
- Contributing to Increase resilience.
- Reduction of the dependence on the imported fossil fuels in terms of fuel storage capacity and vulnerability to price fluctuations.
- Increasing the energy security of the Pacific Small Island countries.
- It can be taken as a model from other small island states in the Region.
- Promotion of an integrated approach to tackle climate change and improve air quality.
- Local fishermen have been trained.

Technology transferred

- PV Solar off-grid System.
- Training programs, monitoring and evaluation activities.

Impact on greenhouse gas emission/removals (optional):

The implementation of the project will contribute to consume less amount of fossil fuels to produce electricity, reducing GHG emissions, and to improve, at the same time, air quality of the island.

Project / Program title

Implementation of an Integrated Meteorological and Climatological Information and Decision Support System at the Maldives Meteorological Service (MMS)

Purpose

The main objective of the project is to strengthen Maldives meteorological monitoring network, early warning and disaster prevention.

Recipient Country	Sector	Total funding	Years in operation
Maldives	Adaptation	903,745.00 €	2018 - 2020

Description

The project has been approved in 2018 under the Memorandum of Understanding on climate change, vulnerability, risk assessment adaptation and mitigation, between MASE and the Ministry of the Environment and Energy of the Republic of Maldives.

The project represents the completion of the setting up of the Maldives Meteorological Service laboratories system for the integrated management of all meteorological and oceanographic data, upgrading the warning and information dissemination systems, thus constituting to provide information to support decision-makers.

The Project management was under the Ministry of the Environment and Energy of the Republic of Maldives while the actions to Strengthen the Observation Network, data automation and integration has been taken by the private sector. The installation and maintenance of the he AWSs (Automatic Weather Stations) were under the responsibility of the Contractors (Italian Company selected by bidding procedure). The AWSs are powered by solar panels to measure the following parameters: air temperature, relative humidity, air pressure, wind direction and speed, cumulative rain and rain intensity.

Factors which led to project/programme's success:

- Support Government to take decisions and actions.
- Contributing to reduce the impact of weather-climatic hazards and related risks.
- Strengthening the national capacity to implement practical adaptation actions.
- Improve climate resilient infrastructure to address impacts of climate change.
- public awareness strengthening Early Warning Communication (Public/private).

Technology transferred

- Automatic Weather Stations (private).
- PV solar panels (private).
- Training courses and human Capacity Building (private).

Impact on greenhouse gas emission/removals (optional):

Project / Program title

Sustainable Energy Services for Rural Democratic Republic of Congo.

Purpose

The overall objective of the proposed action is to improve living conditions and strengthen resilience to climate change of populations in South Kivu, DRC, through access to renewable energy.

Recipient Country	Sector	Total funding	Years in operation
Democratic Republic of Congo	Energy	1,015,401.00€	2019-2021

Description

The objective of the rural electrification pilot project, called ENRU project, is to provide access to electricity produced from renewable and clean sources through the installation of a mini-grid composed of an off-grid hybrid solar-PV and hydro power generation plant together with a smart distribution line.

Thus, the energy needs of the target community will be satisfied through an installed solar-PV power

generation capacity of 150 of kWp coupled with a hydropower capacity of 15 kW and the hybrid plant will be supported by a storage system made of lithium batteries with a capacity of 350 kWh. The proposed mini-grid is zero CO2 emission and with very low operational costs since no fuel will be necessary. Taking into consideration the huge micro and mini-hydropower potential in Republic of Congo, this project aims at demonstrating a long-term sustainable solution both from the technical and financial point of view to be replicated over the country.

- This solution would:
- Allow to exploit an important energy source that Congo is greatly endowed with which is hydro power;
- By introducing the solar component, AVSI Foundation and the Ministry of Environment, Nature Conservation and sustainable development (MECNDD) of the Democratic Republic of Congo could demonstrate the potential of mini-grid off-grid solar solutions, their convenience in terms of realization and their replicability;
- By partnering with a private subject (the owner of the hydro power plant), AVSI and MECNDD will finally be able to prove the business case for private-public partnership (PPP) in the provision of off grid energy services and its economic sustainability.

The project implementation foreseen the following division of roles and responsibilities among the parties involved in the action:

1. MECNDD (project partner)

- Provision of technical and legal support.
- Project supervision and monitoring.
- Participation in the committee selecting the company that will construct the mini-grid.
- Contribution to the identification of the mini-grid management strategy.

2. AVSI Foundation with its technical partner EnGreen (project partner and implementer):

- Overall implementation of the project.
- Administrative and technical responsibility.
- Definition of the dimension and technical specification for the mini grid.
- Lead the bid process.
- Supervision of the company selected to build the mini-grid.
- Support and supervision to the entity managing the mini-grid.
- Implementation of all socio-economic interventions.

3. Company selected for the construction of the mini-grid (project supplier):

- Selected through a bid process by invitation.
- Construction of Stand-alone power plants with storage.
- Construction of Smart distribution grid.
- Construction of infrastructures for logistical purposes.
- Management of the grid for the inception period (duration TBD).

4. Community (project beneficiary):

- Identification of the location for the mini-grid.
- Provision of the land.
- Participation in the project activities as beneficiaries.

Factors which led to project/programme's success: - Increasing the energy offer from renewable sources on Idjwi island Lake Kivu. - Supporting the sustainable economic growth of the idjwi community through the promotion of productive use of electricity. - Strengthen the capacity of the players in the energy supply chain. - At least 80 businesses trained and/or coached in 2 villages.
Technology transferred - Mini-generation off-grid plant. - Distribution network. - Provision of Training on renewable energies and planning of electrification interventions.
Impact on greenhouse gas emission/removals (optional): The proposed mini-grid is zero CO2 emission and it will contribute to consume no fossil fuels to produce electricity, reducing GHG emissions.

7.10 Capacity building

Enhancing the ability of individuals, organizations and institutions in developing countries to identify, plan and implement ways to mitigate and adapt to climate change is critical to enabling developing countries to pursue their objectives for sustainable development in a climate-friendly manner.

The common objectives of capacity building activities of Italian cooperation agreements are: to strengthen and coordinate efforts to combat global climate change, to support mechanisms for regional climate change vulnerability and risk assessment, to promote clean and efficient energy ensuring energy security, to stimulate and disseminate the transition towards a sustainable low-carbon economy through technology development and transfer, to implement adaptation actions and opportunities to protect the environment and natural resources. Among the instruments of intervention, a major role is played by technology transfer as widely presented in the previous paragraph, with the involvement of the private actors, in several sectors such as energy, transport, industrial or urban management. The following are some of the most relevant capacity building initiatives supported by the Italian Ministry of Environment and Energy Security.

Since 2003, MASE has promoted an Advanced Training Program on Environmental Management and Sustainable Development aimed at technicians, academics, young professionals and decision-makers from Chinese administrations, universities and companies: the **Sino Italian Capacity Building for Environmental Protection - SICAB**. This high-level training program is supported by the Italian Ministry for the Environment, Land and Sea within the SINO-Italian cooperation program for environmental protection (SICP), it has been launched in 2017 and it concluded in March 2022.

Within SICAB several training courses have been provided by a professional consortium led by the **Politecnico di Milano** both in Italy and in China. From February 2018 to December 2021, 28 courses were organized. Even if during the COVID-19 pandemic SICAB had to stop, it concluded in March 2022 also achieving its goal, that was to identify training as an essential tool to support the protection and the management of the environment and the fight against climate change, facilitating exchange of activities, best practices and Knowledge by promoting cooperation projects also technological and industrial. About 1.300 participants from all the provinces of China took part in the training programme on mitigation and adaptation to climate change in the perspective of a green and sustainable growth. The consortium includes Euro-Mediterranean Center on Climate Change, Italy China Foundation, Fondazione Politecnico di Milano and Sapienza University of Rome. The training modules aimed at strengthening the planning capacity of the representatives of the central and local Chinese institutions in the field of environmental issues that have been deemed as a priority in the Chinese agenda including climate change.

In 2018 a **Memorandum of Understanding between MASE and the University of Tongji on the**

Sino-Italian Center for Sustainability (SICES) was signed with a duration of five years. The Center aims at enhancing the collaboration between Italian Research centers and Chinese Research center on Greener Cities, to promote research and capacity building in the following sectors: Climate Change Adaptation/Mitigation, Energy Efficiency/Renewable Energy, Resource Efficiency/Circular Economy. This cooperation aims at promoting SICES as a center of excellence for the research and innovation on the development of green technologies and solutions for Green Cities and in advancing in Sustainable Development. The main objectives are to improve the urban environment quality to tackle climate change, wellbeing and health in cities and to actively participate in global environmental governance through China-Italy cooperation in the framework of several national and international development scenarios and strategies including the Paris Agreement.

In **Middle East** technical Agreements continued also with the **United Arab Emirates** and with **Jordan** in which the transfer of technologies and the capacity building aim to ensure the involvement of the private sector focused on renewable energy and energy efficiency measures.

As already highlighted in the previous chapters of this National Communication, **Africa** has become a top priority in the Italian strategy for development cooperation. Capacity building activities in this context are focused to support national strategies to face the high climate change vulnerability that often prevents African countries from consolidating their economic growth and addressing its environmental consequences above all to promote 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.

In **Central and Latin America**, besides the bilateral agreements already launched by MASE with Argentina, Costa Rica, Cuba, Mexico and Peru, new Memoranda of Understanding have been signed with **Dominican Republic and Paraguay** in 2018 and 2019. Capacity building activities in these countries are focused on: renewable energy and energy efficiency, management of environmental risks resulting from global climate change (Cuba); sustainable management of forests, biodiversity preservation, energy efficiency and sustainable integrated water management (Paraguay).

To support global youth mobilization on climate change, the Italian Ministry of Ecological Transition subscribed a memorandum of understanding with the United Nations Secretariat on Climate Change (UNFCCC) to establish a capacity building programme open to all young people with particular reference to those from developing countries.

The aim of this new program called "**Youth4Capacity**" is to help develop the capacities of young people on climate change, also seeking to address the links between climate action and the implementation of the Sustainable Development Goals and the three Rio Conventions, in order to provide young beneficiaries with the capacity and knowledge to develop and implement actions in support of integrated and complementary approaches to support climate action in the context of sustainable development.

The programme has been officially presented and launched on August 31, 2022, in Libreville, Gabon on the occasion of the Africa Climate Week organized by the local government in collaboration with UNFCCC, UNDP and World Bank, in order to achieve the above objectives, focusing on activities such as: targeted virtual events, webinars, in person training sessions during Regional Climate Weeks and other relevant events organized by the UNFCCC Secretariat and a "Tutoring Program", in collaboration with the Youth4Climate Initiative, developed by the Italian Government in collaboration with UNDP will be designed and implemented by the UNFCCC secretariat with the contribution of the Italian Government.

Among the voluntarily and multi-stakeholder partnership, since November 2015, Italy is party and donor of the **Initiative for Climate Action Transparency (ICAT)**. This Initiative is working with developing countries to strengthen capacity to assess climate actions (in the context of their NDC's) and report their progress in line with the Paris Agreement, based on individual country needs. The Initiative supports in country capacity development programmes through training modules on measurement, reporting and verification (MRV) of policies and actions, and knowledge sharing of good practice and lessons learned. ICAT was created as an unincorporated multi-stakeholder partnership by the Children's Investment Fund Foundation (CIFF); ClimateWorks Foundation (CWF); the German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU); and the Italian Ministry for the Environment (MASE). The implementing partners are currently the UNEP-CCC (UN environment programme copenaghen climate centre), former UNEP DTU Partnership (UDP), World Resources Institute (WRI), the Italian Institute for Environmental Protection and Research (ISPRA), GHG Management Institute, and Aether. In 2018 a

Contract Agreement between ISPRA and UNEP-DTU was signed (duration 18 months and renewed up to March 2013) for capacity building activities on the themes of transparency and reporting of the commitments undersigned by the Parties as established in the Paris Agreement (art 13) in 11 beneficiary Countries (Argentina, Belize, Botswana, China, Cuba, Ethiopia, , Maldives, Sudan, Tunisia,Vietnam and Zimbabwe). ISPRA has supported capacity building activities transferring acquired experience in the field of accounting and reporting of the greenhouse gas emissions. Specific training initiatives have been addressed to officers and to key stakeholders of beneficiary countries. Scoping missions occurred in almost all the countries, with opening workshops and detailed discussion of workplans with the relevant stakeholders and experts. Where these in country missions were not possible (Botswana, Cuba, Sudan, Zimbabwe), they were conducted remotively. Since the beginning of the COVID-19 pandemic and the accompanying restrictions enacted by the international community, all support has been provided remotely but it overally worked very good. Some problems occurred for countries with limited internet access but with an improvement over time. Four countries have already ended the project (Belize, China, Vietnam and Zimbabwe) and some of them will join a second phase of the project.

Table 11 of the CTF provides further details on capacity building intervention activities implemented by Italy.

8 RESEARCH

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 climate related programs. The chapter also details 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 very active in the economic and social impacts with expertise and numerical economic models. Some of the members of the Institute for Atmospheric Sciences and Climate (ISAC) of the National Research Council (CNR), namely Annalisa Cherchi, Susanna Corti, Sandro Fuzzi, have been leading authors of the latest IPCC assessment report for the working group 1 (AR6-WG1), and others have contributed to the review and/or the drafting of specific sections.

8.2 General policy on research and systematic observation

8.2.1 National Research Projets

The National Research Program 2015-2020 (*PNR – Programma Nazionale della Ricerca*[122]) is the main national policy on research. It used to be a threeyears financial plan until 2013, but the PNR for the period that goes from 2015 to 2020 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 this 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 2015-2020 promotes applied research through publicprivate partnerships and the technological transfer from research institute to market. The PNR 2015 - 2020 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 2015- 2020 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 Ministry of University and research (MUR) 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 MUR 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.

In December 2020 CIPE approved another PNR that covers the period 2021-2027. The 2021-2027 PNR is divided into system priorities, major areas of research and innovation and related areas of intervention, national plans and missions. The six major areas of research and innovation (and related areas of intervention) mirror the six clusters of Horizon Europe and take into consideration the areas of the National Smart Specialization Strategy as well.

Other elements of the policy framework on research in Italy remained the same as in the previous period. It is the case of the National Smart Specialisation Strategy (*SNSI – Strategia Nazionale di Specializzazione*

[122] http://www.miur.gov.it/web/guest/programma-nazionale-della-ricerca

Intelligente[123]) that represents the cornerstone between the European Horizon 2020 program and the National Research Program as a result of the effort made by the Italian Ministry of University and Research (*MUR – Ministero dell'Univerità e della Ricerca*) and the Ministry of Economic Development (*MSE – Ministero dello sviluppo economico*) to harmonize national policies with the European ones. 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
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. Beside the PNR, the MSE and the MUR developed the National Operative Program "Research and Innovation" 2014-2020 (*PON RI 2014-2020 – 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. In 2021, the Commission approved the reprogramming of the program which provides for new actions financed with ESF REACT-EU resources. Following the new rescheduling of the PON 2014-2020 for Research and Innovation, new interventions were financed relating to, among other things, research doctorates on green and innovation issues, research contracts, scholarships and economic support for students.

Outside the scheme described so far, the MUR also financed the Relevant National Interest Projects (*PRIN - Progetti di Rilevante Interesse Nazionale*[124]), a program that is intended to finance public research projects, with the aim of promoting the strengthening of national scientific bases, also in view of a more effective participation to European initiatives relating to the EU Framework Programmes for Research and

[123] http://www.agenziacoesione.gov.it/it/S3/S3_Nazionale/Strategia_nazionale_di_specializzazione_intelligente.html

[124] http://prin.miur.it/

Innovation. To this end, the PRIN program aims to finance projects which, due to their complexity and nature, may require the collaboration of several professors/researchers, whose financing needs exceed the normal availability of individual institutions.

The budget amounts to 420M €. This budget pertains to investment 1.1, Mission 4 "Education and research" - Component 2 "From research to business" of the National Recovery and Resilience Plan (PNRR).

The new PRIN call finances two-year projects that, due to their complexity and nature, may require the collaboration of several professors and researchers.

Compared to the previous period a new element that has affected the policy framework on research in Italy is the approval of the National Resilence and Recovery Plan (PNRR). The PNRR is a package of investments and reforms that is part of Next Generation EU (NGEU), the instrument established at European level to respond to the pandemic crisis and transform the economies of the member states in view of the future challenges including the ecological transition. The Italian Plan envisages investments for 191.5 billion euros, financed through the Recovery and Resilience Facility (RRF).

One of the six missions envisaged by the PNRR concerns 'Education and research'. This mission aims to promote a knowledge-intensive, competitive, and resilient economy, by strengthening the entire education and training system, enhancing digital and STEM (Science, Technology, Engineering, and Mathematics) skills, and supporting research activities and technology transfers. Another relevant mission of the PNRR regards the "Green Revolution and Ecological transition" that aims at increasing the sustainability and resilience of the Italian economy, by supporting a fair and inclusive transition. Relevant measures relate to sustainable mobility, the production and use of renewable energy, energy efficiency of private and public buildings, the circular economy, and management of water and waste as well as hydrogeological risks. To the "Green revolution and Ecologic transition" mission must be dedicated at least 37% of the fund according to the lines dictated by the EU. As regards Italy's NRRP, the Commission estimates the share of the allocation devoted to the green transition at 37.5 % (criterion No 5), which is a downwards revision of the government's assessment (40 %), but still above the RRF requirement (37 %). The second mission, "Green Revolution and Ecological Transition", allocates 68.6 billion - of which 59.4 billion from the RRF and 9.1 billion from the Complementary Fund. The National Plan must also be consistent with the country-specific challenges and priorities identified in the context of the European Semester and with the information contained in the National Reform Programmes, the National Energy and Climate Plans (PNIEC) and the Territorial Just Transition Plans.

Moreover, the MUR also supports the National Research Program in Antarctica (*PNRA – Programma Nazionale di Ricerca in Antartide*[125]). The last three-year strategy goes back to the period 2017 – 2019. In 2022 the Ministry launched a new call. The call aims at identifying project proposals for carrying out research activities aimed at deepening knowledge in Antarctica, and, obtaining a better understanding of the processes of interaction and connection between the different compartments of the Earth system (cryosphere, hydrosphere, atmosphere, biosphere and lithosphere).

The scientific topics considered are:

a) Life in Antarctica

b) The geology of Antarctica

c) The Antarctic ice system and sea level

d) The definition of the global impact of the Antarctic atmosphere and the Southern Ocean

e) The Universe above Antarctica and Space Weather.

f) Man in Antarctica: adaptation and impact

The total financial resources made available amount to €6,440,000.00

The Italian Ministry for University and Research also supports the Arctic Research Program (PRA – Programma di Ricerche in Artico; https://www.programmaricercaartico.it/). The Program was started in 2018, and the Arctic Scientific Committee defined the strategy for the three-year periods 2018-2020 and

[125] http://www.miur.gov.it/web/guest/programma-nazionale-di-ricerca-in-antartide

2021-2023. The strategy, approved by the Italian Ministry for University and Research and Ministry for Foreign Affairs and International Cooperation, focusses on 5 main research areas which are strongly related with climate processes and impacts. The identified research areas are as follows:

- Processes connected with the Arctic amplification
- Changes in atmospheric and marine composition and dynamics, also in relation with the hydrologic cycle and links with mid-latitudes
- Changes in the Arctic ecosystems
- Palaeoclimatology
- Climate change impacts on health, safety, and sustainable development of indigenous people in the Arctic.

The annual budget of PRA is 1 M€, annualy distributed mainly through open calls for research projects.

The Ministry of Agricultural and Forestry (*MASAF – Ministero dell'agricoltura, della sovranità alimentare e delle foreste*), contributes to shape the Italian landscape on climate research, as well. 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 2014-2020 (Piano strategico per l'innovazione e la ricerca nel settore agricolo, alimentare e forestale 20142020[126]).

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 aim is to coordinate national agricultural laws, the PNR and the national and regional policies cofinanced through European funds (ERDF, EMFF, SEF, etc.) in order to give to national research a coherent direction on this topic in the programming period 2014-2020.

8.2.2 Observations

According to the *PNR 2011-2013*, 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 Services* (Copernicus Climate Change Service-*C3S,* Copernicus Marine Environment Service-CMES, 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).

As seen above, in 2022, the Italian government has adopted, in the framework of the *Next Generation EU* (European Commission, 2022), the *National Plan for Recovery and Resilience (PNRR)* that includes financial measures dedicated to support employment, economy, and gender equality as well as to develop and implement innovative services aimed at protecting citizens and environment. Adaptation and mitigation measures and tools to reduce the climate change impacts play a key role in the national Plan strategic

[126] https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/9065

implementation. Moreover, an essential element is the *National Space Economy initiative* that, especially its link with Copernicus and other EU Flagship Programme, has introduced the *Mirror Copernicus Programme* to create an open, scalable, and interoperable system that will make it easier than ever to access data services from multiple information sources (in-situ instruments, remote sensing systems, models, etc.). In this context, as well as research field, Italy is fostering a national marketplace for Earth Observation (EO) services in specific thematic areas, basing on national competences and expertises and through the promotion of innovative public-private partnerships. These EO national services include coastal and maritime monitoring, climate and hydro-meteorological variables monitoring and forecasting, air quality monitoring and forecasting, water resources monitoring and management, monitoring of land cover and land use and emergency. The services will require a strong cooperation between institutions at national and local scales, and a continuous involvement of the Entrusted Entities responsible of the European Copernicus "core" Services to guarantee the maximum uptake of Copernicus data and information. In this contest, a *Memorandum of Understanding* between the Italian government - through the *MSE* - and the *Euorpean Centre for Medium-Range Weather Forecast (ECMWF*) – the Entrusted Entity for the *C3S* and *CAMS* (*Copernicus Atmosphere Monitoring Service*) – was signed on 24th October 2022, to support the development of information and tools for making informed choices relating to climate change mitigation and adaptation.

Furthermore, considering the increasing interest in satellites and constellations and the users' need of tailored EO products with proper spatial and temporal resolution, the *PNRR* provides investments for the design and development of a satellite constellation at low altitude ("IRIDE" constellation) and ground segment to support the national requirements from users communities, in synergy with the European Copernicus satellites.

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 (CREA CREA-Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria) https://www.crea.gov.it/home ;
- 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 for the Research on Terrestrial Ecosystems of the National Research Council (IRET CNR – Istituto di Ricerca sugli Ecosistemi Terrestri del Consiglio Nazionale delle Ricerche), https://www.iret.cnr.it/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 for BioEconomy of the National Research Council (IBE CNR - Istituto per la BioEconomia del Consiglio Nazionale delle Ricerche) https://www.ibe.cnr.it/;
- Institute for Agricultural and Forest Systems in the Mediterranean of the National Research Council (ISAFoM CNR, Istituto per i Sistemi Agricoli e Forestali del Mediterraneo del Consiglio Nazionale delle Ricerche), https://www.isafom.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/

- Institute for Hydrogeological Protection (IRPI Istituto di Ricerca per la Protezione Idrogeologica) https://www.irpi.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), https://www.ogs.it/it
- National Institute of Geophysics and Volcanology (INGV – Istituto Nazionale di Geofisica e Vulcanologia), https://www.ingv.it/it/organizzazione/dipartimenti-di-ricerca/dipartimento-ambiente
- National Interuniversity Consortium for Marine Sciences, (CONISMA), http://www.conismamibi.it/
- Water Research Institute of the National Research Council (IRSA CNR - Istituto di Ricerca sulle Acque), http://www.irsa.cnr.it/
- International Center in Environmental Monitoring, (CIMA Centro Internazionale in Monitoraggio Ambientale) https://www.cimafoundation.org/
- Zoological Station Anton Dohrn of Naples (Stazione Zoologica Anton Dohrn di Napoli), http://www.szn.it/
- Research Institute on Agriculture and Environment (Fondazione Edmund Mach) https://www.fmach.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 International Research Project

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) field. Furthermore, CMCC has the responsibility of the CMES medium range operational ocean predictions for the Mediterranean and Black Sea regional basins. An outcome of this activity is the annual Ocean State Report where the ocean climate indicators are developed and monitored at high resolution from the global ocean to the European Seas.

Similarly, CNR-ISAC is involved in international framework for the sub-seasonal-to-seasonal (S2S) and longer timescale simulation with the Italian atmospheric models' chain GLOBO/BOLAM/MOLOCH (https://www.isac.cnr.it/dinamica/projects/forecasts/) and with the European community model (EC-Earth, https://ec-earth.org/).

For the seasonal prediction activity, the CMCC Seasonal Prediction system (SPS) version 3 (CMCC-SPS3) has been implemented and extensively tested in the configuration with a ¼ degree in the ocean coupled to a 1degree horizontal resolution for the atmosphere, and then increasing the atmosphere horizontal resolution to ½ degree (CMCC-SPS3.5). The number of ensemble members has set to 50 (40 for hindcasts along 1993-2016). Starting from 2018 and then with the new version since 2020, the CMCC-SPS is used to produce the operational seasonal outlook on a monthly basis for the C3S seasonal multi-system (https://climate.copernicus.eu/seasonal-forecasts). 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 further international programs of multimodel ensemble predictions such as, for example, 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.

Then, there is also the sub-seasonal to seasonal prediction project (S2S) that is a 5-year project, established in 2013 by the World Weather Research Program (WWRP) and the World Climate Research Program (WCRP). The S2S project was established to improve forecast skill and understanding on the sub-seasonal to seasonal time scale and promote its uptake by operational centres and exploitation by the applications community.

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. These data are freely available for research purposes and can be downloaded through the ESGF[127] (Earth System Grid Federation) portal and, some of them, also in C3S Climate Data Store (CDS)[128].

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 (2006.2100) according to the IPCC RCP2.6, RCP4.5 and RCP8.5 scenarios. Data from several Regional Climate Models (RCMs) are available, driven by different General Circulation or Earth System Models (GCMs/ESMs); 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. 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 follow-up of previous and existing initiatives. It represents a framework where the research community makes 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 Models.

MENACORDEX is one of the last domains 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).

It has also to be mentioned that on Copernicus data store are also available many climate services based on EURO-CORDEX and also some on MED-CORDEX permitting the support for impact and risk analysis for many different sectors (e.g., health, water management, agriculture, infrastructure).

At CMCC, results of regional simulations over Italy have been previously published using the COSMOCLM model at spatial resolution of 0.0715° (about 8 km) over the period 19712100, driven by the GCM CMCC-CM 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 has been used for several applications,

[127] https://www.euro-cordex.net/060378/index.php.en

[128] https://cds.climate.copernicus.eu/cdsapp#!/dataset/projections-cordex-domains-single-levels?tab=overview

especially as input for impact models, for evaluation of climate change effects on different hydrogeological hazards (drought, flooding and landslides). Data are currently freely available on the CMCC Data Delivery System (DDS)[129]. In the context of the HIGHLANDER project, CMCC exploited CINECA High Performance Computing (HPC) resources for further downscaling the ERA5 reanalysis at about 2km horizontal resolution, at hourly time step from 1981 to 2020, to be used for past studies and evaluation. Such data are completely available on the project's platform as well as CMCC DDS[130] and provided with the reference scientific publication. Still in the framework of the Highlander project, downscaled climate projections at about 2 km, at hourly time step, with historical forcing (1981-2005) and under IPCC RCP4.5 and RCP8.5 scenarios (2006-2070) have been conducted using CINECA and CMCC HPC, and will be soon available on project's platform and CMCC DDS. These simulations have the goal to permit the assessment of the added value of Convection Permitting Model (CPM) for specific analysis (for example based on hourly and extreme data) and sectorial evaluation. Assessment of CPM added values is also a topic developed by CORDEX-FPS convection (https://www.hymex.org/cordexfps-convection/wiki/doku.php).

The UN Decade of ocean science for Sustainable Development has started its activities in 2021 and will continue up to 2030. This is a major international effort to advance ocean science and find solutions to ocean management issues in a changing climate. Italy contributes with two UN endorsed Programmes, CoastPredict (https://www.coastpredict.org/) to transform coastal ocean observing and modelling, coordinated by the University of Bologna, and the Mediterranean that We Want-SciNMeet coordinated by CNR.

In addition, the University of Bologna hosts the UN Decade Collaborative Center for Coastal Resilience that will coordinate all Decade Actions related to the Decade Community of Practice on Coastal Resilience.

At CNR-ISAC, the group on "Climate and Meteorology, modelling and Earth observations" (CAMEO) has developed and continues to maintain an original model chain to simulate the atmospheric circulation from the global to the local scale, at different temporal ranges. GLOBO is the global-scale hydrostatic general circulation model of the atmosphere, based on the equations and parameterization set of the limited area model BOLAM. MOLOCH is the non-hydrostatic mesoscale model with an explicit treatment of convection. This model chain is operated in the framework of a multi-annual agreement between CNR-ISAC and the Italian Civil Protection Department (DPC) to provide daily forecasts at different scales and up to 7 days. In the agreement with DPC, GLOBO is also used to issue, on a weekly basis, monthly ensemble forecasts: a 41-member ensemble of simulations with a horizontal resolution of about 50 km at mid-latitudes produces probabilistic 32-day forecasts. The real-time forecasts are calibrated through the reforecast dataset produced with GLOBO and covering a climatic reference period. With the same ensemble forecasting activity CNR-ISAC is one of the 12 forecasting centres participating in the WWRP/WCRP Subseasonal-to-Seasonal (S2S) Project. GLOBO forecasts and reforecast are contributed to the S2S database since late 2015. In the context of the S2S Project, CNR-ISAC participated in the Real-Time Pilot Initiative, where S2S data were shared in real-time among the participating centres to explore the benefits of real-time subseasonal forecast applications provided to selected end users. In addition, GLOBO is involved in the SPARC-S2S project Stratospheric Nudging And Predictable Surface Impacts (SNAPSI), a multi-model numerical experiment to investigate the predictability of stratospheric polar vortex disturbances and their tropospheric impact on the subseasonal scale.

At the climate timescale, the CAMEO group contributes to the development and update of state-of-the-art EC-Earth Earth System Model taking part into the EC-Earth consortium (https://ec-earth.org/). Within the consortium, ISAC-CNR is currently participating in the development and testing of the 4th generation of the EC-Earth ESM, namely EC-Earth4. ISAC-CNR has performed many simulations with the previous versions of EC-Earth (EC-Earth2 and EC-Earth3) contributing to various WCRP model intercomparison projects (MIPs): CMIP5, CMIP6 Deck, ScenarioMIP, HigResMIP, DCPP, among others. Using EC-Earth, ISAC-CNR has taken part to several EU-funded activities, aimed at exploring the capabilities of the model under different horizontal resolutions (H2020 PRIMAVERA), looking for critical transitions under specific forcing scenarios and analysing the response of global climate to changes in the freshwater influx in the North Atlantic (H2020 TiPES), exploiting the observations and land-surface representation for seasonal and

[129] https://dds.cmcc.it/#/dataset/climate-projections-8km-over-italy/historical
[130] https://dds.cmcc.it/#/dataset/era5-downscaled-over-italy/VHR-REA_IT_1989_2020_hourly

decadal prediction (H2020 CONFESS). ISAC-CNR is also taking part in the Destination Earth Climate Adaptation Twin to develop and deliver km-scale climate integrations for adaptation purposes (ECMWF DE_340). Regarding model analysis and intercomparison, the CAMEO group is participating, coordinating or leading activities in several fields: providing readily usable, seamless model diagnostics (ESMValTool, C3S), understanding the mechanisms driving North Atlantic climates that are crucial for their impacts on Europe (JPI ROADMAP). For the next generation of ESMs, ISAC-CNR will contribute to the evolution and improvement of EC-Earth considering new/updated parametrizations and increased horizontal resolution (OptimESM HE).

Part of the climate modelling activity is devoted to the development of an integrated meteo-climate general circulation model based on the GLOBO/BOLAM core. Specifically, efforts are dedicated to extend the domain of applications of GLOBO to climate-relevant scales, focusing on conservation issues, improving/upgrading physical parameterizations, and enabling the coupling with a state-of-the-art ocean model (e.g. ShyFEM, NEMO or FESOM) through the inclusion of the coupling libraries (e.g. OASIS-MCT). This activity will lead to a prototype coupled (ocean-atmosphere) forecast system for sub-seasonal, seasonal and possibly longer-range applications.

In order to set up a proper model hierarchy, efforts are devoted to maintenance and development of simplemodels, ranging from Energy Balance Models (EBM) through intermediate complexity (SPEEDY, SPEEDY-NEMO) up to simplified coupled general circulation models (PlaSim-LSG). This model hierarchy is crucial in order to understand specific modes of variability (e.g., ENSO, monsoons, the AMOC), and also allow to explore more completely the conservation properties, equilibrium climate sensitivity and the response to external forcings by the more complex ESMs. Inspecting the impact of stochastic physics on climate models' performance and evaluating their benefits with respect to enhanced model resolution is another core research activity in CAMEO.

Moreover, in the framework of the group “Impacts on Environment, Cultural Heritage and Human Health” (IMPEACH), CNR-ISAC is working on studies related with the risk assessment for cultural heritages and landscapes in the changing climate. Natural and man-made hazards, anthropogenic effects and extreme climate change events, are persistently putting the cultural heritage and landscapes of Europe under pressure, with a daily incremental frequency. In addition, such disasters and catastrophes compound the conservation challenges and needs of the heritage assets. In this perspective, tools for risk mapping, transnational preparedness strategies, coordinated evacuation plans in emergency situations and systems for early warning specifically dedicated to the protection of heritage assets, need to be set up and subsequently integrated in the approaches and international agreements for Disaster Risk Reduction and Management. CNR-ISAC is involved in research on adaptation strategies, methodologies and other remedial tools, in order to safeguard Europe's cultural heritage from the continuous pressures it faces and the related consequences. In particular, CNR-ISAC is developing models for risk assessment in complex scenarios (e.g., historic centres, archaeological sites and terraced landscapes) exposed to multiple hazards due to climate change and provides risk mapping for landscape extreme weather conditions at short, medium and long terms (see e.g., INTERREG Central Europe Projects “ProteCHt2save” and “STRENCH”).

8.3 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 (€)
AGREED	Agriculture, Green & Digital	MUR PON	11/2020- 04/2023	Corvallis S.p.A.	CIHEAM Istituto Agronomico Mediterraneo di Bari (IAMB), Consorzio Interuniversitario Nazionale per l'Informatica – CINI, CMCC, Horta S.r.l., Infobiotech S.r.l., Politecnico di BARI, UKE - Università Kore di ENNA	7,992,909.80
CIR PER-ACTRIS-IT	Rafforzamento del Capitale umano per ACTRIS Italia	MUR	Jan 2021 - July 2025	CNR-DSSTTA	CNRISAC, CNRIMAA, ENEA, INFN, UniAQ, UniNA, UniSa;	1,921,711
CIR01_00019 - PROICOS_MED	Rafforzamento del Capitale umano per ICOS Italia	MUR	Jan 2021 - July 2025	CNR-DSSTTA	CNRISAC, CNRIMAA, ENEA, CREA	1,978,468
CLARA2	CLouds And Radiation in the Arctic and Antarctica https://www.thuleatmos-it.it/	MUR through PNRA	May 2019 Nov. 2022	ENEA	INGV, University of Rome "La Sapienza", CNR-IMAA	125,400
ICOS Italy	ICOS Italy Joint Research Unit (JRU) https://www.icos-italy.it/	MUR via CNR	2016 – multiyear renewal	CNR	Partners making part of the ICOS-IT JRU	400,000- 500,000/year
JRU ICOS-IT	Joint Research Unit "ICOS-Italia"	CNR	Sep 2021 -	CNR	CMCC, UniTiscia, CREA, ENEA, ARPA VdA, Provincia Autonoma di Bolzano, FEM, UniSass, UniGe, UniCatt, OGS, UniBz, UniUdine, RSE S.P.A.	N.A>
LO@DC	Lidar Observatory @ Dome C	MUR PNRA	N.A.	CNRISAC	CNR	N.A.
MARISA	MARISA Maritime Integrated Surveillance Awareness https://www.marisaproject.eu/	H2020	2018 2020	Leonardo SpA	University of Bologna	120,000
MADAMES and MADAMES-AX	Mitigation and ADaptation Analysis for Mediterranean Ecosystem Services (Pathfinder and Accelerator projects); https://www.madames-ax.info/	EIT Climate KIC	2018; 2020	MEEO srl	CMCC PEFC Italia	170,250 (both projects)
N.A.	Italian Antarctic MeteoClimatological Observatory at MZS and in the Victoria Land	MUR through PNRA	Feb. 2017 Jan. 2023	ENEA	ENEA	100,000

N.A.	Italian Antarctic MeteoClimatological Observatory at Concordia	MUR through PNRA	Feb. 2017 Jan. 2023	ENEA	ENEA	99,000
N.A.	Convenzione per la Manutenzione straordinaria e upgrade della Rete degli Osservatori Permanenti nell'ambito del Programma Nazionale di Ricerche in Antartide	MUR through CNR	Sep. 2020 Nov. 2022	ENEA	ENEA	92,700
OPLAM	Open Lab per l'Atmosfera e il Mare	Regione Lazio	2016-2018	CNRISAC	CNR	N.A.
PER-ACTRIS-IT	Potenziamento della componente italiana della Infrastruttura di Ricerca Aerosol, Clouds and Trace Gases Research Infrastructure	MUR	June 2019 – June 2023	CNR-DSSTTA	CNRISAC, CNRIMAA, ENEA, INFN, UniSal, UniNA, UniAQ	19,998,000
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
SOLAS Italy	Surface Ocean Lower Atmosphere Study	Future Earth	2015-2020	CNR	http://www.isac.cnr.it/solas/participants	N.A.
SENTINEL	SENTINEL - The impact of sea ice diSappearance on highEr North aTlantic clImate and atmospheric bromiNe and mErcury cycLes	MUR through PRA	2019-2022	CNR	Univ. Ca' Foscari, ENEA, CNR	154,000
n.a.	The host-parasite association formed by anisakid parasites and their fish hosts: a model to investigate temporal changes in marine Arctic biodiversity and trophic webs	MUR through PRA	2020-2022	Sapienza University of Rome	Tuscia University	69,000
PAST-HEAT	PermAfroSt Thawing: what Happened to the largest tErrestrial cArbon pool during lasT deglaciation? Acronym: PAST-HEAT	MUR through PRA	2020-2022	CNR	CNR, OGS, Stockholm University	136,000
EcoClimate	Nutrient cycling, ecosystem functioning and climate change in Arctic lake ecosystems - EcoClimate	MUR through PRA	2020-2022	Sapienza University of Rome	CNR	132,000
ECAPAC	Effects of changing albedo and precipitation on the Arctic climate	MUR through PRA	2020-2022	ENEA	INGV, Sapienza Univ. of Rome, Lamont-Doherty,	177,000
A-PAW	Air Pollution in the Arctic Winter (A-PAW): an Italian contribution to the ALPACA field experiment	MUR through PRA	2020-2022	CNR	CNR, Univ. Ca' Foscari	101,000
n. a.	Abrupt climate change and Greenland ice cover in a high-resolution ice core record	MUR through PRA	2021-2022	Univ. Ca' Foscari	Univ. Milano Bicocca	103,279
MICROTRACER	Small MICROplastics (<100 µm) bioindicaToRs in the changing ArctiC EnviRonment	MUR through PRA	2021-2022	CNR	Padua University; ENEA; Sapienza Univ. Of Rome	95,953
ICED EARTH	Interactions between the CryospherE and Dust	MUR through PRA	2021-2022	Univ. Milano		69,600

	in the EARTH system			Bicocca		
CHANGE	Fish communities of Northeastern Greenland shelf at a glance: diversity, functioning and resilience	MUR through PRA	2021-2022	CNR	Stazione Zoologica; Sapienza University of Rome	112,000
CASSANDRA	AdvanCing knowledge on the present Arctic Ocean by chemical-phySical, biogeochemical and biological obServAtioNs to preDict the futuRe chAnges	MUR through PRA	2021-2022	CNR		112,000
BETHA-NyÅ	Boundary layer Evolution Through Harmonization of Aerosol measurements at Ny-Ålesund research stations	MUR through PRA	2021-2022	CNR	University of Florence, University of Genova; University of Perugia; INFN	107,840
IRIDYA	Integrated Reconstruction of Ice sheet DYnamics during late quaternary Arctic climatic transitions	MUR through PRA	2021-2022	OGS	INGV; Pisa University; Ca' Foscari University	103,158
Melting ICE	Impact of climate change-induced permafrost and ice melting on the biodiversity and ecosystem functioning of Arctic environments	MUR through PRA	2021-2022	Naples University Federico II	CNR, Perugia University	115,989
ICEtoFLUX	HydrologIcal changes in ArctiC Environments and waterdriven biogeochemical FLUXes	MUR through PRA	2021-2022	CNR	Turin Politechnic University, Bari University	90,159
SUSTAINadapt	Strumenti e approcci per declinare l'integrazione fra sostenibilità e adattamento	MASE - Bando per promuovere progetti di ricerca a supporto dell'attuazione della Strategia Nazionale per lo Sviluppo Sostenibile	28/09/2020 28/03/2022	UNISS	CMCC	153,000
Convenzione MASE DG SVI 2 – 3 – 4 – 5	Continuazione di supporto tecnico scientifico nell'ambito delle negoziazioni multilaterali della Convenzione Quadro ONU sui Cambiamenti Climatici (UNFCCC) e del Comitato Intergovernativo sui Cambiamenti Climatici (IPCC)	MATMM	From 23/01/2017 to 30/06/2022	CMCC	CMCC	around 250,000,00/year
PNRR - CN - HPC	Big data e Quantum Computing Spoke: Spoke Earth and Climate	NRRP – National Recovery and Resilience Plan	01/09/2022 31/08/2025	INFN	INFN, CINECA, GARR, CNR, INAF, INGV, IIT, CMCC, FBK, ENEA, CRS4, OGS, Università di Bologna, Università di Ferrara, Università di Bari, Università di Milano Bicocca, Sapienza Università di Roma, Università degli Studi di Roma Tor	306,213,979

					Vergata, Università di Trieste, UniPd, Università di Pavia, Unitn, UniTo, Università dell'Aquila, Università Federico II di Napoli, Università di Pisa, Università di Firenze, Università di Catania, Università della Calabria, Università del Salento, Università di Modena e Reggio Emilia, Università di Parma, Politecnico di Bari, Politecnico di Milano, PoliTO, SNS Scuola Normale Superiore, SISSA Scuola Internazionale Superiore di Studi Avanzati, Gruppo Autostrade, Engineering Ingegneria Informatica, Eni, Ferrovie dello Stato, Fincantieri, Fondazione Innovazione Urbana, IRCCS Istituto Clinico Humanitas, IFAB International Foundation Big Data and Artificial Intelligence for Human Development, Intesa Sanpaolo, Leonardo, Sogei, Thales Alenia Space Italia, Terna, UnipolSai Assicurazioni.	
PNRR - CN - NBFC (Marino)	National Biodiversity Future Center Spoke Marino	NRRP – National Recovery and Resilience Plan	01/09/2022 31/08/2025	CNR	CNR:OGS, INFN, la Stazione Zoologica Anton Dohrn, Polimi, l'Università degli Studi del Molise, Unitus, Unifi, Unimib, Unimore, Unina, Unipa, Unipv, Uniroma1, Uniss, Unisa, Unisi, Uniud, Univr, Uniroma3, Unisalento, Unibo, Unige, Unipd, Univpm, Unito, Aboca SPA Società Agricola, CINECA, CMCC, CORILA, CREA Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Dompé farmaceutici S.p.A., ENEA, ENEL, ERSAF - Ente di Ricerca Scientifica ed Alta Formazione, Fondazione CIMA, Fondazione Edmund Mach di San Michele all'Adige, Fondazione IMC Centro Marino Internazionale ONLUS, Fondazione Ri.MED, FS Sistemi Urbani, HUMANITAS UNIVERSITY, Infrastrutture S.p.A., Innomed srl, Istituto Italiano di Tecnologia, Istituto Superiore per la Protezione e la Ricerca Ambientale, Novamont S.p.A., Università Campus Bio-Medico di Roma, SSUP (Sant'Anna) e UNICATT.	320,086,665
PNRR - CN - NBFC (Terrestre)	National Biodiversity Future Center Spoke Terrestre	NRRP – National Recovery and	01/09/2022 31/08/2025	CNR	Cnr, OGS, INFN, la Stazione Zoologica Anton Dohrn, il Politecnico di Milano,	320,086,665

		Reslience Plan			Unimol, UNITUS, l'Università degli Studi di Firenze, Unimib, UNIMORE, Unina, Unipa, Unipv, Uniroma1, Uniss, UNISA, Unisi, Uniud, Univr, Uniroma3, Unisalento, Unibo, Unige, Unipd, Univpm, Unito, Aboca SPA Società Agricola, CINECA, CMCC, CORILA, CREA, Dompé farmaceutici S.p.A., ENEA, ENEL, ERSAF, Fondazione CIMA, Fondazione Edmund Mach di San Michele all'Adige, Fondazione IMC Centro Marino Internazionale ONLUS, Fondazione Ri.MED, FS Sistemi Urbani, HUMANITAS UNIVERSITY, Infrastrutture S.p.A., Innomed srl, Istituto Italiano di Tecnologia, ISPRA, Novamont S.p.A., Università Campus Bio-Medico di Roma, Scuola Superiore di Studi Universitari e di Perfezionamento Sant'Anna, UNICATT.	
PNRR - CN - AGRITECH	Centro Nazionale Ricerca per le Tecnologie dell'Agricoltura Spoke 7: Integrated Models for the development of marginal areas to promote multifunctunal production systems enhancing agroecological and socio-economic sustainability	NRRP – National Recovery and Reslience Plan	01/09/2022 31/08/2025	Università degli Studi di Napoli Federico II	UNINA, CNR, Uniba, Unibo, Unimi, Unipd, UNIsi, Unito, UNITUS, CMCC, CREA, New Technologies, Energy and Sustainable Economic Development, Fondazione Edmund Mach di San Michele all'Adige, Polimi, Polito, SSUP, Unibas, Università di Bolzano, Università Campus Bio-Medico di Roma, UNICATT, Università di Catania, Università di Foggia, Università di Firenze, Unige, Università di Perugia, Unipi, Università di Parma, Università di Reggio Calabria, Uniroma1, Università di Salerno, Università di Sassari, Università di Udine, Univpm, Antares Vision, Consorzi Agrari d'Italia, Gruppo Casillo, CNH Industrial, De Matteis Agroalimentare, e-geos S.p.A., Engineering, Eni, Graded, IBF Servizi, Irritec, Relatech, Società Sementi Italiana, Telespazio, IBF Servizi, Fondazione Cassa Depositi e Prestiti, Intesa San Paolo e Nestlé.	320,070,095
Contratto di Ricerca "FIT for 55"	Contratto di Ricerca "FIT for 55"	Ministero delle Infrastrutture e della Mobilità Sostenibili	01/06/2022 31/12/2022	CMCC	CMCC	41,124
Dottorati -	Integrazione di dati, metodi e tecnologie a	Università degli	01/07/2022	Università degli	CMCC	67,500

Regione Lazio	supporto di una gestione climate smart e sostenibile dei laghi e dei loro servizi ecosistemici	Studi Niccolò Cusano (Regione Lazio)	30/06/2025	Studi Niccolò Cusano	Università degli Studi Niccolò Cusano	
BTOLIUM	Modelli sostenibili per la rigenerazione, la protezione e la valorizzazione del patrimonio naturale	Compagnia di San Paolo, Bando Restauro Ambientale Sostenibile	23/09/2022 31/12/2022	Comune di Bioglio	CMCC Comune di Bioglio POLITO Istituto italiano ricerca e sviluppo - Organismo di ricerca srl Associazione Artieri	5,100
Un filo Naturale	Una comunità che partecipa per trasformare la sfida del cambiamenti climatico in opportunità https://www.cmcc.it/it/articolo/un-filo-naturale-una-comunita-che-partecipa-per-trasformare-la-sfida-del-cambiamento-climatico-in-opportunita	Fondazione Cariplo	01/03/2021 28/02/2022	Comune di Brescia	CMCC Comune di Brescia Parco delle Colline Ambiente parco	6,280,000
FEAMP	Approccio ecosistemico come strumento per supportare la protezione e la gestione dei siti Natura 2000 in aree fortemente antropizzate https://www.cmcc.it/it/projects/feamp-ecosystem-approach-to-support-the-protection-and-management-of-natura-2000-sites-in-heavily-anthropized-areas	MIPAAF - PO FEAMP 2014/2020 - Misura 1.40	03/03/2021 02/09/2021	CMCC	CMCC	200,000
MITIGO (Smart Communities) ARS01_00964	Mitigazione dei Rischi Naturali per la Sicurezza e la Mobilità nelle Aree Montane del Mezzogiorno https://www.mitigoinbasilicata.it/home/	PON Ricerca e Innovazione 2014-2020 - MUR	01/09/2020 31/12/2023	Università della Basilicata	Unibas, Poliba, Unitn, CUGRI), Unina, Unisa, CMCC, Regione Basilicata – Dipartimento Infrastrutture e Mobilità, CREATEC S.c.r.l., Cedat Europa S.r.l. Centro Dati e Servizi per l'Ambiente e il Territorio, Geocart S.p.A. INNOVA Consorzio per l'Informatica e la Telematica S.r.l., Openet Technologies S.p.A., PUBLISYS S.p.A., Sintesi S.r.l., Exprivia S.p.A., TAB Consulting S.r.l., TeRN, Istituto di Metodologie per l'Analisi Ambientale di Tito Scalo (PZ) – Consiglio Nazionale delle Ricerche e-GEOS S.p.A	
FISH RISE (BG - ACQUACOLTURA) ARS01_01053	Remote, Intelligent & Sustainable aquaculturE system for Fish https://www.cmcc.it/projects/fish-rise-remote-intelligent-sustainable-aquaculture-system-for-fish	PON Ricerca e Innovazione 2014-2020 - MUR	01/09/2021 30/11/2023	XENIA PROGETTI SRL	UniSalento, Uniupo, Amedeo Avogadro, Fondazione Istituto Italiano di Tecnologia Apphia S.r.l., Unitus, Badinotti Group S.p.A., CMCC, Istituto Cooperativo di Ricerca Soc.Coop. , Maricoltura Mattinatese Società Cooperativa Agricola, ISPRA	9,020,938
AGREED	AGREED – Agricolture, Green & Digital	PON Ricerca e	01/11/2020	Corvallis	CIHEAM Istituto Agronomico	8,783,417

(AGRIFOOD) ARS01_00254		Innovazione 2014-2020 - MUR	30/04/2023		Mediterraneo di Bari (IAMB) CMC S.r.l. Consorzio Interuniversitario Nazionale per l'Informatica - CINI Corvallis S.r.l. CMCC Horta S.r.l. Infobiotech S.r.l. Politecnico di BARI UKE - Università Kore di ENNA	
ISMEA - CMCC	Attività di ricerca in materIa di valutazione del contributo dell'Agricoltura italiana alla mitigazione dei cambiamenti climatici nell'ambito della convenzione tra MASE e ISMEA	ISMEA (Istituto di Servizi per il Mercato Agricolo Alimentare)	13/07/2018 27/01/2019	CMCC	CMCC	37,240
ECCAP	Ecological Calendars and Climate Adaptation in the Pamirs http://nemesi-project.it/partners/privres	Convenzione CNR - DTA (Nextdata funds), progetto Belmont Forum	01/03/2017 31/12/2018	CMCC	CMCC Centro di Ricerca, Sperimentazione e Formazione in Agricoltura Centro Internazionale di Alti Studi Agronomici Mediterranei – Istituto Agronomico Mediterraneo di Bari Federazione Provinciale Coldiretti Lecce, Lab. Instruments S.R.L. Leanfa S.R.L., Licofarma S.R.L. Nanoshare Srl, Phy.Dia. S.R.L. Spagro S.R.L., Studio Effemme Chimica Applicata S.R.L. Unitus, UniSalento	80,000
ISMEA - CMCC 3	SERVIZIO DI AVANZAMENTO DI UN PROGETTO DI SVILUPPO DI UN MECCANISMO VOLONTARIO PER LA RIDUZIONE E LA COMPENSAZIONE DELLE EMISSIONI ZOOTECNICHE CLIMALTERANTI MEDIANTE AZIONI VIRTUOSE REALIZZATE NEL SETTORE AGROFORESTALE, ATTUABILE A LIVELLO DI DISTRETTO AGRICOLO-ZOOTECNICOFORESTALE	ISMEA (Istituto di Servizi per il Mercato Agricolo Alimentare)	16/02/2022 30/07/2023	CMCC	CMCC Centro di Ricerca Intedipartimentale Laboratorio Urbanistica e Pianificazione Territoriali - Università di Napoli D'Urso Loredana Don Marcello Società Agricola Liberti Paolo Università degli Studi della Tuscia	57,905.00
IFAB - E3CI	European Extreme Events Climate Index (E3CI) 2.0 https://coast-puglia.it/portal/previsioni-puglia	IFAB - International Foundation Big Data & Artificial Intelligence For Human Development	09/02/2022 15/02/2023	IFAB	CMCC Centro di Geomorfologia Integrata per l'Area del Mediterraneo Consorzio per il coordinamento delle ricerche inerenti al sistema lagunare di Venezia Geoprove Srl Impreservice Srl	120.000,00

					Istituto Nazionale di Geofisica e Vulcanologia Moreno SPA Pernice Umberto Provveditorato Interregionale alle Opere Pubbliche per il Veneto-Trentino Alto Adige-Friuli Venezia Giulia, SPIRE Srl, Università degli Studi di Catania, Università del Salento	
AQP	Valutazione dei Rischi Climatici e della Vulnerabilità del Sistema AQP" con riferimento all'Ambito di Rischio Operativo ("ARO") 1 "Sicurezza Risorsa Idrica" https://www.innodunecost.it/it/soggetti-nel-progetto.html	Convenzione Acquedotto Pugliese	01/08/2022	CMCC	Athanor Consorzio Stabile Scarl Geoprove S.R.L. Moreno S.P.A. Sipre S.R.L. Impreservice S.R.L. Cmcc Universita' Del Salento Consorzio Di Gestione Area Marina Protetta Porto Cesareo Cna Balneatori Puglia Centro Di Ricerche Europeo Di Tecnologie Design E Materiali (Cetma)	
DaJS		Convenzione DAJS - Distretto Agroalimentare di Qualità Jonico-Salentino	01/08/2022	CMCC	CMCC	
CUBA TRAINING	STRENGTHENING THE CUBAN MARINE METEOROLOGICAL SYSTEM (MARINE SURVEILLANCE - Training	e-GEOS (UNDP funds)	01/07/2022 30/09/2022	CMCC	CMCC	88.600,00
Studio Progetto Ambiente	Fornitura Dati piattaforma DATACLIME	Studio Progetto Ambiente	01/04/2022 01/05/2022	CMCC	CMCC	1.600,00
FIRESPILL	SERVIZI DI ASSISTENZA TECNICA E SUPPORTO ALLA SEZIONE PROTEZIONE CIVILE DELLA REGIONE PUGLIA PER L'ATTUAZIONE DELL'AZIONE PILOTA 4.3 DEL PROGETTO STRATEGICO FIRESPILL (FOSTERING IMPROVED REACTION OF CROSSBORDER EMERGENCY SERVICES AND PREVENTION INCREASING SAFETY LEVEL) FINANZIATO DAL PROGRAMMA DI COOPERAZIONE TERRITORIALE EUROPEA INTERREG CBC ITALIA – CROAZIA 2014/2020 https://www.italy-croatia.eu/web/firespill	Regione Puglia, Protezione Civile	15/12/2021 31/12/2022	CMCC	CMCC	140.146,00

TERNA - NOWCASTING	Sviluppo di un modello predittivo con tecniche di Nowcasting - FASE 1 Sviluppo della metodologia e applicazione del modello ad una sola zona di mercato https://apollon-project.it/	TERNA Rete Italia	12/05/2021 11/05/2022	RINA	CMCC Alba Project - Inventive Solutions Srl AMIGO s.r.l. Consorzio Interuniversitario Nazionale per l'Informatica Corvallis Spa HESPLORA srl Politecnico di Bari	110.000,00
INHALE	Impact on Human heatlth of Agriculture and Livestock Emissions https://www.cmcc.it/it/projects/inhale-impact-on-human-health-of-agriculture-and-livestock-emissions	Fondazione Cariplo , Bando Data Science for Science and Society	01/09/2021 28/02/2023	Università Bocconi	CMCC, Unibocconi, Legambiente Lombardia	125.000,00
Supporto Bando MUTAMENTI	supporto della Missione Proteggere l'ambiente – Obiettivo Pianeta della Fondazione Compagnia San Paolo, in particolare per il supporto al bando "MUTAMENTI – Idee e azioni per il clima che cambia"	Compagnia di San Paolo, Bando MUTAMENTI	15/06/2021 31/12/2021	CMCC	CMCC	90.280,00
Convenzione DIBAF 2021	Convenzione DIBAF 2021	Convenzione DIBAF	28/01/2021 27/01/2022	CMCC	CMCC	50.000,00
Convenzione DIBAF 2019-2020	Convenzione DIBAF 2019-2020	Convenzione DIBAF	07/06/2019 31/12/2020	CMCC	CMCC	50.000,00
RESTORE	Ridurre l'Erosione del Suolo Tramite buOne pRatiche di gEstione https://www.progettorestore.cloud/	PSR Misura 16.5.1 GAL (Gruppo di Azione Locale) Terra E' Vita (regione Campania)	15/02/2021 31/12/2021	CMCC	CMCC	53.700,00
UNIPALMA	Convenzione Esecutiva per lo svolgimento di attività di Ricerca sul tema "Olio di Palna e Sostenibilità"	Unione Italiana per l'Olio di Palma Sostenibile (UNIPALMA)	14/09/2020 13/09/2021	CMCC	CMCC	45.000,00
SIMPLe	Sistemi Integrati autoMatizzati Per la coLtivazione Indoor https://www.progettosimple.it/index.php	PSR Regione Puglia 2014 2020, Misura 16 -	02/07/2020 01/07/2022	CMCC	CMCC, Coldiretti Lecce, Cooperativa Hydra, UniSalento, Azienda Agricola Masseria Bianca O.P. Società Agricola Cooperativa San Rocco, Università Di Bari, Smarteducationlab New Generation Aquaponics Srl Joulehub Mediterranean Srls	500.000,00
Strategia	Servizi Di Supporto Specialistico Per Le Attività	LAZIO INNOVA SPA	26/01/2022	CMCC	CMCC	69.152,00

Regionale per lo Sviluppo Sostenibile - Lazio - 2	Di Elaborazione Di Modelli E Scenari A Livello Regionale E Settoriale E L'organizzazione Di Focus Group, Incontri E/O Seminari Formativi Per Gli Stakeholders E Le Imprese Del Territorionell'ambito Della Definizione Del Contributo Dell'adattamento Ai Cambiamenti Climatici Alla Strategia Regionale Di Sviluppo Sostenibile (Srsvs)		31/05/2022			
Strategia Regionale per lo Sviluppo Sostenibile - Molise	Servizi di supporto specialistico per l'Elaborazione Strategia Regionale per lo Sviluppo Sostenibile della Regione Molise	Regione Molise	20/09/2021 31/12/2021	CMCC	CMCC	31.080,00
Strategia Regionale per lo Sviluppo Sostenibile - Molise	Servizi di supporto specialistico per l'Elaborazione Strategia Regionale per lo Sviluppo Sostenibile della Regione Molise	Regione Molise	13/01/2020 17/09/2020	CMCC	CMCC	35.000,00
INVASI	International Variability of the Antarctic Sea Ice/ocean system from ocean reanalysis	MUR - Ministero dell'Università e della Ricerca, Progetti di Ricerca rivolte ad approfondire le conoscenze in Antartide (PNRA 2018)	27/03/2019 26/03/2021	CMCC	CMCC	76.400,00
FERS	Future Earth Research School https://www.cmcc.it/projects/fers-future-earth-research-school	Regione Emilia-Romagna - Progetti Triennali di Alta Formazione in ambito culturale, economico e tecnologico	01/09/2019 30/12/2021	CMCC	CMCC	560.000,00
Torno Subito 2019 (Candidata: Alessandra Santini)	Metodi quantitativi e sistemi informativi geografici per la valutazione degli impatti dei cambiamenti climatici in agricoltura	Regione Lazio - TORNO SUBITO 2019 Programma di interventi rivolto a studenti universitari e laureati	09/03/2020 31/08/2020	CMCC	CMCC	0,00
Torre Guaceto - MYSEA	Programma sperimentale di monitoraggio ambientale della caretta caretta "MYSEA	Consorzio di gestione di Torre	20/12/2019 19/12/2020	CMCC	CMCC Consorzio di gestione Torre Guaceto	127.920,00

	osservatorio sui mari di Puglia per la tutela della caretta caretta" https://www.cmcc.it/projects/mysea-torre-guaceto	Guaceto				
Accordo Attuativo di Collaborazione UNINA (CRISP) - CMCC	Accordo Attuativo di Collaborazione UNINA (CRISP) - CMCC	UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II (UNINA - CRISP)	30/09/2019 30/09/2020	CMCC	CMCC	23.000,00
Corila Venezia 2021	Convenzione per la collaborazione nella ricerca - Progetto Corila "VENEZIA 2021" http://www.corila.it/it/Venezia2021	Università Ca' Foscari Venezia	18/09/2019 31/10/2021	CMCC	CMCC Unversità di Venezia IUAV	110.000,00
SUPER (INSPIRE)	Supercomputing Unified Platform https://www.hpc.cineca.it/projects/super	Regione Emilia-Romagna POR FESR 2014-2020 -	18/12/2019 17/06/2021	CINECA	CMCC, CINECA, ENEA, CNR, Consorzio Interuniversitario Istituto Nazionale di Astrofisica Istituto Nazionale di Fisica Nucleare Istituto Nazionale di Geofisica e Vulcanologia Istituto Ortopedico Rizzoli UniBo, UniFe, UniPr, UNIMORE	5.823.706,00
CREA	Acquisizione di servizi di collaborazione, supporto e assistenza tecnica su tematiche relative alle normative internazionali in tema di cambiamenti climatici in relazione al settore forestale nell'ambito del progetto "Osservatorio Politiche Strutturali"	Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (CREA)	03/12/2018 15/12/2018	CMCC	CMCC	4.000,00
Convenzione Fiumicino (2)	Convenzione operativa n.2 PRP di Fiumicino - Monitoraggio ambiente marino esteso all'unità fisiografica https://www.eflip-project.org/	Autorità di Sistema Portuale del Mar Tirreno Centro Settentrionale	31/08/2020 31/12/2025	CMCC	CMCC Fondazione CIMA, Italy Istituto Universitario di Studi Superiori di Pavia (IUSS)	1.797.698,00
Convenzione Fiumicino (1)	Convenzione operativa n.1 PRP di Fiumicino - Monitoraggio ambiente marino esteso all'unità fisiografica	Autorità di Sistema Portuale del Mar Tirreno Centro Settentrionale	31/01/2020 31/12/2020	CMCC	CMCC Isires - Istituto Italiano Ricerca E Sviluppo	388.116,85
Banca d'Italia - ESS2019	Contributo Liberale per Summer School EAERE 2019	Banca d'Italia	30/06/2019 06/07/2019	CMCC	CMCC, Amundi, PoliMi	46.000,00
EFLIP	conomic impacts of Flood risk in Lombary and Innovative risk mitigation Policy (Impatti economici del rischio alluvioni in Lombardia e politiche innovative per la mitigazione del rischio)	Fondazione Cariplo	15/11/2019 14/11/2021	CMCC	CMCC	200.000,00

ISMEA - CMCC 2	Servizio di attività connesse allo sviluppo progettuale di una metodologia di meccanismi di compensazione a livello di distretto agricolo zootecnico	ISMEA (Istituto di Servizi per il Mercato Agricolo Alimentare)	30/10/2019 31/12/2020	CMCC	CMCC	93.125,00
CONTRATTO ENEL GREEN POWER	MODELLI STAGIONALI EUROPEI VALUTAZIONE DELLO "SKILL" DI PREVISIONE DELLA PRECIPITAZIONE ED EMISSIONE BOLLETTINI DI PREVISIONE CLIMATICA STAGIONALE	ENEL Green Power	01/10/2019 30/06/2020	CMCC	CMCC	18.400,00
Castagni Parlanti	Nuove tecniche di monitoraggio dello stato di salute del castagneto e del bosco: da Industria 4.0 a Natura 4.0	PSR Emilia Romagna, Misura 16.1.01 - Focus Area 5E	01/10/2019 30/09/2021	Open Fields	CMCC	196.702,00
ALCOTRA - ARTACLIM	Studio di Vulnerabilità formazione e strategie nell'ambito del progetto ALOCTRA ARTACLIM	Politecnico di Torino (Progetto ALCOTRA ARTACLIM)	21/06/2018 20/05/2019	CMCC	CMCC	38.000,00
DESARC - MARESANUS	DEcreasing Seawater Acidification Removing Carbon	Convenzione AMUNDI SGR S.P.A.	19/12/2018 18/12/2018	CMCC	CMCC	250.000,00
NEMESI (CHIMICA VERDE) ARS01_01002	NanotEcnologie chiMiche green per la protEzione Sostenibile delle pIante http://nemesi-project.it/partners/privres	PON Ricerca e Innovazione 2014-2020 - MUR	01/09/2018 28/02/2021	Università del Salento	CMCC, Centro di Ricerca, Sperimentazione e Formazione in Agricoltura ,Centro Internazionale di Alti Studi Agronomici Mediterranei – Istituto Agronomico Mediterraneo di Bari, Federazione Provinciale Coldiretti Lecce, Lab. Instruments S.R.L., Leanfa S.R.L., Licofarma S.R.L., Nanoshare Srl, Phy.Dia. S.R.L., Spagro S.R.L., Studio Effemme Chimica Applicata S.R.L. Università Degli Studi Della Tuscia Università Del Salento	4.036.499,31
ISPRA - Clima & Energia	Analisi di sensitività sui principali driver macroeconomici e analisi dell'impatto macroeconomico degli scenari con politiche e misure in materia di clima e energia	ISPRA - Istituto Superiore per la Protezione e la Ricerca Avanzata	10/12/2018 10/03/2019	CMCC	CMCC Centro di Ricerca Intedipartimentale Laboratorio Urbanistica e Pianificazione Territoriali - Università di Napoli D'Urso Loredana Don Marcello Società Agricola Liberti Paolo, Unitus	39.900,00
RURAL	RidUrre la distanza tra RicercA e imprese agricoLe https://coast-puglia.it/portal/previsioni-puglia	Regione Campania PSR 2014-2020 16.5.1	26/09/2018 25/03/2020	CMCC	CMCC, Centro di Geomorfologia Integrata per l'Area del Mediterraneo Consorzio per il coordinamento delle	142.603,00

					ricerche inerenti al sistema lagunare di Venezia, Geoprove Srl, Impreservice Srl, INGV, Moreno SPA Pernice Umberto, Provveditorato Interregionale alle Opere Pubbliche per il Veneto-Trentino Alto Adige-Friuli Venezia Giulia, SPIRE Srl, Università degli Studi di Catania, UniSalento	
Accordo di Collaborazione CMCC - AGRIS	Accordo di Collaborazione AGRIS - CMCC per la realizzazione del progetto di ricerca: Gestione conservativa dei suoli in alcune colture arboree ed erbacee tipiche/tradizionali della Sardegna (TERRA') https://www.innodunecost.it/it/soggetti-nel-progetto.html	Agris Sardegna – Servizio per la Ricerca sui Sistemi Colturali Erbacei (Agris)	01/07/2018 30/06/2021	CMCC	Athanor Consorzio Stabile Scarl Geoprove S.R.L., Moreno S.P.A., Sipre S.R.L., Impreservice S.R.L. Cmcc, Unisalento, Consorzio Di Gestione Area Marina Protetta Porto Cesareo Cna Balneatori Puglia, Cetma	400.000,00
UNISS - RAS	realizzazione delle attivita 1 e 3 previste nel piano operativo di dettaglio di cui all'accordo di collaborazione tecnico scientifica, "Strategia regionale di adattamento ai cambiamenti climatici".	Università degli Studi di Sassari, Regione Autonoma Sardegna	10/07/2018 09/11/2018	CMCC	CMCC	39.900,00
Convenzione Biennale di Venezia	Convenzione con La Biennale di Venezia per attività di consulenza scientifica sui dati climatici dei territori interessati dal progetto "Arcipelago Italia", Padiglione Italia, 16 Mostra Internazionale di Architettura	La Biennale di Venezia	14/03/2018 30/05/2018	CMCC	CMCC	8.000,00
ENI REDD Ecuador	Prestazione di servizi per la quantificazione delle riduzioni di emissioni per un progetto REDD in Ecuador	ENI SpA	22/02/2018 21/02/2020	CMCC	CMCC	179.900,00
ARPA VALLE D'AOSTA	SERVIZIO ELABORAZIONE SCENARI MODELLISTICI CLIMATICI AD ALTA RISOLUZIONE SPAZIALE E TEMPORALE PROGETTO CLIMAERA, PROGRAMMA COOPERAZIONE TERRITORIALE TRANSNAZIONALE ALCOTRA 2014-20 PER ARPA VALLE D'AOSTA	ARPA VALLE D'AOSTA	21/06/2018 20/06/2019	CMCC	CMCC	70.000,00
COAST (INNOLABS JM914O0)	DIScoVER Apulian Sea beauTy https://apollon-project.it/	Regione Puglia, INNOLABS Sostegno alla creazione di soluzioni innovative	24/02/2021 28/07/2022	LINKS S.P.A.	CMCC Alba Project - Inventive Solutions Srl AMIGO s.r.l. Consorzio Interuniversitario Nazionale per l'Informatica	1.009.248,00

		finalizzate a problemi di rilevanza sociale			Corvallis Spa HESPLORA srl Politecnico di Bari	
INNO-DUNECOST (INNOLABS RM5UKM3)	Sperimentazione di tecnologie innovative per il consolidamento delle dune costiere https://www.sagace.eu/en/	Regione Puglia, INNOLABS Sostegno alla creazione di soluzioni innovative finalizzate a specifici problemi di rilevanza sociale	14/01/2019 19/06/2020	Athanor	CMCC CASTALIA Operations s.r.l. Consiglio Nazionale delle Ricerche Environmental Survey s.r.l. I.D.S. Ingegneria dei Sistemi S.p.A. Isalit s.r.l. Università del Salento Wide Pilot	1.208.287,00
PAE Paestum - Poseidonia	Accordo Parco Archelogico Paestum per Mostra "Poseidonia: storia e futuro di una città d'acqua"	Parco Archeologico Di Paestum (PAE)	01/08/2019 31/01/2020	CMCC	CMCC	6.000,00
PAE Paestum	ATTO ATTUATIVO PER L'ORGANIZZAZIONE DELLA MOSTRA EVENTO CLIMATE CHANGE PAESTUM 3000 BC - 3000 AC	Parco Archeologico Di Paestum (PAE)	17/09/2019 31/01/2020	CMCC	CMCC	9.080,00
ADAPT Comune Olmedo	Servizi Aggiuntivi per il Comune di Olmedo	Comune di Alghero, Interreg Italia-Francia Marittimo 2014-2020 – progetto "ADAPT	01/10/2019 31/12/2019	CMCC	CMCC	4.300,00
ADAPT Workshop Porto Torres	Assistenza specialistica per il Workshop fuori area del progetto ADAPT	Comune di Sassari, Interreg Italia-Francia Marittimo 2014-2020 – progetto "ADAPT	10/05/2019 10/05/2019	CMCC	CMCC	2.650,00
ADAPT (Vado Ligure)	Attività di ricerca scientifica per la realizzazione del profilo climatico locale e per il supporto allo sviluppo del piano di azione locale del Comune di Vado Ligure in relazione alle attività del progetto "ADAPT - Assistere l'aDAttamento ai cambiamenti climatici dei sistemi urbani dello sPazio Transfrontaliero"	Comune di Vado Ligure, Interreg Italia-Francia Marittimo 2014-2020 – progetto "ADAPT	17/07/2018 31/12/2018	CMCC	CMCC	13.500,00
ADAPT (Anci Toscana)	Assistenza al coordinamento scientifico e sviluppo linee guida del progetto ADAPT",finanziato dal PO Interreg Italia Francia Marittimo 2014-2020	ANCI Toscana, Interreg Italia-Francia Marittimo 2014-2020 – progetto "ADAPT"	16/03/2018 14/02/2020	CMCC	CMCC	47.786,07
ADAPT (Comune Alghero)	Assistenza tecnica nell'ambito del progetto "ADAPT - Assistere l'aDAttamento ai cambiamenti climatici dei sistemi urbani dello sPazio Transfrontaliero"	Comune di Alghero, Interreg Italia-Francia Marittimo 2014-2020 –	15/12/2017 14/12/2018	CMCC	CMCC	25.409,00

		progetto "ADAPT				
ADAPT (Comune Sassari)	Assistenza tecnica specialistica per le attività relative al profilo climatico, linee guida e definizione dei piani d'azione per l'adattamento dei sistemi urbani ai cambiamenti climatici. Programma europeo di cooperazione transfrontaliera Interreg Italia-Francia Marittimo 2014-2020 – progetto "ADAPT"	Comune di Sassari, Interreg Italia-Francia Marittimo 2014-2020 – progetto "ADAPT	24/01/2018 24/01/2019	CMCC	CMCC	25.300,00
Consulenza GCA	Consulenza Green Capital Alliance Società Benefit srl (Geo-Climatic Risk on Water & Energy - analisi e predizione di scenari climatici)	Green Capital Alliance Società Benefit srl	01/11/2017 28/02/2018	CMCC	CMCC	40.000,00
SICAB	Sino Italian capacity building for environmental protection (Programma di Alta Formazione nei settori dello sviluppo sostenibile e della gestione dell'ambiente nel quadro della cooperazione bilaterale Italia – Cina) https://www.sicab.net/	MASE - Ministero dell'Ambiente	28/11/2017 27/05/2020	POLIMI - Politecnico di Milano	CMCC, PoliMi, Fondazione Politecnico di Milano, Fondazione Italia Cina Università Degli Studi Di Roma "La Sapienza"	2.567.508,00
ENI - Dati Meteo Marini 2	Fornitura Dati Meteo Marini	ENI SpA	01/12/2020 30/11/2025	CMCC	CMCC	
ENI - Dati Meteo Marini	Fornitura Dati Meteo Marini	ENI S.p.A. (Ctr n. 2500029775)	15/07/2017 14/07/2020	CMCC	CMCC Università degli Studi di Bologna	
ENEL Green Power	Strategies and tools to face seasonal climate variability	ENEL Green Power	19/01/2018 18/01/2020	CMCC	CMCC	100.000,00
APOLLON (1ZTSD52)	environmentAl POLLutiOn aNalyzer https://apollon-project.it/	Regione Puglia - INNONETWORK Sostegno alle attività di R&S per lo sviluppo di nuove tecnologie sostenibili, di nuovi prodotti e servizi	01/06/2018 17/04/2020	Corvallis	CMCC Alba Project - Inventive Solutions Srl AMIGO s.r.l. Consorzio Interuniversitario Nazionale per l'Informatica Corvallis Spa HESPLORA srl Politecnico di Bari	2.017.441,80
SAGACE (M7X3HL2)	Sistema Avanzato di monitoraGgio AmbiEntale https://www.sagace.eu/en/	Regione Puglia - INNONETWORK Sostegno alle attività di R&S per lo sviluppo di nuove tecnologie sostenibili, di nuovi prodotti e servizi	22/10/2018 14/04/2021	WidePilot	CMCC CASTALIA Operations s.r.l. Consiglio Nazionale delle Ricerche Environmental Survey s.r.l. I.D.S. Ingegneria dei Sistemi S.p.A. Isalit s.r.l. Università del Salento Wide Pilot	1.477.187,81

Contratto FERRERO	Strategies and tools to face climate change and variability in the agri-businnes sector	Ferrero Trading Lux S.A.	01/06/2017 31/05/2018	CMCC	CMCC	74.600,00
PLANETARY HEALTH	CAMBIAMENTI CLIMATICI E SALUTE NELLA VISION "PLANETARY HEALTH"	Accordo di Collaborazione Misistero della Salute - Istituto Superiore di Sanità (ISS)	13/03/2017 12/03/2018	Istituto Superiore di Sanità (ISS)	CMCC ISS Istituto Superiore di Sanità	620.000,00
PAESC (Collaborazione AZZEROCO2)	Collaborazione per la redazione di PAESC (Piani d'Azione per l'Energia Sostenibile e il Clima) nell'ambito dell'accordo con AzzeroCO2 https://www.sagace.eu/en/	Accordo di Collaborazione AZZEROCO2	30/03/2017 30/03/2018	CMCC	CMCC CASTALIA Operations s.r.l. Consiglio Nazionale delle Ricerche Environmental Survey s.r.l. I.D.S. Ingegneria dei Sistemi S.p.A. Isalit s.r.l. Università del Salento Wide Pilot	5.400,00
ANTIDOTE	frAmework for moNiTorIng Detection and fOrecasTing for xylElla http://antidote-project.it/site/partners	Convenzione Regione Puglia	10/01/2016 09/09/2020	CMCC	CMCC Università del Salento	217.500,00
Convenzione Comune di Prato	Progetto di ricerca finalizzato alla creazione di un modello di verifica dell'impatto dei cambiamenti climatici sulla salute umana al fine di orientare la pianificazione urbanistica del Comune di Prato	Comune di Prato	07/11/2016 06/03/2018	CMCC	CMCC	11.000,00
Food and Sustainability	Attività di ricerca relative al tema "Food and Sustainability in the context of the one health approach"	Fondazione Barilla Center for Food & Nutrition	13/02/2020 12/02/2021	CMCC	CMCC	6.900,00
Migration & Food	The geopolitics of migration and food in the Mediterranean	Fondazione Barilla Center for Food & Nutrition	19/04/2017 18/04/2018	CMCC	CMCC	37.000,00
ECO SMART BREAKWATER C6LU5I7	Calcestruzzo ecosostenibile per elementi smart in ambiente marino http://www.ecosmartbreakwater.com/	Regione Puglia - Cluster Tecnologici Regionali per l'Innovazione	18/11/2016 17/11/2018	ATHANOR CONSORZIO STABILE	Athanor Consorzio Stabile Cmcc Università Del Salento Pietro De Pascalis Srl Eurostrade Icatec Global Software	1.932.155,50

8.4 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)
AdriaCLIM	Climate change information, monitoring and management tools for adaptation strategies in Adriatic coastal areas https://www.italy-croatia.eu/web/adriaclim	EU Italy-Croatia Interreg	Jan 2020 May 2023	ARPAE (ARPA Emilia Romagna)	CMCC University of Bologna ISPRA CNR-ISMAR ARPA Veneto ARPA Marche ARPA Friuli Venezia Giulia ARPA Puglia
FORCeS	Constrained aerosol forcing for improved climate projections	H2020	Oct. 2019 March 2024	Stockholms Universitet	CNR
FPCUP projects	Framework Partnership Agreement on Copernicus User Uptake, Caroline-Herschel-FPA Programme - GROW-EIP-GEN – Copernicus	EU		ISPRA	TBC
ACTRISPPP	Aerosol, Clouds and Trace gases Research Infrastructure Network – Preparatory Phase Project	EC	2017-2019	CNRS France	CNR
AFV	Arctic Fog Variability in a Warming Arctic and Its Impact on Maritime Human Activities	Belmont Forum 2014	2015-2019	CNR	CNR
AMARE	Actions for Marine Protected Areas https://amare.interregmed.eu/	Interreg MED 20142020	Nov. 2016 – Oct. 2019	CONISMA Consorzio Nazionale Interuniversitario per le Scienze del Mare	CMCC
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, University of Bologna
ATMO-ACCESS	Sustainable Access to Atmospheric Research Facilities	EC, Horizon 2020	Apr 2021 - Mar 2025	CNRS	CNR
BACCHUS	BACCHUS Impact of Biogenic versus Anthropogenic emissions on Clouds and Climate: towards a Holistic UnderStanding	EC	2013-2018	ETHZurig	ISACCNR

BAQUNIN	Boundary layer Air Quality-analysis Using Network of Instruments https://www.baqunin.eu/	ESA	2019-2024	Serco Italia	University of Rome "La Sapienza", CNR, Sardegna Clima APS, ARPA Valle d'Aosta
BEOI	Beyond EPICAOldest Ice http://www.beyondepica.eu	EC, H2020	Oct. 2016 Sep. 2019	AWI	ENEA, University of Bologna
BIOcean5D	Marine biodiversity assessment and prediction across spatial, temporal and human scales	EC, HE	Dec 2022-Nov 2026	European Molecular Biology Laboratory	Enea, Stazione Zoologica Anton Dohrn, Univ Padova,
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
BLUE DEAL	BLUe Energy Deployment Alliance	EC, INTERREG	Nov 2019-Jun 2022	Univ Siena	ENEA. Univ Siena
BlueHealth	Linking Up Environment, Health and Climate for Intersector Health Promotion and Disease Prevention in a Rapidly Changing Environment https://bluehealth2020.eu/	EC, H2020	Jan. 2016 – Jun. 2020	University of Exeter	CMCC, Istituto Superiore di Sanità
C3S SOIL EROSION	Soil erosion in Italy https://climate.copernicus.eu/soil-erosion-italy	ECMWF/C3S (Demo Case)	Jul. 2019-Sept. 2020	CMCC	CMCC
C3S Disaster Risk Reduction	Pluvial Flood Risk Assessment in Urban Areas https://climate.copernicus.eu/pluvial-flood-risk-assessment-urban-areas	ECMWF/C3S (Sectoral Information system)	Jun. 2019-May 2021	CMCC	GECOsistema srl
C3S_511	Copernicus Climate Service – Quality Assessment of ECV products	ECMWF	Sep. 2017 – Jun. 2021	CNRISMAR	CNR, ENEA
C3S_512	Copernicus Climate Service – Quality Assurance for the Climate Data Store	ECMWF	Oct. 2018 – Jul. 2021	BSC	CNR
CAREHeat	Detection and threats of marine heat waves	ESA	May 2022 Feb 2024	ISMAR-CNR	ENEA, CNR
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

CLARA	Climate forecast enabled knowledge services https://www.clara-project.eu/	H2020	Jun. 2017 Sep. 2020	CMCC	ISPRA Regional Agency for the Prevention, the environment and the Energy of Emilia Romagna (ARPAE) Emilia Romagna Region (RER) GECOsistema (srl)
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.cobham-erc.eu/	EC, FP7	Aug. 2014 – Jul. 2019	POLIMI Politecnico di Milano	CMCC
CoCliCo	COASTAL CLIMATE CORE SERVICES	Ec, H2020	Sept 2012- Aug 2025	BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES	ENEA, FEDERLOGISTICA
COCO2	Building the EU's CO2 monitoring and verification support capacity https://coco2-project.eu/	EC, H2020	1/01/2021 31/12/2023	ECMWF	CMCC
CONFESS	Consistent representation of temporal variations of boundary forcings in reanalyses and seasonal forecasts https://confess-h2020.eu	EC, Horizon 2020	Nov. 2020 – Oct. 2023	ECMWF	CNR
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	2016-2019	CNRISAC	CNR

C3S2_520	Copernicus - Quality Assurance for Datasets in the Climate Data Store	EC; ECMWF; Copernicus Climate Change Service	May 2022 Apr 2024	CNR-ISAC	ENEA, CNR, CMCC
CORDEX4CDS	CORDEX for the Copernicus Data Store	C3S_34b Lot 1 Copernicus Climate Change Service	Jun2017-Apr. 2021	ECMWF	ENEA
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
ECEM	European Climatic Energy Mixes http://ecem.climate.copernicus.eu/	Copernicus Climate Change Service (C3S) – Sectorial Information Systems (SIS)	Nov. 2016-Jan 2018	University of East Anglia (United Kingdom)	ENEA
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
EMODnet Sea-basin Checkpoint: Black Sea	EMODnet Sea-basin Checkpoints https://emodnet.ec.europa.eu/en/checkpoints	DG MARE	2015 2018	IO-Bas (Bulgaria)	CMCC
ENVRI-FAIR	ENVironmental Research Infrastructures building Fair services Accessible for society, Innovation and Research https://envri.eu/home-envri-fair/	EC, 2020	Jan. 2019 Jun. 2023	FORSCHUNGSZENTRUM JULICH GMBH (DE)	CMCC, Università della Tuscia, EMSO-ERIC, CNR, INGV, CREA, OGS
EO4EU	AI-augmented ecosystem for Earth Observation data accessibility with Extended reality User Interfaces for Service and data exploitation https://eo4eu.eu/	EC, Horizon Europe	Jun. 2022-May 2025	National and Kapodistrian University of Athens	CMCC, CINECA, TRUST-IT srl, COMMPLA srl, METEOROLOGICAL AND ENVIRONMENTAL EARTH OBSERVATION (MEEO) SRL, INTELLIGENCE FOR ENVIRONMENT AND SECURITY (IES) SRL, ENGINEERING - INGEGNERIA INFORMATICA SPA
EP FWC Lot 2	Provision of external expertise on regulatory and policy issues in	European Parliament		Milieu	CMCC

	the field of Climate Change (Lot 2)				
ERA4CS	ERANET Cofund for Climate services http://www.jpiclimate.eu/ERA4CS	EU, H2020 (ERANET)	Jan 2016 Dec 2020	ANR France	CNR, CMCC
e-SHAPE	EuroGEO Showcases: Applications Powered by Europe https://e-shape.eu/	EC, 2020	May 2019 Apr. 2023	ARMINES (FR)	CNR, CMCC, Università della Calabria, INGV, CIMA, ISPRA, MEEO srl, PLANETEK Italia srl, APPLICA srl.
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
EUCP	European Climate Prediction System. Producing actionable climate information for risk-based planning. https://www.eucp-project.eu/	EC, Horizon 2020	Dec 2017- May 2022	Met Office	CMCC,
EuroSea	Improving and integrating the European Ocean Observing and Forecasting System https://eurosea.eu/	H2020	Nov. 2019 Nov. 2023	GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany	University of Bologna, CMCC, OGS, SZN
ForestPaths	Co-designing holistic forest-based policy pathways for climate change mitigation http://forestpaths.eu/	EC, Horizon Europe	1/09/2022 28/02/2027	European Forest Institute (EFI)	CMCC
FirEUrisk	'Fireurisk - Developing A Holistic, Risk-Wise Strategy For European Wildfire Management' https://fireurisk.eu/	EC, Horizon Europe	Apr. 2021 Feb. 2025	Associacao Para O Desenvolvimento Da Aerodinamica Industrial (Adai),	Cnr-Ibe, Istituto Di Sociologia Internazionale Di Gorizia Isig, Universita Degli Studi Di Roma La Sapienza (Sia),
HIGHLANDER	High performance computing to support land based services https://highlanderproject.eu/	EC, CEF-Telecom	Oct 2018 – Jan 2023	CINECA	CMCC, ARPAE, ARPA Piemonte, CIA Piemonte, Fondazione Edmund Mach, Università della Tuscia, ART-ER, Dedagroup spa.
KNOWING	"Framework for defining climate mitigation pathways based on understanding and integrated assessment of climate impacts, adaptation strategies and societal transformation"	Ec, HE	01-06-2022 31-05-2026	AIT AUSTRIAN INSTITUTE OF	ENEA

				TECHNOLOGY	
ICOS-ESFRI	Integrated Carbon Observation System (ICOS)	EC, ESFRI infrastructure	2015-multiyear renewal	ICOS-ERIC	ICOS-IT JRU
ICOS-ETC	ICOS Ecosystem Thematic Centre	MUR via CNR	2015-multiyear renewal	CMCC	University of Tuscia
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
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
MARISA	MARISA Maritime Integrated Surveillance Awareness https://www.marisaproject.eu/	H2020	2018 2020	Leonardo SpA	University of Bologna
MED-GOLD	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, LUTECH, Horta srl, CREA (third party of ENEA)
MEDNICE	MED programme Networks for an Innovative Cooperation in Energy efficiency https://efficientbuildings.interregmed.eu/	Interreg MED 2014-2020	Nov. 2016 – Oct. 2019	Metropole Nice Cote d'Azur	CMCC
MEDSTAR	Strategie e misure per la mitigazione del rischio di incendio nell'area Mediterranea	Interreg IT-FR 2014-2022	May 2019 Nov 2022	Regione Autonoma della Sardegna	Università di Sassari, CNR-IBE, CMCC, ANCI Liguria, Regione Liguria, CIMA, Consorzio LAMMA, Università degli Studi di Firenze
MEDSCOPE	MEDiterranean Services Chain based On climate PrEdictions https://www.medscope-project.eu/	EC, H2020 ERA4CS	2017-2021	CMCC	CNR (ISAC and IRPI)
NEVERMORE	New Enabling Visions and tools for End-users and stakeholders thanks to a common modeling approach towards a climate neutral and resilient society	EC, Horizon Europe	1/6/2022-31/5/2026	Fondazione Bruno Kessler	CMCC, Provincia Autonoma di Trento, Rina Consulting

OCEANSET	Support to the Realisation of the Ocean Energy Implementation Plan of the SET-Plan	EC, H2020	Mar 2019-Mar 2022	Energy Autority of Ireland (SEAI)	ENEA
OpenEM	Open Earth Monitor https://earthmonitor.org/	EC, Horizon Europe	Jun. 2022 May 2026	STICHTING OPENGEOHUB	Nature 4 SB srl, fodnazione Edmund Mach, CNR, CMCC, EURAC
OptimESM	Optimal High Resolution Earth System Models for exploring future climate changes	EC, Horizon Europe	Jan. 2023 - Dec., 2027	SHMI	CINECA, CNR
PARIS	Process Attribution of Regional Emissions	101081430 Horizon Europe	Jan. 2023	Uthrch University	UNIURB
PAUL	Pilot Applications in Urban Landscapes https://www.icos-cp.eu/projects/icos-cities-project	EC, H2020	Oct. 2021 Sep. 2025	ICOS-ERIC	CMCC, Università della Tuscia, CNR
PELAGOS	Promoting innovative nEtworks and cLusters for mArine renewable energy synerGies in mediterranean cOasts and iSlands	EC, INTERREG-MED	Nov 2016-Jul 2019	CRES	ENEA, UNIONCAMERE VENETO,
PhysioGlob	Assessing the interannual physiological response of phytoplankton to global warming using long term satellite observations	ESA, The Living Planet Fellowship	Oct 2018 Dec 2020	ENEA	ENEA ;
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, CNR
PROLINE-CE	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
RethinkAction	Cross-sectoral planning enhanced by a decision making platform fo foster climate action https://rethinkaction.eu/	EC, H2020	1/10/2021 30/09/2025	CARTIF (ES)	CMCC, RINA Consulting
RINGO	Readiness of ICOS for Necessities of integrated Global Observations	EU Horizon 2020	2017-2020	ICOS ERIC	Tuscia University, INRA, ENEA, OGS, CNR-

					ISMAR
ROADMAP		JPI-Oceans, JPI-Climate	Mar. 2020 Mar. 2023	MPI-Met	CMCC, CNR
S2S4E	Subseasonal to Seasonal climate forecasting for Energy	EC, Horizon 2020 (SC501 RIA)	Dec 2017 – Dec 2020	Barcelona Supercomputing Center (BSC)	ENEA
SEANA	Shipping Emissions in the Arctic and North Atlantic Atmosphere https://www.birmingham.ac.uk/research/activity/environmental-health/projects/seana/index.aspx	Natural Environment Research Council (UK)	2020-2022	University of Birmingham	ENEA, University of Florence, Sapienza University of Rome, CNR
SEBASTIEN	Smarter livEstock Breeding through Advanced Services Tailoring Innovative and multi-sourcE data to users' Needs https://www.sebastien-project.eu/	EC, CEF-Telecom 2020	Jan 2022-Dec 2024	CMCC	CINECA, Università della Tuscia, Nature4 SB srl, NEATEC spa, Università Cattolica del Sacro Cuore, AIA
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
SEETIP	SET Plan Implementation for Ocean Energy	EC, HE	Aug 2022; Jul-2025	ASSOCIATION EUROPEENNE DE L'ENERGIE DE L'OCEAN (OEE)	ENEA,
SILVANUS	Integrated Technological and Information Platform for wildfire Management	EC, H2020	Oct. 2021 Mar. 2025	UNIVERSITA TELEMATICA PEGASO S.R.L	ZANASI ALESSANDRO srl, FINCONS spa, EXPERT.AI spa, CMCC, ASSET, LETS Italia srl, PARCO NATURALE REGIONALE DI TEPILORA, OSPEDALE ISRAELITICO,

SIOS	Svalbard Integrated Earth Observing System	EC	2015 - 2019	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
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)
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
The HuT	The Human-Tech Nexus - Building a Safe Haven to cope with Climate Extremes	Horizon Europe	Oct. 2022- Sept. 2026	Universita Degli Studi Di Salerno	CMCC, CNR-IBE, Fondazione ICONS, Leithà S.r.l., Comune di Sorrento, Confagricoltura Nuoro-Ogliastra
TEACHER-CE	joinT Efforts to increase water management Adaptation to climate CHanges in central EuRope	Interreg Central Europe 2014-2020	2020 - 2022	UNIVERSITY OF LJUBLJANA - SLOVENIA	CMCC, AdbPo
VERIFY	Observation-based system for monitoring and verification of greenhouse gases https://verify.lsce.ipsl.fr/	EC, H2020	Feb. 2018 Jul. 2022	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	CMCC, ISPRA
OceanICU	Ocean-ICU Improving Carbon Understanding	HEU - Horizon Europe Framework Programme	01/11/2022 31/10/2027	NORCE (Norce Norwegian Research Centre AS)	CMCC
CYCLOPS	Improving Mediterranean CYCLOnes Predictions in Seasonal forecasts with artificial intelligence https://www.cmcc.it/projects/cyclops-improving-mediterranean-cyclones-predictions-in-seasonal-forecasts-with-artificial-intelligence	HEU - Horizon Europe Framework Programme	01/07/2022 30/06/2024	CMCC	CMCC
THE HUT	The Human-Tech Nexus - Building a Safe Haven to cope with Climate Extremes	HEU - Horizon Europe Framework Programme	01/10/2022 30/09/2026	UNISA	CMCC Comune di Sorrento Confagricoltura Nuoro Ogliastra Consiglio

					Nazionale delle Ricerche Fondazione Icons Leithà srl Università degli Studi di Salerno
Invest4Nature	Promoting investments in NBS and accelerating market uptake by gaining a better understanding of the economic performance of NBS, considering climate mitigation and risk reduction	HEU - Horizon Europe Framework Programme	01/07/2022 30/06/2026	Joanneum Research Institute	CMCC Engineering Ingegneria Informatica S.p.A.
NATURANCE	Nature for insurance, and insurance for nature	HEU - Horizon Europe Framework Programme	01/10/2022 31/03/2026	CMCC	CMCC
OEMC	Open-Earth-Monitor Cyberinfrastructure	HEU - Horizon Europe Framework Programme	01/06/2022 31/05/2026	OGH - Open Geo Hub	CMCC Fondazione Edmund Mach Nature 4.0 CNR Accademia europea di Bolzano
EO4EU	AI-augmented ecosystem for Earth Observation data accessibility with Extended reality User Interfaces for Service and data exploitation https://eo4eu.eu/	HEU - Horizon Europe Framework Programme	01/06/2022 31/05/2025	NKUA	CMCC Commpla srl Consorzio Interuniversitario Engineering Ingegneria Informatica S.p.A. Intelligence for Environment and Security srl Ies Solutions srl Meteorological Environmental Earth Observation Trust-it srl
FOODCLIC	integrated urban FOOD policies – developing sustainability Co-benefits, spatial Linkages, social Inclusion and sectoral Connections to transform food systems in city-regions	HEU - Horizon Europe Framework Programme	01/09/2022 28/02/20	Stichting Vrije Universiteit - VU	CMCC Cariplo Factory srl

			27		Comune di Capannori Università di Pisa
ID Alert	Infectious Disease decision-support tools and Alert systems to build climate Resilience to emerging health Threats	HEU - Horizon Europe Framework Programme	01/06/2022 31/05/2027	Umea University (Joacim Rocklov, Jan Semenza), Sweden	CMCC
BlueAdapt	Reducing climate based health risks in blue environments: Adapting to the climate change impacts on coastal pathogens https://www.cmcc.it/projects/blueadapt-reducing-climate-based-health-risks-in-blue-environments-adapting-to-the-climate-change-impacts-on-coastal-pathogens	HEU - Horizon Europe Framework Programme	01/10/2022 30/09/2026	Basque Centre for Climate Change BC3	CMCC Istituto Superiore di Sanità
REPAIR	Removing non-CO2 greenhouse gas emissions to support ambitious climate transitions	HEU - Horizon Europe Framework Programme	01/10/2022 30/09/2026	KUNGLIGA TEKNISKA HOEGSKOLAN	CMCC
AdJust	Advancing the understanding of challenges, policy options and measures to achieve a JUST EU energy transition https://www.cmcc.it/projects/adjust-advancing-the-understanding-of-challenges-policy-options-and-measures-to-achieve-a-just-eu-energy-transition	HEU - Horizon Europe Framework Programme	01/10/2022 30/09/2026	CMCC	CMCC
Skills4EOSC	Skills for the European Open Science Commons: Creating a Training Ecosystem for Open and FAIR Science	HEU - Horizon Europe Framework Programme	01/09/2022 31/08/2025	CONSORTIUM GARR	CMCC, CNR, Consortium GARR European Plate Observing System - European Research, Infrastructure Consortium Fondazione Istituto Italiano di Tecnologia, INFN, INGV, PoliTo, Unimib,Unitn
iMagine	Imaging data and services for aquatuc science	HEU - Horizon Europe Framework Programme	01/09/2022 31/08/2025	EGI (MARIS)	CMCC European Multidisciplinary Seafloorand Water Column Observatory -

					European Research Infrastructure Consortium Istituto Nazionale di Oceanografia e di Geofisica Sperimentale Università degli Studi di Trento
InterTwin	An interdisciplinary Digital Twin Engine for science	HEU - Horizon Europe Framework Programme	01/09/2022 31/08/2025	EGI - European Grid Infrastructure	CMCC EURAC Accademia Europea di Bolzano Istituto Nazionale di Fisica Nucleare Università degli Studi di Trento
RESCUE	Response of the Earth System to overshoot, Climate neUtrality and negative Emissions	HEU - Horizon Europe Framework Programme	01/09/2022 31/08/2026	BSC - Barcelona Supercomputing Center	CMCC
CIRCOMOD	Circular Economy Modelling for Climate Change Mitigation	HEU - Horizon Europe Framework Programme	01/06/2022 31/05/2026	UNIVERSITEIT UTRECHT	CMCC
circEUlar	Developing circular pathways for a EU low-carbon transition	HEU - Horizon Europe Framework Programme	01/09/2022 31/08/2026	IIASA	CMCC T6 Ecosystems srl
MAGICA	MAximising the synergy of European research Governance and Innovation for Climate Action	HEU - Horizon Europe Framework Programme	01/06/2022 31/05/2026	CMCC	CMCC H Farm Education
ELEVATE	ENABLING AND LEVERAGING CLIMATE ACTION TOWARDS NET-ZERO EMISSIONS	HEU - Horizon Europe Framework Programme	01/09/2022 31/05/2026	Ministerie Van Infrastructuur En Waterstaat	CMCC
NeverMore	New Enabling Visions and tools for End-useRs and stakeholders thanks to a common MOdeling fRamework	HEU - Horizon Europe Framework Programme	01/06/2022	Fondazione Bruno Kessler FBK	CMCC Fondazione

	towards a climatE neutral and resilient society		31/05/2026		Bruno Kessler Provincia Autonoma di Trento RINA CONSULTING SPA
ClimatEurope-2	Supporting and standardizing climate services in Europe and beyond	HEU - Horizon Europe Framework Programme	01/09/2022 28/02/2027	BSC - Barcelona Supercomputing Center	CMCC
ForestPath	Co-designing Holistic Forest-based Policy Pathways for Climate Change Mitigation	HEU - Horizon Europe Framework Programme	01/09/2022 28/02/2027	EFI - EUROPEAN Forest Institute	CMCC
CULTURAL - E	Climate and cultural based design and market valuable technology solutions for Plus Energy Houses https://www.cultural-e.eu/	H2020 - HORIZON 2020 FRAMEWORK PROGRAMME	01/01/2022 30/09/2024	Accademia Europea Di Bolzano - Eurac Research	CMCC EURAC Research
REnergyStorageDESIGN	Europe's Moment: Designing Effective Policies in Energy Storage Technology for Renewables https://www.cmcc.it/projects/redesign-europes-moment-designing-effective-policies-in-energy-storage-technology-for-renewables	H2020 - HORIZON 2020 FRAMEWORK PROGRAMME	01/09/2022 31/08/2024	CMCC	CMCC
SILVANUS	Integrated Technological and Information Platform for wildfire Management https://cordis.europa.eu/project/id/101037247/it	H2020 - HORIZON 2020 FRAMEWORK PROGRAMME	01/10/2021 30/03/2025	Università Telematica PEGASO	CMCC, ASSET - Agenzia regionale Strategica per lo Sviluppo Ecosostenibile del Territorio Expert System SPA, Fincons spa, Lets Italia srls, Ospedale Israelitico, Parco Naturale Regionale di Tepilora, Università telematica Pegaso, Zanasi Alessandro srl
PAUL	Pilot Application in Urban Landscapes towards integrated city	H2020 – HORIZON 2020	01/10/20	Integrated Carbon	CMCC

	observatories for greenhouse gases https ://www.cmcc.it/projects/paul-pilot-application-in-urban-landscapes-towards-integrated-city-observatories-for-greenhouse-gases	FRAMEWORK PROGRAMME	21 30/09/2025	Observation System Euopean Research (ICOS-ERIC) Infrastructure Consortium	Consiglio Nazionale delle Ricerche
TransformAR	Accelerating and upscaling transformational adaptation in Europe : demonstration of water-related innovation packages https://transformar.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/10/2021 30/09/2025	Universiteit Antwerpen	CMCC Mediterranean Sea and Coast Foundation
MYRIAD-EU	Multi-hazard and sYstemic framework for enhancing Risk-Informed mAnagement and Decision making in the E.U. https://www.cmcc.it/projects/myriad-eu-multi-hazard-and-systemic-framework-for-enhancing-risk-informed-management-and-decision-making-in-the-e-u	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/09/2021 31/08/2025	Stichting VU	CMCC
ECEMF	European Climate and Energy Modelling Forum https://www.ecemf.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/05/2021 30/04/2025	KTH – Kungliga Tekniska Hoegskolan	CMCC
eFlows4HPC	Enabling dynamic and Intelligent workflows in the future EuroHPCecosystem https://eflows4hpc.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/01/2020 31/12/2022	Barcelona Supercomputing Center	CMCC, DtoK Lab S.r.l Istituto Nazionale di Geofisica e Vulcanologia Scuola Internazionale Superiore di Studi Avanzati di Trieste
COACCH	CO-designing the Assessment of Climate Change costs http://www.coacch.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/12/2017 31/05/2021	CMCC	CMCC Fondazione Eni Enrico Mattei
SINCERE	Strengthening International Cooperation on climatE change Research https ://jpi-climate.eu/programme/sincere/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/02/2018 31/01/2022	Service Public Federal De Programmation Politique Scientifique (Belspo)	CMCC
FIRELOGUE	Cross-sector dialogue for Wildfire Risk Management https://firelogue.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/11/2021 31/10/2025	Fraunhofer Gesellschaft Zur Foerderung Der Angewandten	CMCC

				Forschung E.V.	
REST COAST	Large scale RESToration of COASTal ecosystems through rivers to sea connectivity https://rest-coast.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/10/2021 30/03/2026	Universitat Politecnica De Catalunya	CMCC, CORILA, Pernice Umberto, Provveditorato Interregionale alle Opere Pubbliche per il Veneto-Trentino Alto Adige-Friuli Venezia Giulia, Università degli Studi di Catania
RethinkAction	Cross-sEcToral planning decisIoN-maKing platform to foster climate Action https://rethinkaction.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/10/2021 30/09/2025	Fundacion Cartif	CMCC RINA CONSULTING SPA
REACHOUT	RESILIENCE IN EUROPE THROUGH ACTIVATING CITY HUBS REACHING OUT TO USERS WITH TRIPLE-A CLIMATE ADAPTATION TOOLS https://reachout-cities.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/10/2021 30/09/2025	Stichting Deltares	CMCC Comune di Milano
LOCALISED	Localised decarbonisation pathways for citizens, local administrations and businesses to inform for mitigation and adaptation action https ://www.cmcc.it/projects/localised-localised-decarbonisation-pathways-for-citizens-local-administrations-and-businesses-to-inform-for-mitigation-and-adaptation-action	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/10/2021 30/09/2025	Potsdam Institut Fuer Klimafolgenforschung	CMCC
ERN APULIA 3	European Researchers' Night Apulia 2021 – Discovering the fascinating world of research https://www.cmcc.it/projects/ern-apulia-3-european-researchers-night-apulia-2021-discovering-the-fascinating-world-of-research	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	02/05/2021 02/03/2021	Università del Salento	CMCC, ENEA, CNR, Consorzio Interuniversitario Nazionale per la Scienza e Tecnologia dei Materiali Ente Ospedaliero Saverio De Bellis Fondazione Istituto Italiano di Tecnologia, Museo Archeologico Nazionale di Taranto,

					Politecnico di Bari , Università degli Studi di Bari, UniSalento, Università di Foggia
CLINT	CLImate INTelligence: extreme events detection, attribution and adaptation design using machine learning https ://www.cmcc.it/projects/clint-climate-intelligence-extreme-events-detection-attribution-and-adaptation-design-using-machine-learning	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/07/2021 30/06/2025	POLIMI – Politecnico di Milano	CMCC Politecnico di Milano
GO NEXUS	Innovative tools and solutions for Governing the water-energy-food-ecosystems NEXUS under global change https ://www.cmcc.it/projects/gonexus-innovative-tools-and-solutions-for-governing-the-water-energy-food-ecosystems-nexus-under-global-change	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/06/2021 31/05/2025	Universitat Politecnica de Valencia (UPV)	CMCC Politecnico di Milano
NEXOGENESIS	Facilitating the next generation of effective and intelligent water-related policies utilising artifical intelligence and reinforcement learning to assess the water-energy-food-ecosystem (WEFE) nexus https://nexogenesis.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/09/2021 31/08/2025	Stichting IHE Delft Institute for Water Education	CMCC EURAC Accademia Europea di Bolzano Università Ca' Foscari
CriceS	Climate relevant interactions and feedbacks: the key role of sea ice and snow in the polar and global climate system https ://www.cmcc.it/projects/crices-climate-relevant-interactions-and-feedbacks-the-key-role-of-sea-ice-and-snow-in-the-polar-and-global-climate-system	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/09/2021 31/08/2025	Finnish Meteorological Institute (FMI)	CMCC
EGI-ACE	EGI Advanced Computing for EOSC https://www.egi.eu/project/egi-ace/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/01/2021 30/06/2022	EGI Foundation (NL)	CMCC European Multidisciplinary Seafloorand Water Column Observatory – European Research Infrastructure Consortium Istituto Nazionale di Fisica Nucleare
EPOC	Economic olicy in Complext Environments https://epoc-itn.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/03/2021	Bielefeld University	CMCC Università Ca'

			28/02/2025		Foscari Università Cattolica del Sacro Cuore
COCO2	Prototype system for a Copernicus CO2 service https://coco2-project.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/01/2021 31/12/2023	Ecmwf – European Centre For Medium-Range Weather Forecasts	CMCC
ERN-Apulia2	European Researchers' Night Apulia 2020 – Discovering the fascinating world of research https://www.ern-apulia.it/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/06/2020 30/03/2021	Università del Salento	Università del Salento CMCC, UNIBA, POLIBA UNI Foggia, CNR, INFN, Fondazione istituto italiano di tecnologia, ENEA, Ente ospedaliero Saverio De Bellis IRCCS, Museo archeologico nazionale di Taranto – MarTA Consorzio interuniversitario nazionale per la scienza e tecnologia dei materiali
GLOBAL AT VENICE	A Research and Training for Global Challenges Cofund Fellowship Programme	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/01/2021 31/12/2025	Ca' Foscari Università di Venezia	CMCC Università Ca' Foscari
MaCoBioS	Marine Coastal Ecosystems Biodiversity and Services in a Changing World https://macobios.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/06/2020 31/05/2024	University of Portsmouth, Higher Education Corporation	CMCC
FutureMARES	Climate Change and Future Marine Ecosystem Services and Biodiversity https://www.futuremares.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/09/2020 31/08/2024	Università di Amburgo	CMCC Consorzio di Gestione Area Marina Protetta

					Portofino Università di Pisa
SMOOTH	Sustainable Finance for a Smooth Low-Carbon Transition https ://www.cmcc.it/projects/smooth-sustainable-finance-for-a-smooth-low-carbon-transition	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/09/2020 31/08/2025	Alma Mater Studiorum – Università di Bologna (UNIBO)	CMCC Università di Bologna
2D4D	Disruptive Digitalization for Decarbonization https://www.2d4d.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/10/2020 30/09/2025	Università degli Studi di Brescia	CMCC Università degli Studi di Brescia
AtlantECO	Atlantic ECOsystems assessment, forecasting & sustainability https://www.atlanteco.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/09/2020 31/08/2024	Stazione Zoologica Anton Dohrn	CMCC Consiglio Nazionale delle Ricerche European Multidisciplinary Seafloorand Water Column Observatory – European Research Infrastructure Consortium Istituto Nazionale di Oceanografia e di Geofisica Sperimentale Stazione Zoologica Anton Dohrn Università degli Studi di Roma La Sapienza
GEOCEP	Global Excellence in Modeling Climate and Energy Policies https://www.geocep.cuni.cz/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/03/2021 28/02/2025	Univerzita Karlova (CUNI)	CMCC
EUROSEA	Improving and Integrating European Ocean Observing and Forecasting Systems for Sustainable use of the Oceans https://eurosea.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/11/2019 31/12/2023	Helmholtz Zentrum fur Ozeanforschung Kiel	CMCC Consiglio Nazionale delle Ricerche ETT SPA European

					Multidisciplinary Seafloorand Water Column Observatory – European Research Infrastructure Consortium Istituto Nazionale di Oceanografia e di Geofisica Sperimentale Istituto Superiore per la Protezione e la Ricerca Ambientale Stazione Zoologica Anton Dohrn Università di Bologna
BLUE CLOUD	Blue-Cloud : Piloting innovative services for Marine Research & the Blue Economy https://blue-cloud.org/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/10/2019 30/09/2022	Trust-IT Services	CMCC Consiglio Nazionale delle Ricerche Consorzio Interuniversitario
EOSC PILLAR	Coordination and Harmonisation of National Inititiatives, Infrastructures and Data services in Central and Western Europe https ://www.eosc-pillar.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/07/2019 30/06/2022	Consortium GARR	CMCC Consortium GARR CNR CONSORZIO NAZIONALE DELLE RICERCHE CINECA INFN
CRAS	Climate change and Resilience of Agricultural System : an econometric and computational analysis https ://www.agriculture-resilience.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	10/08/2019 09/08/2021	CMCC	CMCC
ECO-DEKS	External knowledge sourcing strategies for,environmental	H2020 – HORIZON 2020	23/10/20	CMCC	CMCC

	innovation in the industrial sector of Nigeria https ://www.eiee.org/project/eco-deks-external-knowledge-sourcing-strategies-for-environmental-innovation-in-the-industrial-sector-of-nigeria/	FRAMEWORK PROGRAMME	19 22/10/2021		
GEMCLIME	Global Excellence in Modelling of Climate and Energy http://gemclime.cuni.cz/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/10/2016 30/10/2020	Univerzita Karlova (CUNI)	CMCC Fondazione Eni Enrico Mattei
ANDROMEDA	An EnhaNceD Common InfoRmatiOn Sharing EnvironMent for BordEr CommanD, Control and CoordinAtion Systems https ://www.andromeda-project.eu/partners/index.html	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/09/2019 28/02/2020	Ministry of Maritime Affairs and Insular Policy (GR)	CMCC CODIN – Societa per Azioni Engineering Ingegneria Informatica S.p.A. Ministero della Difesa – Marina Militare
E-SHAPE	EuroGEOSS Showcases: Applications Powered by Europe https ://e-shape.eu/index.php/team	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/05/2019 30/04/2023	Association pour la Recherche et le Developpement des Methodes et Processus Industriels (ARMINES)	CMCC Consiglio Nazionale delle Ricerche Fondazione Centro Internazionale Monitoraggio e Rischio Ambientale Istituto Nazionale di Geofisica e Vulcanologia Planetek Italia Università della Calabria
PARIS REINFORCE	Delivering on the Paris Agreement: A demand-driven, integrated assessment modelling approach https://paris-reinforce.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/06/2019 31/05/2022	Technical University of Athens (NTUA)	CMCC Energy Engineering Economic Environment Systems Modeling and Analysis SRL
CASCADES	CAScading Climate risks: towards Adaptive and resilient European	H2020 – HORIZON 2020	01/09/20	Potsdam Institut	CMCC

	Societies https://www.cascades.eu/	FRAMEWORK PROGRAMME	19 31/08/20 23	fuer Klimafolgenforschun g (PIK)	
RECEIPT	Remote Climate Effects and their Impact on European sustainability, Policy and Trade https://climatestorylines.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/09/20 19 31/08/20 23	Koninklijk Nederlands Meteorologisch Instituut (KNMI)	CMCC
NAVIGATE	Next generation of AdVanced InteGrated Assessment modelling to support 278ultise policy making https://navigate-h2020.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/09/20 19 31/08/20 23	Potsdam Institut fuer Klimafolgenforschun g (PIK)	CMCC
ENGAGE	Exploring National and Global Actions to reduce Greenhouse gas Emissions http ://www.engage-climate.org/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/09/20 19 31/08/20 23	Internationales Institut fur Angewandte Systemanalyse AT (IIASA)	CMCC
IS-ENES 3	Infrastructure for the European Network for Earth System modelling – Phase 3 https://is.enes.org	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/01/20 19 31/12/20 22	Centre National de la Recherche Scientifique (CNRS)	CMCC
ENVRI FAIR	ENVironmental Research Infrastructures building Fair services Accessible for society, Innovation and Research https ://envri.eu/research-infrastructures-fair/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/01/20 19 31/12/20 22	Forschungszentrum Juelich GmbH	CMCC, EUROPEAN RESEARCH INFRASTRUCTU RE CONSORTIUM (EMSO ERIC) CNR CONSIGLIO NAZIONALE DELLE RICERCHE ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA CONSIGLIO PER LA RICERCA IN AGRICOLTURA E L'ANALISI DELL'ECONOMI A AGRARIA ISTITUTO NAZIONALE DI OCEANOGRAFIA

					E DI GEOFISICA SPERIMENTALE
ESIWACE2	Excellence in Simulation of Weather and Climate in Europe, Phase 2 https://www.esiwace.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/01/2019 31/12/2022	Deutsches Klimarechenzentrum Gmbh (DKRZ)	CMCC
IMPRESSIVE	Integrated Marine Pollution Risk assessment and Emergency management Support Service In ports and coastal enVironmEnts http ://www.impressive-project.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/12/2018 31/05/2021	Aratos.Net Ltd	CMCC Planetek Italia Wide Pilot
IMMERSE	Improving Models for Marine EnviRonment Services https ://www.cmcc.it/it/projects/immerse-improving-models-for-marine-environment-services	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/12/2018 30/11/2022	Universitè de Grenoble	CMCC
EXDCI-2	European eXtreme Data and Computing Initiative – 2 https://cop21ripples.climatestrategies.org/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/03/2018 31/08/2020	Partnership For Advanced Computingin Europe Aisbl (PRACE)	CMCC ENEA
ESCAPE-2	Energy-efficient Scalable Algorithms for weather and climate Prediction at Exascale https ://cordis.europa.eu/project/id/800897	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/10/2018 30/09/2021	European Centre For Medium-Range Weather Forecasts (ECMWF)	CMCC POLITECNICO DI MILANO
OPERANDUM	OPEn-air laboRAtories for Nature baseD solUtions to manage environmental risks http ://cca.eionet.europa.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/07/2018 30/06/2022	Alma Mater Studiorum – Università di Bologna (UNIBO)	CMCC Agenzia Regionale Protezione Ambiente nella Regione Emilia-Romagna Centro italiano ricerche aerospaziali RINA CONSULTING SPA Università di Bologna
ENERGYA	ENERGY use for Adaptation https://highlanderproject.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/03/2018 28/02/2023	Università Ca' Foscari Venezia	CMCC Università Ca' Foscari
EOSC-hub	Integrating and managing services for the European Open Science Cloud	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/01/2018	STICHTING EGI (Netherlands)	CMCC Consiglio

	https ://www.eosc-hub.eu/		31/12/2020		Nazionale delle Ricerche Consorzio Interuniversitario Consorzio Interuniversitario Risonanze Magnetiche di Metallo Proteine, INFN, Istituto Nazionale di Geofisica e Vulcanologia, Meteorological Environmental Earth Observation Moxoff, Terra2, Yottacle
EUCP	European Climate Prediction system https://www.eucp-project.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/12/2017 30/11/2021	Met Office	CMCC
SOCLIMPACT	DownScaling CLImate imPACTs and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond. https://soclimpact.net/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/12/2017 30/11/2020	Universidad De Las Palmas De Gran Canaria (Tides)	CMCC Agenzia Nazionale per le nuove tecnologie l'energia e lo sviluppo economico sostenibile Associazione Nazionale Comuni Italiani – Sardegna Osservatorio Turistico delle Isole Europee Università di Bologna
VERIFY	Observation-based system for monitoring and verification of greenhouse gases https ://cordis.europa.eu/project/id/776810	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/02/2018 31/01/20	Commissariat A L Energie Atomique Et Aux Energies	CMCC Istituto Superiore per la

			22	Alternatives	Protezione e la Ricerca Ambientale
CHE	CO2 Human Emissions https://www.che-project.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/10/2017 31/12/2020	Ecmwf – European Centre For Medium-Range Weather Forecasts	CMCC CLU S.r.L Consiglio Nazionale delle Ricerche Istituto Nazionale di Geofisica e Vulcanologia
MEDSCOPE	MEDiterranean Services Chain based On climate PrEdictions https ://www.medscope-project.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	15/09/2017 28/02/2021	CMCC	CMCC Consiglio Nazionale delle Ricerche
WINDSURFER	WIND and wave Scenarios, Uncertainty and climate Risk assessments for Forestry, Energy and Reinsurance https ://jpi-climate.eu/project/windsurfer/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	15/09/2017 14/09/2020	University of Reading	CMCC
CLARA	Climate forecast enabled knowledge services http://www.clara-project.eu	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/06/2017 31/05/2020	CMCC	CMCC Agenzia Regionale Protezione Ambiente nella Regione Emilia-Romagna GECOSISTEMA S.r.L. Istituto Superiore per la Protezione e la Ricerca Ambientale Regione Emilia Romagna
SEACRIFOG	Supporting EU-African Cooperation on Research Infrastructures for Food Security and Greenhouse Gas Observations https://www.seacrifog.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/03/2017 28/08/2019	Thuenen-Institute	CMCC
XF_ACTORS	Xylella Fastidiosa Active Containment Through a multidisciplinary-Oriented Research Strategy https://www.xfactorsproject.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/11/2016 31/10/2020	CNR- Consiglio Nazionale delle Ricerche	CMCC, CNR, Centro Interprofessionale per le Attività

					Vivaistiche, Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Enbiotech SRL, Università degli Studi di Bari
Blue Action	Arctic Impact on Weather and Climate https ://cordis.europa.eu/project/id/727852	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/12/2016 28/02/2021	DMI – Danmarks Meteorologiske Institut	CMCC
EU-MACS	European Market for Climate Services http ://www.eu-macs.eu	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/11/2016 31/10/2018	FMI – Finnish Meteorological Institute	CMCC Consiglio Nazionale delle Ricerche
INNOPATHS	Innovation pathways, strategies and policies for the Low-Carbon Transition in Europe https://innopaths.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/12/2016 30/11/2020	UCL – University College London	CMCC European University Institute
COP 21 RIPPLES	COP21: Results and Implications for Pathways and Policies for Low Emissions European Societies https://cop21ripples.climatestrategies.org/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/12/2016 30/11/2019	IDDRI – Fondation Institut de Recherche pour le Developpement Durable et les Relations Internationales	CMCC ENEA
SMALLDIS	The impact of small-scale disaster events : an exploration of disaster related losses, extensive risk management and learning at the institutional and community level in Italy https ://www.cmcc.it/projects/smalldiss-the-impact-of-small-scale-disaster-events-an-exploration-of-disaster-related-losses-extensive-risk-management-and-learning-at-the-institutional-community-level-in-italysmalldiss-project	H2020 - HORIZON 2020 FRAMEWORK PROGRAMME	01/09/2016 31/08/2018	CMCC	CMCC Politecnico di Milano Regione Umbria
ICARUS	Integrated Climate forcing and Air pollution Reduction in Urban Systems http ://cca.eionet.europa.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/05/2016 30/10/2020	Aristotelio Panepistimio Thessalonikis	FONDAZIONE CMCC European Academy of Bozen-Bolzano (EURAC Research) THETIS S.p.A

					(Thetis)
BlueHealth	Linking Up Environment, Health and Climate for Inter-sector Health Promotion and Disease Prevention in a Rapidly Changing Environment https://highlanderproject.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/01/2016 30/06/2020	University of Exeter	CMCC, Agenzia Regionale per la Protezione Ambientale Piemonte Agenzia Regionale Protezione Ambiente nella Regione Emilia-Romagna, ASTER Confederazione Italiana Agricoltori Provincia di Torino Consorzio Interuniversitario DEADGROUP Public Services S.r.l. Fondazione Edmund Mach Università degli Studi della Tuscia
ERA4CS	European Research Area for Climate Services http://www.jpi-climate.eu/aboutERA4CS	H2020 - HORIZON 2020 FRAMEWORK PROGRAMME	01/01/2016 31/12/2021	Agence Nationale de la Recherche (ANR)	CMCC Consiglio Nazionale delle Ricerche Ministero dell'Istruzione, dell'Università e della Ricerca
ECOMS 2 (Climateurope)	European Climate Observations, Modelling and Services – 2 http ://www.hzg.de/about_us/eu_projects/h2020/earth/060636/index.php.en	H2020 - HORIZON 2020 FRAMEWORK PROGRAMME	01/12/2015 30/11/2020	Met Office	CMCC
EsiWaCE	Excellence in Simulation of Weather and Climate in Europe https://www.esiwace.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/09/2015 31/08/2019	Deutsches Klimarechenzentrum Gmbh (DKRZ)	CMCC

CRESCENDO	Coordinated Research in Earth Systems and Climate : Experiments, kNowledge, Dissemination and Outreach http ://cordis.europa.eu/project/rcn/196812_it.html	H2020 - HORIZON 2020 FRAMEWORK PROGRAMME	01/11/2015 31/10/2020	University of Leeds	CMCC, ENEA, CNR
CD-LINKS	Linking Climate and Development Policies – Leveraging International Networks and Knowledge Sharing http ://www.cd-links.org/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/09/2015 31/08/2019	IIASA – International Institute for Applied Systems Analysis	CMCC
PRIMAVERA	Process-based climate sIMulation: AdVances in high-resolution modelling and European climate Risk Assessment https://www.primavera-h2020.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/11/2015 31/10/2019	Met Office	CMCC Consiglio Nazionale delle Ricerche
PLACARD	Platform for Climate Adaptation and Risk reduction http ://www.cmcc.it/it/projects/placard-platform-for-climate-adaptation-and-risk-reduction	H2020 - HORIZON 2020 FRAMEWORK PROGRAMME	01/06/2015 30/04/2020	FFCUL – Faculdade de Ciências da Universidade de Lisboa	CMCC
JERICO-NEXT	Joint European Research Infrastructure network for Coastal Observatory – Novel European eXpertise for coastal observaTories http ://www.jerico-ri.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/09/2015 31/08/2019	Ifremer (Institut Francaise de Recherche pour l'Exploitation de la Mer)	CMCC Consiglio Nazionale delle Ricerche ETT SPA Istituto Nazionale di Oceanografia e di Geofisica Sperimentale
AtlantOS	Optimizing and Enhancing the Integrated Atlantic Ocean Observing System https ://www.atlantos-h2020.eu/	H2020 – HORIZON 2020 FRAMEWORK PROGRAMME	01/04/2015 30/06/2019	GEOMAR – Helmholtz Centre for Ocean Research Kiel	CMCC CLU S.r.L ETT SPA Università di Bologna
COBHAM	The role of consumer behavior and heterogeneity in the integrated assessment of energy and climate policies http://www.cobham-erc.eu/	FP7 – 7th FRAMEWORK PROGRAMME	01/08/2014 31/07/2019	POLIMI – Politecnico di Milano	CMCC Politecnico di Milano
GreenHeritage	Partnerships for Innovation – Forward-Looking Projects – Cross-sectoral priorities	Erasmus+ Programme	15/11/2022 30/11/2025	CNR	CMCC Consiglio Nazionale delle Ricerche Centro universitario per i beni culturali onlus

EUCRA	EEA/CET/R0/2022/007 – Support to the preparation of an EU-wide climate change risk assessment (EUCRA)	European Environment Agency (EEA), EEA/2022/NP/0026	09/11/2022 31/07/2024	CMCC	CMCC EURAC – Accademia Europea di Bolzano
ECMWF_C3S2_520	ECMWF_C3S2_520: Quality Assurance for Datasets in the Climate Data Store	ECMWF – European Centre for Medium-Range Weather Forecasts	01/05/2022 30/03/2024	CNR- Consiglio Nazionale delle Ricerche ISMAR	CMCC CNR CNRS
COP INNO – LOT 2 EstuarIO	Estuarine box model for Interfacing rivers and Ocean	MERCATOR OCEAN	28/06/2022 26/07/2024	CMCC	CMCC Univeristà della Calabria
CREATE	Climate Responses for the AdriaTic rEgion https://www.italy-croatia.eu/web/create	Interreg Italia- Croazia	01/06/2022 30/06/2023	CMCC	CMCC Università Iuav di Venezia – Iuav University of Venice, CNR, Regione Abruzzo
SEBASTIEN	Smarter 285ultisens Breeding through Advanced Services Tailoring Innovative and multi-sourcE data to users' Needs https://www.sebastien-project.eu/	2020 CEF Telecom Call – Public Open Data (CEF-TC-2020-2)	01/01/2022 30/06/2024	CMCC	CMCC, CINECA, UniTuscia, UniPiacenza, Nature4, Neatec, AIA
CE2COAST	Downscaling climate and ocean change to services : tresholds and opportunities https://www.ce2coast.com/	JPI Climate & JPI Oceans Joint Transnational Call on Next Generation Climate Science in Europe for Oceans	01/09/2020 31/08/2023	NIVA Bergen	CMCC
MEDLEY	Mixed layer heterogeneity https://medley.cnrs.fr/	JPI Climate & JPI Oceans Joint Transnational Call on Next Generation Climate Science in Europe for Oceans	01/06/2020 31/05/2023	CNRS Laboratoire d'Oceanographie Physique et Spatiale	CMCC
ROADMAP	The role of ocean dynamics and Ocean-Atmosphere interactions in Driving cliMAte variations and future Projections of impact-relevant extreme events http ://roadmap.rd.ciencias.ulisboa.pt/	JPI Climate & JPI Oceans Joint Transnational Call on Next Generation Climate Science in Europe for Oceans	01/06/2020 31/05/2023	Max Planck Institute Amburgo	CMCC
LODE	Loss Data Enhancement for DRR and CCA Management https ://www.lodeproject.polimi.it/	DG ECHO – Union Civil Protection Mechanism UCPM-2018-PP-PREV-AG	15/01/2019 14/01/20	POLIMI – Politecnico di Milano	CMCC Politecnico di Milano

			21		Regione Umbria
ETC-CCA 2019-2021	European Topic Centre on Climate Change impacts, vulnerability and adaptation 2019-2021 http ://cca.eionet.europa.eu/	European Environment Agency (EEA)	06/08/2018 06/08/2021	CMCC	FONDAZIONE CMCC European Academy of Bozen-Bolzano (EURAC Research) THETIS S.p.A (Thetis)
MEDNICE	MED programme Networks for an Innovative Cooperation in Energy efficiency https://highlanderproject.eu/	Interreg MED Programme – Horizontal Project	01/11/2016 31/10/2019	METROPOLE NICE COTE D'AZUR	CMCC Agenzia Regionale per la Protezione Ambientale Piemonte Agenzia Regionale Protezione Ambiente nella Regione Emilia-Romagna, ASTER Confederazione Italiana Agricoltori Provincia di Torino Consorzio Interuniversitario DEADGROUP Public Services S.r.l. Fondazione Edmund Mach Università degli Studi della Tuscia
AMARE	Actions for Marine Protected Areas https://amare.interreg-med.eu	Interreg MED Programme	01/11/2016 31/10/2019	CONISMA – Consorzio Nazionale Interuniversitario per le Scienze del Mare	CMCC Consiglio Nazionale delle Ricerche Consorzio di Gestione Area Marina Protetta

					Porto Cesareo Consorzio di Gestione Torre Guaceto Consorzio Nazionale Interuniversitario per le Scienze del Mare
PROLINE	Efficient Practices of Land Use Management Integrating Water Resources Protection and Non-structural Flood Mitigation Experiences http://www.interreg-central.eu/Content.Node/PROLINE-CE.html	Interreg Central Europe	01/08/2016 30/06/2019	Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management	CMCC Agenzia Regionale Protezione Ambiente nella Regione Emilia-Romagna
24-BS-MFC	Black Sea Monitoring & Forecasting Centre	MERCATOR OCEAN	01/04/2016 30/04/2018	IO-BAS – Institute of Oceanology, Bulgarian Academy of Sciences	CMCC
23-GLO-RAN – Global Ocean Reanalysis	23-GLO-RAN – Global Ocean Reanalysis	MERCATOR OCEAN	01/04/2016 31/12/2018	CMCC	CMCC
21003L02-COP-GLORAN-4300-LOT2	Mercator Ocean – PRODUCTION PROVISION AND ANALYSIS OF REANALYSIS PRODUCTS FOR THE GLOBAL OCEAN (21003-COP-GLORAN)	MERCATOR OCEAN	03/01/2022 31/12/2024	CMCC	CMCC, Adbpo , AIPO, Arpae Arpa Piemonte, Unibo Anbi, Fondazione CMCC Mcbo, Comune di Milano Ersaf, legambiente Polito, SMATrer, Co-Adda, Rpiemonte, Rlombardia,Co-Oglio, Co-Ticino, Rveneto
MFC Hydrological	Hydrological River forcing for Copernicus Marine Service Modelling Centres	MERCATOR OCEAN	19/02/2021 30/06/2021	CMCC	CMCC

Black Sea Products (BS-MFC) – 21002L4-COP-MFC BS-5400	COPERNICUS MARINE – PRODUCTION PROVISION OF OCEAN MONITORING AND FORECASTING PRODUCTS MONITORING AND FORECASTING CENTRES (MFC) (21002-COP-MFC)	MERCATOR OCEAN	31/12/2021 31/12/2024	IO-BAS – Institute of Oceanology, Bulgarian Academy of Sciences	CMCC CINECA OGS
MED-MFC (21002L5-COP-MFC MED-5500)	COPERNICUS MARINE – PRODUCTION PROVISION OF OCEAN MONITORING AND FORECASTING PRODUCTS MONITORING AND FORECASTING CENTRES (MFC)	MERCATOR OCEAN	09/12/2021 31/12/2024	CMCC	CMCC Istituto Nazionale di Geofisica e Vulcanologia Istituto Nazionale di Oceanografia e di Geofisica Sperimentale
HARMONY (HRMNY DUIST)	Science Data Utilisation and Impact Study	ESA – European Space Agency	01/10/2021 30/11/2023	Ifremer (Institut Francaise de Recherche pour l'Exploitation de la Mer)	CMCC UNI Milano-Bicocca
ESA GDA	Global Development Assistance – Agile Information Development – Climate Resilience	ESA – European Space Agency	01/08/2022 31/07/2025	GMV	CMCC
ESA – EOatSEE	ESA – SEA LEVEL RISE AND COASTAL HAZARDS	ESA – European Space Agency	24/06/2022 24/06/2024	Deimos (PT)	CMCC UNIBO
FRONTEX – OCEAN	Meteorological and Oceanographic Services – Lot 2 Oceanographic data and visualization	European Border and Coast Guard Agency (Frontex)	08/10/2021 07/10/2025	CMCC	CMCC ETT
ETC-CA 2022-2026	Framework Partnership Agreement Concerning the European Topic Centre on Climate Change Adptation and LULUCF 2022-2026 http ://cca.eionet.europa.eu/	European Environment Agency (EEA)	01/01/2022 31/12/2026	CMCC	CMCC Accademia Europea di Bolzano/European Academy of Bozen/Bolzano Istituto Superiore di Sanità – Roma Thetis S.p.A.

ECMWF C3S2_370 Operational Seasonal Predictions	Copernicus C3S2_370 Operational Seasonal Predictions	ECMWF – European Centre for Medium-Range Weather Forecasts	01/08/2021 31/07/2025	CMCC	CMCC CINECA
LIFE C-FARM	CARBON FARMING CERTIFICATION SYSTEM https://c-farms.eu/	LIFE Climate Action – Preparatory projects. Enabling Carbon Farming via an improved knowledge system	01/12/2021 31/05/2023	Federlegno	CMCC Confagricoltura FederlegnoArredo CREA PEFC Rete Clima ASP UNITUS Terrasystem
CONCEPTU MARIS (LIFE)	CONservation of Cetaceans and Pelagic sea Turtles in the Western Mediterranean sea – Monitoring-Managing Actions for their Recovery In Sustainability https://www.cmcc.it/projects/conceptu-maris-conservation-of-cetaceans-and-pelagic-sea-turtles-in-med-managing-actions-for-their-recovery-in-sustainability	2020 LIFE call for proposals for traditional projects – nature and biodiversity	10/01/2022 09/01/2026	ISPRA	CMCC ISPRA UNI Milano-Bicocca Capo Carbonare SZN
ESA – Sentinel4Carbon	Sentinel4Carbon	ESA – European Space Agency	01/12/2021 30/11/2023	NOVELTIS	CMCC
PRIMA ACQUAOUNT	Adapting to Climate change by Quantifying optimal Allocation of resOUrces and socio-ecoNomic inTerlinkages https ://www.cmcc.it/projects/acquaount-adapting-to-climate-change-by-quantifying-optimal-allocation-of-water-resources-and-socio-economic-interlinkages	PRIMA Section 1 – Water Management 2020 – TOPIC 1.1.1-2020 Implementing sustainable, integrated management of water resources in the Mediterranean, under climate change conditions.	01/07/2021 31/08/2025	CMCC	CMCC UNISS – Università di Sassari NATURE4 – Nature 4.0 Soc. Benefit Srl ABI – ABINSULA SRL
PRIMA TALANOA-WATER	Talanoa Water Dialogue for Transformational Adaptation to Water Scarcity Under Climate Change https://talanoawater.com/	PRIMA Section 1 – Water Management 2020 – TOPIC 1.1.1-2020 Implementing sustainable, integrated management of water resources in the Mediterranean, under climate change conditions.	01/06/2021 30/05/2025	Università Salamanca	CMCC GECOSISTEMA S.r.L.
PRIMA SCALA-MEDI	Improving sustainability and quality of Sheep and Chicken productions by leveraging the Adaptation potential of LocAl breeds in the MEDIterranean area. https://www.scala-medi.eu/	PRIMA Section 1 – Farming Systems 2020 – TOPIC 1.2.1-2020 (A) Genetic conservation and	01/07/2021 31/08/2025	Università Cattolica del Sacro Cuore (UCSC)	CMCC Università Cattolica del Sacro Cuore

		animal feeds Sub-topic A) Conservation and valorization of local Animal Genetic Resources			(UCSC) CNR-IBBA AGRIS Sardegna NAT4
FEVERSEA	Framework for marine heat wave EVEnts integrating Remote Sensing and 290ultisens simulations	ESA – European Space Agency. Climate Change Initiative launches new research fellowship	01/03/2021 28/02/2023	CMCC	CMCC
JRC – Integration of seasonal climate	Integration of seasonal climate	Joint Research Centre (JRC/IPR/2020/VLVP/2891)	18/12/2020 30/11/2021	CMCC	CMCC
ECF- ATLAS – G20	to report the main impacts and climate risks expected for G20 Countries https://www.cmcc.it/g20	ECF – European Climate Foundation	01/04/2021 31/10/2021	CMCC	CMCC Fondazione ENEL
ECF – CCR_IT – 2	Climate Change Risks in Italy	ECF – European Climate Foundation	01/03/2021 30/09/2021	CMCC	CMCC
ECF – CCR_IT	Climate Change Risks in Italy	ECF – European Climate Foundation	15/03/2020 14/10/2020	CMCC	CMCC
AdriaClim	Climate change information, monitoring and management tools for adaptation strategies in Adriatic coastal areas https://www.italy-croatia.eu/web/adriaclim	Interreg Italia-Croazia. Strategic theme 2.1.1: Climate change adaptation S.O.2.1	01/01/2020 21/12/2022	ARPA Emilia Romagna	CMCC, CNR, UNIBO ARPA Emilia Romagna ISPRA, Regione Marche AULSS3, Regione Molise Regione Emilia-Romagna Comune di Venezia
STREAM	Strategic development of flood management https://www.italy-croatia.eu/web/stream	Interreg Italia-Croazia. Strategic theme 2.2.1: Flood risk S.O.2.2	01/04/2020 31/12/2022	Agency for Development of Zadar County ZADRA NOVA	CMCC ADSU Teramo Comune di Venezia Università di Venezia IUAV

					ARPAE ASSET – Regione Puglia ISMAR – CNR Università politecnica delle Marche Regione Marche
CASCADE	CoAStal and marine waters integrated monitoring systems for ecosystems proteCtion AnD managemEnt https ://www.italy-croatia.eu/web/cascade	Interreg Italia-Croazia. Strategic theme 3.2.1: Marine environment S.O.3.2	01/01/2020 31/12/2022	Regione Puglia	CMCC Regione pUGLIA
FRAMEsPORT	Framework initiative fostering the sustainable development of Adriatic small ports https://www.italy-croatia.eu/web/framesport	Interreg Italia-Croazia. Strategic theme 4.1.3: Nautical servic”Interreg Italia-Croazia. Strategic theme 4.1.3: Nautical services S.O.4.1"es	01/01/2020 31/12/2022	Consorzio per il coordinamento delle ricerche inerenti al sistema lagunare di Venezia (CORILA)	CMCC Comune di Montefalcone ITL ASSET – Regione Puglia SVEM ARAP AAST
LONETA	Local Opportunities for Negative Emission Technologies and their Applications https://www.italy-albania-montenegro.eu/loneta	INTERREG IPA CBC ITALY–ALBANIA–MONTENEGRO – Targeted Call for Project proposals – Small scale projects	01/10/2020 31/03/2022	CMCC	CMCC
SEA FOREST LIFE	Definizione di un protocollo standard di stima del carbonio fissato per progetti di compensazione applicabile a posidonieti http://www.seaforestlife.eu/it/il-progetto/partenariato.html	Università degli Studi della Tuscia, DIBAF nell’ambito del progetto “SEA FOREST LIFE” (LIFE17 CCM/IT/000121)	07/05/2020 31/08/2022	CMCC	CMCC, DREAM ITALIA ISPRA, CNR, CARBONSINK UNITUS, WATER RIGHT FOUNDATION, PARCO NAZIONALE DELL’ARCIPELAGO DI LA MADDALENA, PARCO NAZIONALE DELL’ASINARA PARCO NAZIONALE DEL CILENTO, VALLO DI

					DIANO E ALBURNI
TEACHER	joinT Efforts to increase water management Adaptation to Climate Changes in central EuRope https://www.interreg-central.eu/Content.Node/TEACHER-CE.html	Interreg Central Europe	01/03/2020 28/02/2022	University of Ljubljana	CMCC Autorità distrittuale del fiume Po
DG ECHO Peer Review	Programme for peer reviews in the framework of EU cooperation on civil protection and disaster risk management https ://www.cmcc.it/it/projects/peers-peer-review-of-the-disaster-risk-management	DG ECHO – ECHO/B2/SER/2019/819789	01/03/2020 28/02/2022	CMCC	CMCC UNINA
Efficient Buildings	Efficient Buildingd https://efficient-buildings.interreg-med.eu/	Interreg MED Programme – Horizontal Project	01/11/2019 30/06/2022	METROPOLE NICE COTE D'AZUR	CMCC ENEA
EU's ocean diplomacy with China	Strenghtening international ocean data through the EU's ocean diplomacy with China https://emodnet.ec.europa.eu/en/emodnet-leading-implementation-emod-pace-ground-breaking-collaboration-between-eu-and-china-deal	EuropeAid/139904/DH/SER/CN	19/02/2020 18/09/2022	Seascape Belgium bvba	CMCC Consulenti per la Gestione Aziendale (COGEA) ETT S.p.A. (ETT Istituto Nazionale di Oceangrafia e di Geofisica Sperimentale (OGS)
C3S_34c Prototype service for decadal climate predictions	C3S_34c Prototype service for decadal climate predictions https://www.cmcc.it/projects/prototype-service-for-decadal-climate-predictions	ECMWF – European Centre for Medium-Range Weather Forecasts	01/11/2019 30/04/2021	DWD – Deutscher Wetterdienst	CMCC
JRC NBS 0394	Nature Based Solutions in Agriculture – Lot 7 – Landscape Elements fo Water Retention (LWR) in a mountainous environment	JRC/IPR/2019/OP/0394, Nature Based Solutions in Agriculture – Lot 7 – Landscape Elements fo Water Retention (LWR) in a mountainous environment	04/08/2019 30/04/2020	GOCOSISTEMA	CMCC GECOSISTEMA S.r.L.
SAVEMEDCOASTS 2	Sea Level Rise Scenarios Along the Mediterranean Coasts – 2 https://www.savemedcoasts2.eu/index.php/en	EC, DG ECHO	02/12/2019 01/12/2021	Istituto Nazionale di Geofisica e Vulcanologia	CMCC INGV CGIAM Comune di Venezia FARBAS
Study on adaptation	Study on adaptation modelling	EC, DG CLIMA	09/09/20	CMCC	CMCC

modelling	https://www.cmcc.it/projects/sam-ps-study-on-adaptation-modelling	CLIMA.A.3/ETU/2018/0010	19 08/03/2021		
STEAM+	Innovating STE(A)M in Higher Education with Transdisciplinary Talent Programs https://www.cmcc.it/projects/steam-innovating-steam-in-higher-education-with-transdisciplinary-talent-programs	ERASMUS+ Support for Policy Reform EACEA-36-2018 Forward looking cooperation projects	01/01/2020 31/12/2022	Hanzehogeschool Groningen Stichting	CMCC Università Ca' Foscari Venezia
Game Change	Game Change https://www.cmcc.it/projects/change-game-a-game-based-learning-solution-which-helps-to-raise-awareness-and-improve-understanding-of-the-complex-transformational-challenges-faced-by-humanity-when-dealing-with-climate-change	Climate KIC, European Institute of Technology	02/09/2019 31/12/2019	CMCC	CMCC
MADAMES-AX	mAXimizing climate benefits and economic sustainability of forestry with the MADAMES approach (Mitigation and Adaptation Analysis for Mediterranean Ecosystem Services) https ://www.madames-ax.info/	Climate KIC, European Institute of Technology	02/03/2020 30/11/2020	MEEO	CMCC PEFC ITALY Comunellli di Ferriere Consortium
MED FOR HUB	Toward a Med For Hub	Climate KIC, European Institute of Technology	01/07/2019 31/12/2019	CMCC	CMCC Agenzia Forestale Regionale per lo Sviluppo del Territorio e dell'Ambiente della Sardegna Università degli Studi di Sassari
114-R&D-GLO-RAN-CMEMS – Lot 2 (Ocean Reanalysis)	GLOBAL OCEANIC REANALYSIS FOR THE GLO MFC (114-R&D-GLO-RAN-CMEMS) Lot 2 https://www.cmcc.it/projects/glo-mfc-global-physical-reanalysis-lot-2	MERCATOR OCEAN	01/07/2019 31/03/2021	CMCC	CMCC
114-R&D-GLO-RAN-CMEMS – Lot 10 (Ocean Reanalysis)	GLOBAL OCEANIC REANALYSIS FOR THE GLO MFC (114-R&D-GLO-RAN-CMEMS) Lot 10	MERCATOR OCEAN	01/07/2019 31/03/2021	CMCC	CMCC
114-R&D-GLO-RAN-CMEMS – Lot 8 (Ocean Reanalysis)	GLOBAL OCEANIC REANALYSIS FOR THE GLO MFC (114-R&D-GLO-RAN-CMEMS) Lot 8	MERCATOR OCEAN	01/07/2019 31/03/2021	CMCC	CMCC
HIGHLANDER	HIGH performance computing to support smart LAND sERvices https://highlanderproject.eu/	2018 CEF Telecom Call – Public Open Data (CEF-TC-2018-5)	01/10/2019 30/09/20	CINECA	CMCC CINECA Agenzia

			22		Regionale per la Protezione Ambientale Piemonte Agenzia Regionale Protezione Ambiente nella Regione Emilia-Romagna ASTER Confederazione Italiana Agricoltori Provincia di Torino Consorzio Interuniversitario DEADGROUP Public Services S.r.l. Fondazione Edmund Mach Università degli Studi della Tuscia
C3S 429 IAFES (HERACLITUS)	C3S_429 Demo Cases – Hazard of soil Erosion: Assessing Climate impacts across Italy through copernicUS data	ECMWF – European Centre for Medium-Range Weather Forecasts	01/07/2019 30/06/2020	CMCC	CMCC
C3S_430 Sectoral Information System to Support Disaster Risk Reduction	C3S_430 Sectoral Information System to Support Disaster Risk Reduction	ECMWF – European Centre for Medium-Range Weather Forecasts	01/06/2019 30/05/2021	CMCC	CMCC
ClimaTT – Parco Naturale Alpi Marittime	Servizio di formazione sui cambiamenti climatici, a Chiusa di Pesio (CN) nell'ambito del Progetto 1711 "CclimaTT" (Azione 4.2.1) – INTERREG V-A ALCOTRA	Parco Naturale Alpi Marittime through Progetto 1711 ClimaTT Interreg V-A ALCOTRA (Azione 4.2.1)	11/03/2019 12/03/2019	CMCC	CMCC
Med-Star	Strategie e misure per la mitigazione del rischio di incendio nell'area Mediterranea https://interreg-maritime.eu/web/med-star	INTERREG MARITTIMO ITALIA FRANCIA	01/05/2019 30/04/2022	Regione Sardegna con il supporto del CNR-IBIMET di Sassari	CMCC, Regione Autonoma della Sardegna – Direzione generale della Protezione civile

					Regione Liguria Dipartimento Agricoltura, Turismo, Formazione e Lavoro – Settore Politica della Montagna e della Fauna Selvatica ANCI Liguria, Centro Internazionale in Monitoraggio Ambientale Fondazione CIMA Consiglio Nazionale delle Ricerche – Istituto per la BioEconomia – IBE (Sede di Sassari) Università di Sassari – Dipartimento di Agraria Regione Toscana Consorzio LAMMA – Laboratorio di Monitoraggio e Modellistica Ambientale per lo sviluppo sostenibile, Università degli Studi di Firenze Dipartimento di Scienze e Tecnologie Agrarie, Alimentari e Forestali – DAGRI

COMMIT	Modelling of national greenhouse-gas emission mitigation policies and the relationship with global low emission pathways	EuropeAid/138749/DH/SER/ Multi	18/12/2017 17/06/2020	Netherlands Environmental Assessment Agency (PBL)	CMCC
Adriadapt	a Resilience information platform for Adriatic cities and towns https ://www.italy-croatia.eu/web/adriadapt	Interreg Italia- Croazia, S.O.2.1	01/01/2019 31/12/2020	CMCC	CMCC, Agenzia Regionale Protezione Ambiente nella Regione Emilia-Romagna Comune di Cervia Comune di Udine Università IUAV di VeneziaAgenzia Regionale Protezione Ambiente nella Regione Emilia-Romagna Comune di Cervia Comune di Udine Università IUAV di Venezia
GUTTA	savinG fUel and emissions from mariTime Transport in the Adriatic region https ://www.italy-croatia.eu/web/gutta	Interreg Italia- Croazia, S.O.4.1	01/01/2019 30/06/2021	CMCC	CMCC Autorità di Sistema Portuale del Mare Adriatico Meridionale
KIC INNOSPACE Journey	KIC INNOSPACE Journey	Climate KIC, European Institute of Technology	01/01/2018 30/09/2018	CMCC	CMCC
CLIMATHON Lecce	CLIMATHON Lecce	Climate KIC, European Institute of Technology	01/01/2018 31/12/2018	CMCC	CMCC
CLIMATHON Venezia	CLIMATHON Venezia	Climate KIC, European Institute of Technology	01/01/2018 31/12/20	CMCC	CMCC Istituto Nazionale di

			18		Oceanografia e di Geofisica Sperimentale – OGS, Italy CINECA, Italy
SAFERPLACES	Improved assessment of pluvial fluvial and coastl flood hazards https://saferplaces.co/	Climate KIC, European Institute of Technology	16/07/2018 15/07/2021	GECOSISTEMA	CMCC CINECA GECOSISTEMA
SUSHI	Potential historic Mediterranean districts project	Climate KIC, European Institute of Technology	20/07/2018 31/12/2018	Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa	CMCC
MARINE EO – LOT1 – Planetek	Pre-commercial procurement (PCP) to buy R&D services to bridge innovative downstream EO and Copernicus enabled services for integrated maritime environment, surveillance and security – Lot 1 – SATOCEAN	MARINE-EO	18/06/2018 15/10/2020	Planetek Hellas	CMCC Agenzia Nazionale per le nuove tecnologie l'energia e lo sviluppo economico sostenibile
MARINE EO – LOT1 – Telespazio	Pre-commercial procurement (PCP) to buy R&D services to bridge innovative downstream Earth observation and Copernicus enabled services for integrated maritime environment, surveillance and security – Lot 1 – SATOCEAN http://marine-eo.eu/	MARINE-EO	18/06/2018 15/10/2020	Telespazio France	CMCC
MARINE EO – LOT2 – e-GEOS	Pre-commercial procurement (PCP) to buy R&D services to bridge innovative downstream Earth observation and Copernicus enabled services for integrated maritime environment, surveillance and security – Lot 2 – SATSURVEILLANCE http://marine-eo.eu/	MARINE-EO	18/06/2018 15/10/2020	e-GEOS	CMCC eGEOS
72-CMEMS-MFC-BS Black Sea	Copernicus Marine Monitoring Service (CMEMS) Provision of Ocean Analysis and Forecast products for the Black Sea	MERCATOR OCEAN	01/01/2018 31/12/2021	Institute of Oceanology, Bulgarian Academy of Sciences (IO-BAS)	CMCC
74-CMEMS-MFC-MED Med Sea	Copernicus Marine Monitoring Service (CMEMS) Provision of Ocean Analysis and Forecast products for the MED Sea	MERCATOR OCEAN	01/01/2018 31/12/2021	CMCC	CMCC Istituto Nazionale di Oceanografia e di Geofisica

					Sperimentale – OGS, Italy CINECA, Italy
ECMWF C3S_330 Operational Production of Seasonal Forecasts	C3S_330 Operational Production of Seasonal Forecasts	ECMWF – European Centre for Medium-Range Weather Forecasts	01/04/2018 30/06/2021	CMCC	CMCC CINECA
Formazione Comune Cuneo (ALCOTRA)	FormazioneComune Cuneo (Interreg ALCOTRA Italia-Francia)	Comune di Cuneo through Progetto Interreg ALCOTRA Francia -Italia 2014-2020	30/12/2017 30/03/2018	CMCC	CMCC
Consulenza UNI Palermo – Desertificazione	Servizio di consulenza di un esperto sui temi della desertificazione e del cambiamento climatico	Università di Palermo – through LIFE16 CCA/IT/000011	14/12/2017 13/12/2022	CMCC	CMCC Agenzia Nazionale per le nuove tecnologie l'energia e lo sviluppo economico sostenibile
OFIDIA2	Operational Fire Danger 298ultisenso 298ultisen 2 https://www.mitigoinbasilicata.it/home/	Interreg Greece-Italy 2014-2020	30/03/2018 30/03/2020	CMCC	Unibas, PoliBa, Unitn, CUGRI, Unina, Unisa, CMCC, Regione Basilicata – Dipartimento Infrastrutture e Mobilità CREATEC S.c.r.l., Cedat Europa S.r.l. Centro Dati e Servizi per l'Ambiente e il Territorio, Geocart S.p.A., INNOVA Consorzio per l'Informatica e la Telematica S.r.l. Openet Technologies S.p.A. PUBLISYS

					S.p.A., Sintesi S.r.l. Exprivia S.p.A., TAB Consulting S.r.l., TeRN, Istituto di Metodologie per l'Analisi Ambientale di Tito Scalo (PZ) – CNR e-GEOS S.p.A
TRITON	Development of management Tools and diRectives for immediate protection of bIodiversity in coasTal areas affected by sea erOsion and establishment of appropriate eNvironmental https://www.interregtriton.eu/	Interreg Greece-Italy 2014-2020	16/04/2018 16/04/2020	Regione Puglia – Dipartimento Sviluppo Economico, Innovazione, Istruzione, Formazione e Lavoro	CMCC Regione Puglia
CLIMTOUR	C3S_422 Operational climate service for European tourism operators	ECMWF – European Centre for Medium-Range Weather Forecasts	01/10/2017 31/03/2019	TEC Conseil – Tourisme, Transports, Territoires, Environnement Conseil	CMCC Regione Puglia
MADAMES	Mitigation and Adaptation Analyses for Mediterranean Ecosystem Services https ://www.madames-ax.info/	Climate KIC, European Institute of Technology	01/05/2018 31/10/2018	MEEO	CMCC Meteorological Environmental Earth Observation
SAVEMEDCOASTS	Sea level rise scenarios along the Mediterranean coasts http://www.savemedcoasts.eu/	EC, DG ECHO	01/01/2017 30/11/2018	Istituto Nazionale di Geofisica e Vulcanologia	CMCC Centro di Geomorfologia Integrata per l'Area del Mediterraneo Istituto Nazionale di Geofisica e Vulcanologia
SOSSTA (21-MED-CMEMS)	Statistical-Dynamical Observation Operator for SST Data Assimilation https://www.cmcc.it/it/projects/feamp-ecosystem-approach-to-support-the-protection-and-management-of-natura-2000-sites-in-heavily-anthropized-areas	MERCATOR OCEAN	01/03/2016 28/02/2018	CMCC	CMCC

ECMWF – C3S_433 Seasonal Forecasts	C3S_433 Seasonal Forecasts https://www.hpc.cineca.it/projects/super	ECMWF – European Centre for Medium-Range Weather Forecasts	01/01/2016 31/03/2018	CMCC	CMCC CINECA
Sea-Basin checkpoints - Lot 4. Black Sea	Sea-Basin checkpoints - Lot 4. Black Sea	DG MARE MARE/2014/09	15/08/2015 13/07/2018	IO-BAS – Institute of Oceanology, Bulgarian Academy of Sciences	CMCC
Uptake Copernicus Services (FWC)	Framework Contract – Support to the Uptake of the Copernicus Services by Users https ://www.eflip-project.org/	DG Enterprise and Industry	01/01/2017 31/12/2020	SPACETEC	CMCC Fondazione CIMA, Italy Istituto Universitario di Studi Superiori di Pavia (IUSS)
MED-MFC	Mediterranean Monitoring and Forecasting Centre	MERCATOR OCEAN	01/05/2015 30/04/2018	CMCC	CMCC Istituto Nazionale di Geofisica e Vulcanologia Istituto Nazionale di Oceanografia e di Geofisica Sperimentale
OceanCOST	Evaluation of Ocean Syntheses	COST European Cooperation in Science and Technology	11/07/2014 13/05/2018	University of Liege	CMCC AMUNDI POLITECNICO DI MILANO
ETC-ICM 2014-2018	European Topic Centre on Inland, coastal and marine waters 2014-2018 https://www.eionet.europa.eu/	European Environment Agency	02/01/2014 31/12/2018	Helmholtz – Zentrum für Umweltforschung (UFZ)	CMCC
ETC-CCA 2014-2018	European Topic Centre on Climate Change impacts, vulnerability and adaptation 2014-2018 https://www.eionet.europa.eu/	European Environment Agency	02/01/2014 31/12/2018	CMCC	CMCC EURAC

8.5 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 and in the Arctic in the frame of PNRA and PRA programmes, 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 and PRA (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.

By the MUR support, Italy is contributing to the Integrated Carbon Observation System (ICOS) Research Infrastructure (www.ico-ri.eu): Italy hosts the ICOS Ecosystem Thematic Center (ETC) and by the ICOS-Italia Joint Research Unit is operating a national network composed by 3 atmospheric stations, 10 ecosystemic sites and 4 oceanic stations (https://www.icos-italy.it/italian-network/). The ICOS major aim is to produce 96 ultisensory, high-precision and long-term observations and facilitate research to understand the carbon cycle and to provide necessary information on greenhouse gases.

8.5.1 Atmospheric Climate Observing System, including those measuring atmospheric constituents

The Italian observing network is managed by several institutions and agencies: the Joint Research Council ICOS-Italia, the Agrarian Research Council, the Italian Air Force Meteorological Service, ENEA, University of Urbino, 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 expresses the Italian Permanent Representative with the WMO, with the ECMWF (European Centre for Medium Range Weather Forecast) and with the EUMETSAT (European Organisation for the Exploitation of Meteorological Satellites).*

The observation network for atmospheric parameters relies on two different networks, the first is devoted to meteorological parameters, the second one is dedicated to environmental and climate parameters.

The *Italian Air Force Meteorological Service* (http://www.meteoam.it) manages a network of 64 manned surfacestations and of 48 automatic surfacestations (43 Data Collection Platforms + 5 SWS). Other meteorological data are collected by the *National Agency for Aviation Aids* (ENAV, http://www.enav.it), which operates a network of 44 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	64	WMOGTS, ICAOAFTN	~ 66 years
Air Force Met Service	surfaceautomatic (DCP)	43	synoptic use	~ 14 years (not continuously)
Air Force Met Service	surfaceautomatic (SWS)	5	WMOGTS, ICAOAFTN	More than 4 years
Air Force Met Service	surface solar radiation and sunshine	34	WMOGTS	~ 58 years
ENAV	surfacemanned	~ 44	WMOGTS, ICAOAFTN	~ 66 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

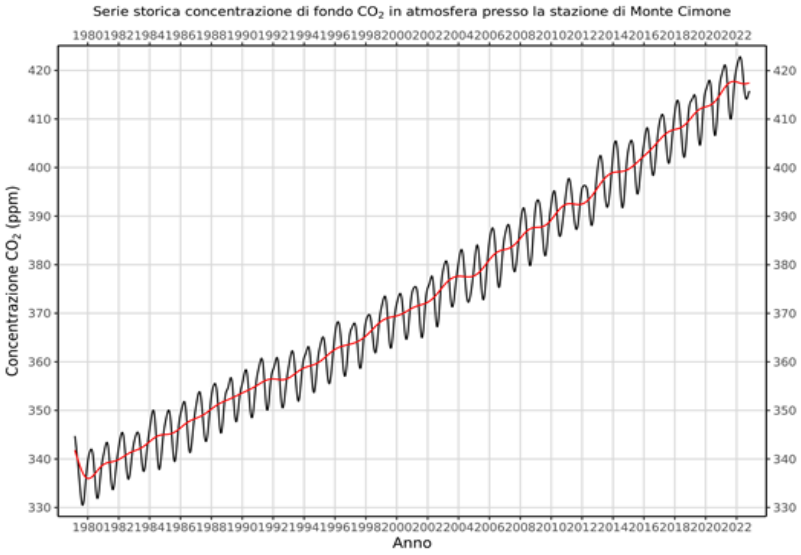
The Italian Air Force Met Service has developed a new *Standard Weather System* (SWS), based on the EUMETNET *AWS* (automatic weather station) Program requirements, in order to substitute gradually the acquisition tool and sensors in each meteorological station. The system is able to operate both in 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.

In addition, measurements of CH_4 are provided since February 2015.

CO_2 and CH_4 data data are regularly transmitted to the WDCGG: World Data Centre for Greenhouse Gases, Tokyo (Japan) https://gaw.kishou.go.jp/; and to - NOAA-ESRL-GMD (National Oceanic & Atmospheric

Administration - Earth System Research Laboratory - Global Monitoring Division/Obspack database). Total column O_3 is measured in two stations: Sestola (1020 m a.s.l., close to Mt. Cimone), Vigna di Valle by means of spectrophotometer Brewer. Ozone data are regularly transmitted to the Canadian WOUDC (World Ozone and Ultraviolet Radiation Data Centre, http://www.woudc.org/index_e.html).



Time series of CO2 concentration data in the atmosphere at the C.A.M.M. station of Monte Cimone (black curve). Time series without the contribution of seasonal fluctuations (red curve). The trend in the figure is 1.88 ppm/year.

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	~ 63 years
Regional EnvMet Services	upperair	2	WMOGTS	~ 23 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

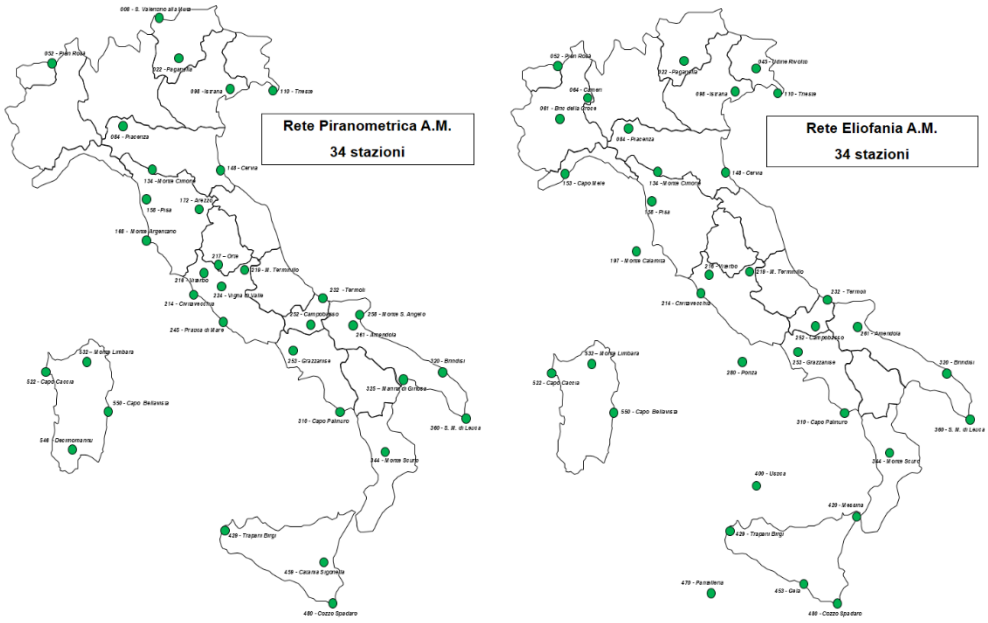


Table 8.7 The Italian GAW stations on national territory

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
Total column Ozone and Surface UVB Radiation	Brewer spectrophotometers	daily	2 (Sestola, Vigna di Valle)	Brewer data time series 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	34	data time series since 1958 for most of historical stations
Sunshine Duration	CampbellStokes sunshine recorder	daily	34	data time series since 1958 for most of historical 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	PICARRO G2301	Every 5 seconds	1	since March 1979
CH_4	PICARRO G2301	Every 5 seconds	1	since February 2015

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

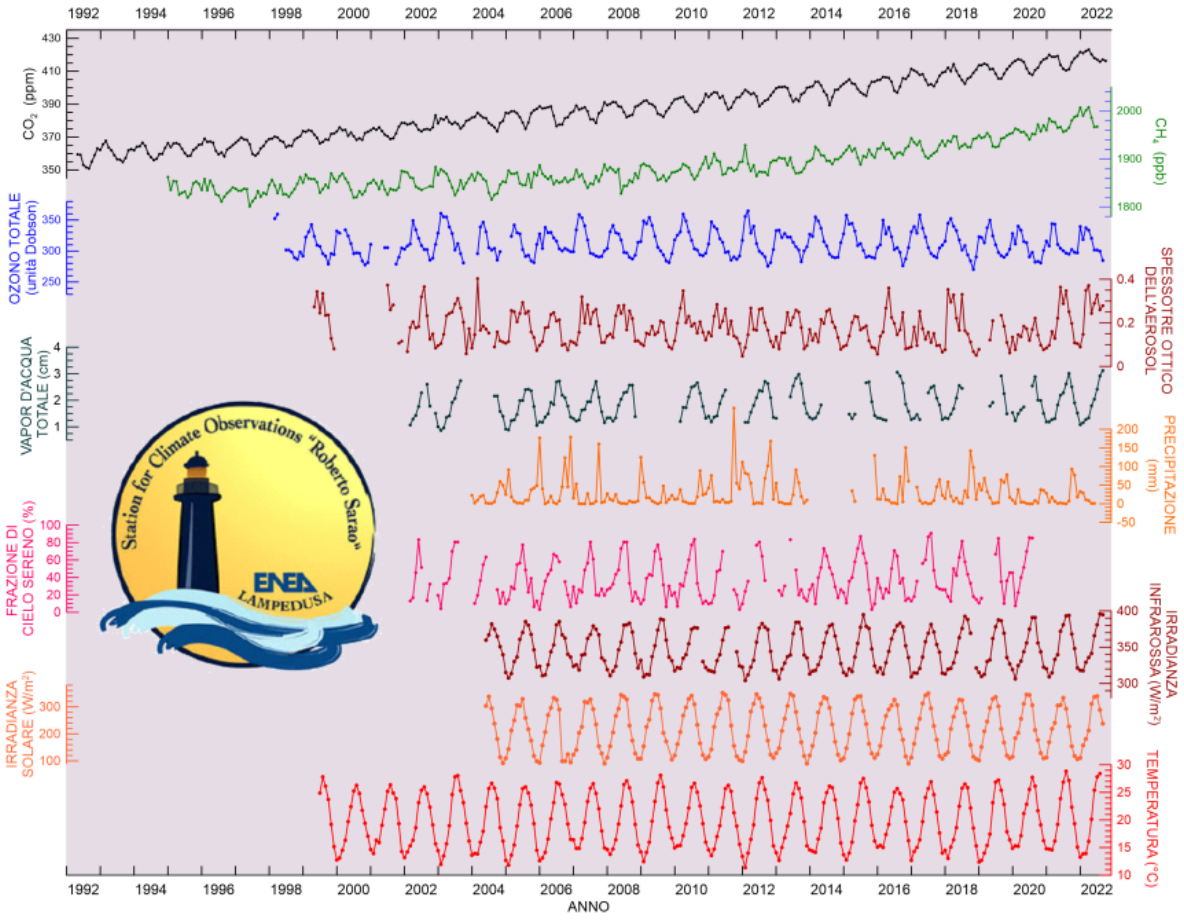
EEA (European Environmental Agency) and to other international bodies such as EMEP (*European Monitoring and Evaluation Programme*). For over 15 years ISPRA has developed and manages, in collaboration with the most important national and regional meteorological networks, the National System for Climate Data Collection and Dissemination (*SCIA, www.scia.isprambiente.it*). In agreement with the National Permanent Representative and in collaboration with the Italian Air Force Met Service, 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). All essential atmospheric and marine climate variables are routinely monitored at Lampedusa.

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) total ozone , aerosols (optical properties, chemical composition), water vapour and clouds, meteorological parameters, CO, ultraviolet, solar, and infrared radiation.

Figure 8.2. Time series of the main atmospheric parameters measured at the Atmospheric Observatory at Lampedusa.



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.

Thanks to national programmes supporting the development of Italian sites within the European Research Infrastructures, the observatory is joining the ACTRIS aerosol and cloud remote sensing networks; it is part of ICOS; an ICOS ecosystem site is under development on the island to provide information on the atmospheric, marine and ecosystem components of the carbon cycle.

A New Climate Observatory, Madonie-Piano Battaglia (MDN) has been set up in Sicily at 1650 m a.m.s.l. Greenhouse gases are monitored at MDN since 2006, and data contribute to GCOS through the GAW programme.

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 (THAAO, 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 PNRA and PRA programmes; they were supported also by the European Union, the MUR 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 French-Italian 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 Meteo Climatological Antarctic Observatory is supported by the *Italian Antarctic Programme*.

UNIVERSITY OF URBINO

The University of Urbino, Department of Pure and AppliedSciences, since two decades is measuring all the halogenated gases relevant for stratospheric ozone depletion and climate. The activity is performed via a GC-Ms (gas-chromatography/mass spectrometry) instrumentation at Mt. Cimone within the AGAGE (The Advanced Global Atmospheric Gases Experiment) international programme, under the coordination of the Massachusett Institute of Technology (MIT).

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 long-term scientific programmes covering a large suite of climate altering species (including Montreal and Kyoto gases as well as short-lived climate forcers) and other species (e.g. CO, Nox, COS, aerosol properties) useful to attribute the sources of GHG variability are carried out in the framework of international measurement networks (WMO/GAW, AGAGE, ACTRIS). Mt. Cimone is also a class-2 atmospheric site of the ICOS-RI: carbon dioxide (CO_2) and methane (CH_4) continuous observations are carried out in this framework. Starting from 2022, these observations will be further integrated with nitrous oxide (N_2O).

List observation programmes running at the "O. Vittori" observatory at Mt. Cimone (Uniurb: Urbino University; Unibo: Bologna University) with potential for monitoring and verification of greenhouse gas emissions.

Observations	Starting year	Lead institution
CO_2, CH_4, CO	2018	CNRISAC
Surface O_3	1996	CNRISAC
NO,NO_2	2012	CNRISAC
CO	2008-2017	CNRISAC/Uniurb
CH_4	2008-2017	Uniurb
N_2O	2008-2020	Uniurb
SF_6	2008	Uniurb
CFCs, HCFCs	2002	Uniurb
HFCs	2002	Uniurb
PFC	2002	Uniurb
COS	2008	Uniurb
Columnar O_3, NO_2	1993-2019	CNRISAC
Aerosol scattering	2005	CNRISAC
Aerosol absorption	2005	CNRISAC
Equivalent BC	2005	CNRISAC

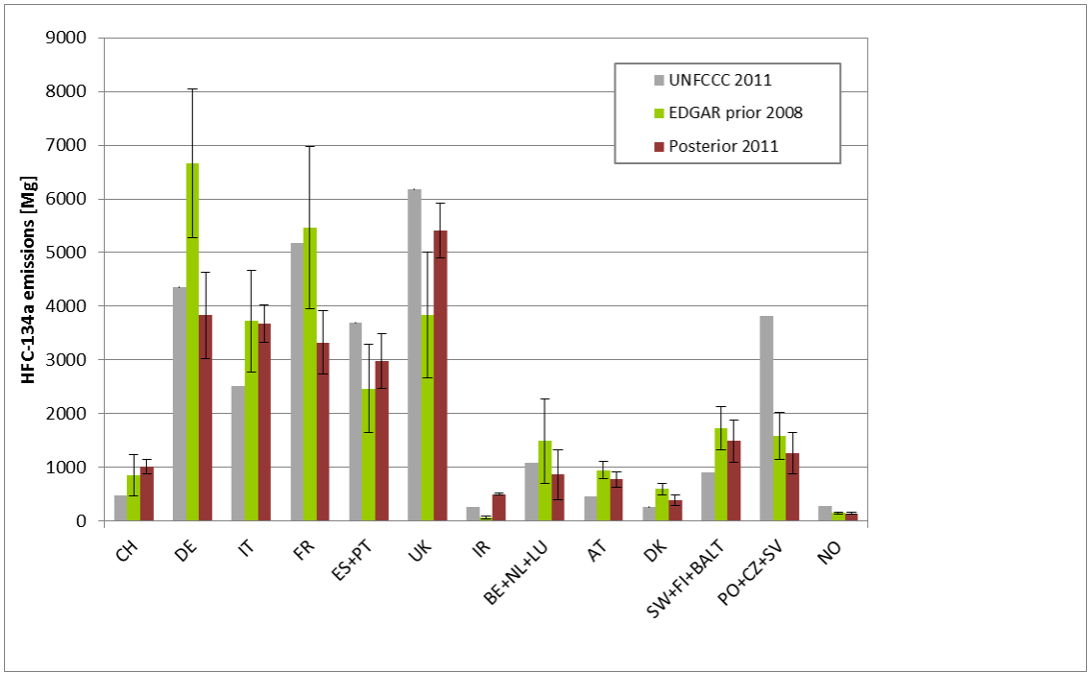
Even if carbon dioxide is the major anthropogenic contributor to radiative forcing, other gases such as methane, nitrous oxide, SF6, and halogenated gases (CFCs, HCFCs, PFCs, HFCs), are extremely relevant in climate issues because of their very high Global Warming Potential. Moreover, other shortlived 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. These observations are used in research studies devoted to: evaluating long term trends, early detection of the interannual variability of GHG atmospheric growth rates, early detection of newly introduced species, detection of fraudulent emissions of regulated species and to the attribution of impacts by natural and anthropogenic sources/sinks.

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.

Inverse modelling approaches to be used for the evaluation of non-CO_2 GHG emissions at the regional scale

combine atmospheric observations with atmospheric transport modelling, and have the potential to improve the accuracy and transparency of national emission inventories. Inverse modelling is based on a Lagrangian Particle Dispersion Model (LPDM) used in a backwards-in-time mode, and a Bayesian inversion technique. In the past few years a lot of attention has been devoted to testing regional modelling setups to lower uncertainties associated with different aspects of the modelling cascade, thus improving the accuracy of the estimates. As an example, country aggregated emissions of the refrigerant HFC-134a are reported below: bottom-up data (EDGAR, UNFCCC) are compared with inversion results (Posteriori) for the year 2011 for different European countries (Italy: IT). Simulations have been performed using the database EDGARv4.2 2008 as prior field and the time series observed at the WMO-GAW stations of Mt. Cimone, Mace Head and Jungfraujoch. The LPDM has been driven by meteorological fields based on dataset ERA5, provided by the ECMWF.

Country aggregated emissions of HFC-134a for the year 2011

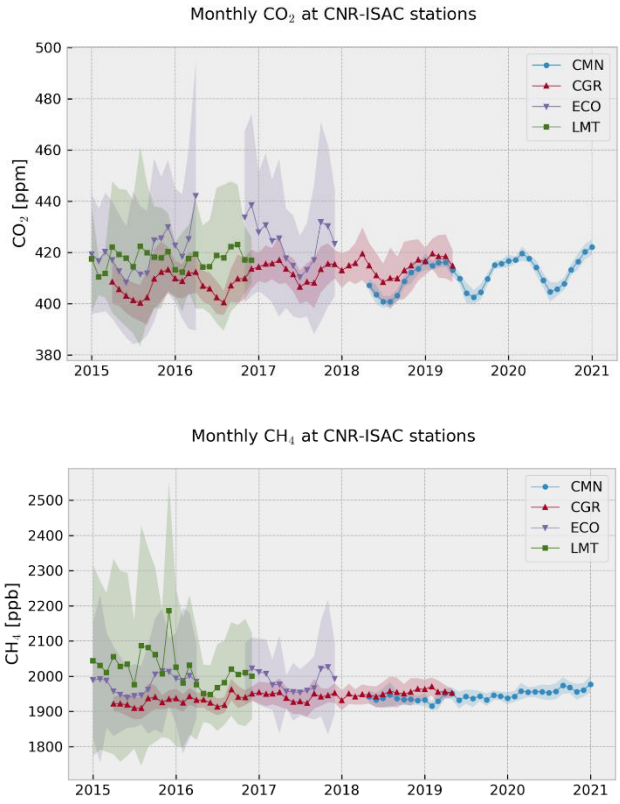


The analysis of these data using inverse modelling approaches (e.g. *Graziosi, F. et al., Emissions of carbon tetrachloride from Europe, Atmos. Chem. Phys., 16, doi:10.5194/acp16128492016, 2016; Graziosi F, et al. 2017. European emissions of the powerful greenhouse gases hydrofluorocarbons inferred from 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 WMO, 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.

Besides Mt. Cimone "O. Vittori" Observatory, within the group "Atmospheric composition, climate forcing and air quality" (CAFCA), CNRISAC operates three permanent observatories (Capo Granitola, Lamezia Terme and Lecce). At these observatories, part of the WMO/GAW network (GAW ID: CGR, LMT, ECO), continuous observations of GHG (CO_2, CH_4) and SLCF (near surface 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. Thanks to the participation in the

National Programme "PON Ricerca e Innovazione 2014-2020" (Projects "PON-ICOS_MED" and "PER-ACTRIS-IT") the CNRISAC stations went to a significant increase of the observation capabilities. Similar observations were also implemented by CNRIIA at the Monte Curcio Observatory (GAW ID: CUR).

Time series of the CO_2 and CH_4 monthly mean values observed at CNRISAC stations.



CNRISAC hosts a series of DOAS/MAX-DOAS both research-grade and custom-built spectrometers (in Lecce (2016-now), Bologna (2018-now) and Mt. Cimone (1993-2019)) and recently acquired commercial state-of-the-art systems (at S. Pietro Capofiume and Rome). In particular, they are used to retrieve total column amount and tropospheric profiles of aerosol extinction and trace gases (NO_2 and O_3). The two state-of-the-art systems are compliant with satellite validation networks (e.g. European Space Agency (ESA) Fiducial Reference Measurements for Ground-Based DOAS Air-Quality Observations (FRM4DOAS) activity) and are continuously monitoring NO_2 and O_3 total columns since October 2021.

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 2005 manage continuous near-surface O_3 observations in Concordia on the Antarctic Plateau. 310ultisensory310ent

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 310ultis 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 ((https://bo.isp.cnr.it/main/CCTower/). CO_2 and CH_4 fluxes by eddy-covariance method are measured by CNRISAC. 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).

University of Rome "La Sapienza"

The Physics Department of the University of Rome "La Sapienza", jointly with *Serco Italia* (www.serco.com/eu), the *National Research Council (CNR) Institute of Atmospheric Sciences and Climate (CNR-ISAC)*, located in the Research Area of Tor Vergata, Rome, the *CNR Institute of Atmospheric Pollution Research (CNR-IIA)*, located in the Research Area of Montelibretti, Rome, *Sardegna Clima APS*, and the *Regional Environmental Protection Agency of Valle d'Aosta region (ARPA Valle d'Aosta)*, is part of the BAQUNIN (Boundary layer Air Quality-analysis Using Network of Instruments) consortium.

In its current configuration, the BAQUNIN supersite (Iannarelli et al., 2022, DOI: https://doi.org/10.1175/BAMS-D-21-0099.1) consists of three observation sites, located at the Atmospheric Physics Laboratory of the **University of Rome "La Sapienza"** (41.90°N, 12.52°E, 75 m a.s.l.), **CNR-ISAC** (41.84°N, 12.65°E, 117 m a.s.l.) and **CNR-IIA** (42.11°N, 12.64°E, 92 m a.s.l.) selected in the urban, semirural, and rural environments, respectively.

BAQUNIN is a project financed and supported by ESA with the dual purpose of carrying out atmospheric studies in urban and non-urban environments, and cal/val activities for multiple satellite missions.

BAQUNIN includes active and passive remote sensing and surface instruments, which allow the retrieval of fundamental parameters for the investigation of atmospheric properties, gases, and atmospheric aerosols. Most of the instruments are housed in the Atmospheric Physics Laboratory of the University of Rome "La Sapienza" to allow in-depth studies of urban heat island and urban pollution island and to support cal/val activity of latest generation satellite products in downtown Rome and in the Tiber valley surrounding Rome. In the following it is reported the list of products supplied by BAQUNIN.

Product	Instrument	References	Data availability
GASES			
O_3 TC	Brewer	Siani et al. 2018	1992-today
NO_2 Surf, NO_2 Trop	Pandora-2S	Herman et al. 2015	2016-today
NO_2 TC	Brewer	Diémoz et al. 2021	1996-2017
H_2O TC	Cimel-CE318	Berezin et al. 2017	2017-today
AEROSOL			
AOD, AE	Cimel-CE318	Giles et al. 2019	2017-today

	Prede-POM	Nakajima et al. 2020	2010-today
	LIDAR (MWL & RAP)	Klett 1985	2016-today
AerBack, AerExt profiles	LIDAR	Klett 1985	2016-today
SAE, AAE	Cimel-CE318	Klett 1985	2017-today
SSA, VSD, Refr. Index, PF	Cimel-CE318	Giles et al. 2019	2017-today
	Prede-POM	Kudo et al. 2021	2010-today
METEO			
H	Pyranometer	Azouzoute et al. 2019	2018-today
UVI, UVD	Brewer Meteorological Station SCO	Kerr 2010	1996-today
Profiles of U and θ	SODAR	Mastrantonio and Fiocco 1982	2007-2010, 2017-today
Surface measurements: U, θ, T, RH	Meteorological Station SCO & OMD	*n.a.*	2019-today
P	Microbarometer	*n.a.*	2020-today
RI, DP	Meteorological Station SCO	*n.a.*	2020-today

The advantageous location of its three stations, and the contemporary presence of several diverse instruments for atmospheric observation, have fostered the insertion of BAQUNIN in several national and international remote sensing networks, for which it now represents a certified cross-point. These networks are:

- Pandonia Global Network (PGN; www.pandonia-global-network.org): the network of Pandora instruments, promoted by ESA and by the National Aeronautics and Space Administration (NASA);
- International SKYNET Data Center (www.skynet-isdc.org/): international radiometers network of Prede-POM sun sky radiometers;
- Aerosol Robotic Network (AERONET; https://aeronet.gsfc.nasa.gov/): run by NASA and Laboratoire d'Optique Atmosphérique (LOA-PHOTONS) (www-loa.univ-lille1.fr/photons);
- European Brewer Network (EUBREWNET) (www.eubrewnet.org/): the network of European Brewer Spectrophotometer monitoring stations launched as part of a COST Action;
- Climate Network (OMD; https://fondazioneomd.it/climate-network): Italian national network of certified quality weather stations;
- Sardegna Clima APS (www.sardegna-clima.it/): Sardinian network of weather stations.

The BAQUNIN instruments that are included in such officially recognized networks are subject to quality control, thus assuring community-certified quality data. For those instruments that do not belong to a network, specific procedures are anyway followed to verify the quality of measurements and retrievals, according to the guidelines provided by the manufacturers or by the scientific community. All data are freely disseminated through the network portals and the BAQUNIN website.

In addition, the BAQUNIN consortium actively participates in the design and organization of measurement campaigns, and is part of several projects, in collaboration with several international and national research institute (e.g., Effect of Megacities on the Transport and Transformation of Pollutants on the Regional to Global Scales, EmeRGe, www.iup.uni-bremen.de/emerge/home/home.html; Quality and Traceabiliy of Atmospheric aerosol Measurements, QUATRAM, www.euroskyrad.net/quatram.html; Metrology for Aerosol Optical Properties, MAPP, www.pmodwrc.ch/en/MAPP/).

The data collected by BAQUNIN have already been used for micro- and local-scale analyses of atmospheric

dynamic phenomena (Di Bernardino et al., 2021, DOI: https://doi.org/10.1016/j.uclim.2021.100842), for the assessment of air pollution in an urban environment (Campanelli et al., 2021, DOI: https://doi.org/10.1016/j.uclim.2021.100954), and for the investigation of the interaction between synoptic weather conditions and atmospheric particulate matter concentration and composition (Di Bernardino et al., 2021, DOI: https://doi.org/10.1016/j.apr.2021.02.019).

8.5.2 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 (OGS coordinates MONGOOS and CMCC , CNR, OGS, ISPRA, University of Bologna and ARPAE are partners). The development of operational oceanography in Italy is coordinated within MONGOOS and has been developed in the last year through several projects such as MYOCEAN 1 and 2, RITMARE, ARGOIT and the operational phase of the Copernicus Program. Italian research agencies and institutions are contributing to GOOS through the *insitu* and satellite ocean monitoring systems, the basin scale Mediterranean and Black Sea forecast for the ocean general circulation and marine biochemistry (CMES), Mediterranean, Black Sea and global scale reanalyses, and limited area forecasts for the Italian seas.

The Italian tide gauge and wave network is coordinated and maintained by ISPRA and contributes to GLOSS and several other data delivery portals in Europe and internationally (https://www.mareografico.it/?session=0S330110955883VMP9085T87&syslng=ing&sysmen=-1&sysind=-1&syssub=-1&sysfnt=0).

The open ocean real time observations in the Mediterranean Sea have been collected since the early 2000s through the coordination of ENEA and OGS. Other monitoring products are derived from satellite observations consisting of Sea Surface Temperature, Sea Level Anomaly and Chla concentration specifically analyzed for the Mediterranean Sea by CNR.

The Copernicus service (https://www.copernicus.eu/en/copernicus-services) organises the access to multiple sources of observational and modelling data, from Earth Observation satellites to *insitu* platforms and provides users with reliable and up-to-date information through a set of services related to environmental and security issues. CMCC has the responsibility of the Mediterranean Monitoring and Forecasting Centre (in partnership with OGS) and partially of the Black Sea monitoring and forecasting Centre. CNRISAC has the responsibility of the Ocean Color Thematic Assembly Centre and partially of the Sea Surface Temperature Thematic Assembly Centre. CMCC produces reanalyses of all in situ and satellite observations for CMES and disseminates products openly and freely through its own server (https://www.cmcc.it/lectures_conferences/data-delivery-system-the-cmcc-platform-to-access-share-and-analyse-climate-data).

ARGO-ITALY (http://argo.ogs.it/#/projects/argo-italy) is the Italian component of a worldwide *in situ* global observing system, based on autonomous profiling floats and it is financed by the MUR. 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. ARGO-ITALY 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 (Ship Of Opportunity Program for 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 an oceanographic observatory (35.49°N, 12.47°E) South of the Sicily channel, close to the island of Lampedusa which contributes to the integrated Climate observatory. 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.

8.5.3 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 di314ultisena Foreste e Legno del Consiglio per la314ultisena in agricoltura e ''analisi del''economia314ultisena) 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). The new CUTFAA Forest Fire Geoportal has been released in April 2022 (https://geoportale.incendiboschivi.it/portal/apps/sites/#/geoportale-incendi-boschivi). 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 measure of vegetation moisture (dead and live) for fire risk assessment are conducted in Sardinia by CNR IBE. Live moisture content of several dominant species of Mediterranean shrubland is measured weekly since 2007. Dead moisture content is monitored through a network of automatic stations, consisting in 10 stations evenly distributed throughout the region. These data are available for evaluating performances of drought indices in (i) describing seasonal pattern of moisture content, (ii) identifying threshold values for drought indices that indicate the end of fire season due to fuel status in Mediterranean shrubland, and (iii) simulating the potential impacts of future climate changes on the duration of fire danger period.

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).

Such national in-situ monitoring networks and field campaigns complement land-based data (e.g. on vegetation, land cover/use, soil, water bodies and impervious areas) available through the Copernicus Land Monitoring Service (CLMS).

8.5.4 GHG Observing System

Italy (through 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. Moreover, 17 monitoring stations, ten for ecosystems, four for the atmosphere and five for the ocean belong to the ICOS Italian network whose activities are managed and conducted through the ICOS-IT Joint Research Unit (JRU).

8.5.5 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.

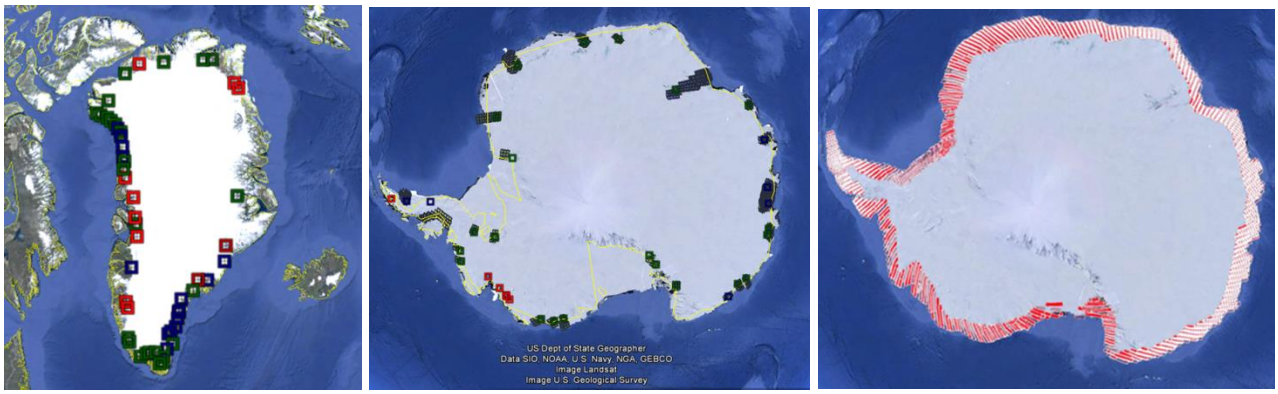
Table 8.8 – COSMOSkyMed acquisition plans in the context of the Background Mission: ASI's contribution to the Polar Space Task Group

	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,317ultisensc. 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 cooperating317ultisensoryr 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 elements in understanding and monitoring of climate change effects on a global scale.

Among activities carried out within Copernicus–- Climate Change Service, **CNRISAC** is involved in activities related to the Evaluation and Quality Controls of satellite greenhouse gases dataset provided by the Climate Data Store (CDS).

CNRISAC is also involved in the preparatory activities of the FORUM (Far-infrared Outgoing Radiation Understanding and Monitoring) mission that is the Earth Explorer 9 mission of the European Space Agency (ESA). FORUM will be launched in 2027, and it will measure the complete spectrum of the Earth Outgoing Longwave Radiation (OLR), with a spectral resolution of 0.5 cm-1. The OLR is a fundamental quantity in the climate system, it represents the radiation emitted by the Earth to space, it is involved into the Earth radiative balance that drives the warming and cooling of the Earth surface. Measuring the spectrally resolved OLR, the FORUM mission will enable us to understand the main processes driving the OLR, from the effects of the water vapour distribution in the atmosphere to the effects of cloud coverage and surface emissivity in the Far-Infrared.

8.6 Support to developing countries

8.6.1 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 Exchang" (IODE) that aims at enhancing the free and open international exchange of data among member 146 countries. Moreover, Italy contributes to the Copernicus free provision of remote sensed and in situ data (e.g. CMES). Italy participates to the Global Ocean Observing System through the coordination of MONGOOS (Mediterranean Oceanography Network for GOOS) and EUROGOOS which share the objective of promoting the free and open data access to the marine observations. Italy has contributed to Seadatanet which coordinated the exchange of historical delayed mode observations. Italy contributes to several EMODNET initiatives sponsored to DG MARE (ETT-Solutions SpA coordinating the EMODnet Physics data portal and OGS coordinating the EMODnet Chemistry data portal) which represent the EU information system for in situ data collection and integrated observations-based products following a free and open data delivery.

8.6.2 Establishing and maintain observing systems, and related data and monitoring systems

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.

9 EDUCATION, TRAINING AND PUBLIC AWARENESS[131]

9.1 Education

Italy benefits from a long and valuable tradition of initiatives and programmes on Environmental Education for Sustainability (EES) and Education for Sustainable Development (ESD) at regional and local level. The Italian Environmental and Sustainability Education context is very much varied and complex and includes a lot of public and private actors, mostly engaged in non-formal and formal education.

The most representative actors are central Institutions, in particular the Italian Ministry of Environment and Energy Security (MASE) and the Ministry of University and Research (MUR); Regions and Autonomous Provinces; National System for Environmental Protection (SNPA), composed by the Italian Institute for Environmental Protection and Research (ISPRA) and the Regional Environmental Agencies (ARPA/APPA); Regional Environmental Education Centres (CEA), deriving from the Information and Education National System (INFEA); Associations, Foundations, NGOs; Protected Areas, Parks, Museums; Schools and Universities.

With Law of 30 December 2018, no.145, the Italian legislator intervened, reshaping the minimum training hours provided for the various study fields and sanctioning the mandatory access to the high school exam as a fundamental part of the study plan, making greater leverage on the objective that these training courses contribute to develop the transversal skills (ref. Recommendation of the Council of the European Parliament of 22 May 2018) most requested in the world of work (so-called soft skills) and, finally, by changing their name to Pathways for transversal skills and guidance.

Another work-based learning modality is achieved through training internships which represent a period of orientation and training carried out in a working context following an agreement between the proposer and the host. In particular, there are two types of internships: curricular training internships promoted by universities, schools or higher education institutions for students in course of study (regulated by Interministerial Decree of 25 March 1998, no.142) and therefore for their future insertion into the world of work; extracurricular internships for reintegration into the world of work, the more general discipline of which is contained in specific Guidelines , while the detailed one is governed by each individual Region or Autonomous Province.

Climate change has become always more a central theme of educational programmes and activities also thanks to some transformative changes that occurred in terms of environmental culture. Over the last years in Italy an important and radical change in terms of environmental awareness has occurred with reference to climate change, shifting from the protection of the environment to the ecological transition including also energy.

In November 2021 the Ministry of Education launched the ReGeneration School Plan for the implementation of the UN Agenda 2030 development goals to accompany schools in the ecological, cultural transition and in the implementation of the paths of education to the sustainable development provided by the teaching of civic education. In August 2019 the civic education became a compulsory study subject in school curricula with environmental education as integral part of it and awareness initiatives to responsible citizenship being launched since the primary school.

The ReGeneration School Plan includes four Pillars or areas of Regeneration: "Knowledges", "Behaviors"," Infrastructures", "Training and Job Opportunities". A national network of both public and private entities, called the "Green Community" has been implemented in order to support the Ministry of Education in planning and sharing projects and materials. SNPA Agencies of Campania, Sicily, Veneto and the Province of Trento also joined the Green Community. ISPRA has joined the Plan and, in addition to being one of the components of the steering committee together with the Ministry of the Environment, actively participates,

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Special Thanks to: the National System for Environmental Protection (SNPA)

contributing in particular to one of the Knowledges' Regeneration".

On the website of ReGeneration School Plan (https://www.istruzione.it/ri-generazione-scuola/index.html), schools can obtain information and find educational resources available on the various issues related to the ecological transition, shared by the members of the Green Community. ISPRA contributed to the platform with information on environmental education initiatives and school-work alternation projects and documentaries on scientific and research projects carried out by the Institute on the protection of biodiversity and the Earth sciences.

The approval of the Law 92/2019, by which Civic Education has been formally included in school curriculum, with ES contents associated, gave a further push forward in the direction of a stronger dialogue and integration between the environmental and educational sectors. Civic Education is at present a teaching subject for all school grades and includes three main thematic areas: "Italian Constitution", "Agenda 2030 and environment", "Digital education.

Another important turning point in terms of ecological transition and attention to climate change is the introduction of the protection of the environment, biodiversity and the ecosystems in the Italian Constitution in February 2022 (the draft constitutional law has been approved on 8 February 2022 by the Parliament). This has given to these topics a renovated and deep meaning extending the national sphere of interest in and action intended as an exercise of active and informed citizenship. The protection of the environment, biodiversity and ecosystems becomes enshrined in the Constitution with Article 9 as the key principle around which the relaunch of the Country after the pandemic rotates.

The COVID-19 pandemic has aroused strong changes in people, above all young people and in the concept of environment. COVID-19 pandemic in 2020 which spread throughout the Planet did not only represent a global sanitary crisis but a crisis affecting every aspect of our life which re-evaluated the fragility of our existence and our interdependence with nature and the interconnections with climate change.

The Ministry of Education has subscribed a lot of Memorandum of Understanding on environmental education to sustainability, cultural heritage and global citizenship with other Ministries, national and international Institutions and Organizations, sector Associations. The Ministry of Education and the Ministry of Environment with the aim of giving a new impetus to this new awareness process for students have subscribed commitments for the protection of the environment and the Biodiversity with the Institution of the Chart for education to Biodiversity to be promoted throughout the country together with the launch of the ecological transition and to sustainability. At this purpose a lot of events have been organised.

On May 19, 2022, during the Nature in mind event held at the Presidential Estate of Castelporziano, in Rome, the "Charter for biodiversity education" was presented, promoted by the Presidency of the Republic and supported by the Ministries of Education and Ministry of Environment.

The Chart for education to Biodiversity intends to accompany the new generations to understand the complexity of the phenomena of nature and to act for the path of ecological and cultural transition. The document testifies the will of the world of schools and civil society to promote innovative training courses and the commitment to spread a culture of sustainability oriented towards respect for nature and a conscious use of the planet's resources. It consists in guidelines and commitments.

Among the eleven commitments, the engagement in continuing to raise awareness on climate crisis and biodiversity loss starting from topics like the use of renewable energies for example sustainable mobility in the frame of the respective Agenda 2030 UN development goals and the goals of the National Strategy for Sustainable Development.

The National Strategy on Sustainable Development, approved by the Council of the Ministries in October 2017 and proposed by the Minister of 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.

Every three years the National Strategy on Sustainable Development is subject to review and in June 2022 a National Conference for Sustainable Development took place as the ultimate step of the last review

process of the National Strategy for Sustainable Development (SNSvS) which undergone a broad consultation process. It was a pilot path of open government launched by the Ministry of the Environment through a Platform, that is about new models of cooperation to put in the field for the implementation of the strategy.

For several years, regional programmes/networks have been based on an institutional framework of collaboration between the State (Ministry of 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.

With reference to the National and Regional Environmental Education System, they are worth to mention the National Conferences promoted in 2018 and 2022 by Sardinia Region, which is the leading Region in the Conference of Regions and Autonomous Provinces, for Environment, Energy and Sustainability.

The two Conferences named N.I.N.F.E.A.S., reminding both at the INFEA System, both to the water floating flower called "ninfea", have been organized with the aims of examining the state of art of the National and Regional System, reaffirming the importance of a national coordination for Environmental Education and Sustainability activities, updating strategies and methodologies with the contribution of all actors involved, and promoting a shared reflection on the challenges and perspective related to the National and Regional Strategies for Sustainable Development and to RRNP (National Recovery and Resilience Plan).

Among regional and local activities, there is still a significant variety of good and excellent practices on ESD promoted by SNPA[132] (National System for Environmental Protection and Research), especially in some advanced Regions, where climate change is tackled as the main issue or the challenging context that affect other issues like the one of the Alpine Arch for example. At local and Regional Level, the Regional and Provincial Agencies for the protection of the environment (ARPAs/APPAs) are particularly active in proposing to schools environmental education paths mostly focused on climate change and cross sectoral topics. SNPA is also competent for Environmental Education and Training activities, playing an important role both at national and regional level for almost twenty years. The specificity of the role of SNPA in environmental and sustainability education is to provide a bridge between technical-scientifical knowledge, based on research and data information, and the pedagogical approach and methodology, to support citizens in the understanding of the complexity of ecosystems mechanisms and to act responsibly.

It is of course worth to mention the Italian National Commission for UNESCO, which coordinates and collects 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 is a key topic of UNESCO ESD Weeks: 2019 (Climate change and Health); 2020-2021 (Planet Health and Men's Health: what to do in front of climate changes and pandemic); 2022 (Energy and Food authonomy, a path for peace and climate justice)

At National level Italy also participates to the World Environmental Education Congress (WEEC) through WEEC Italian Network taking part to the process of building a "European concertation" and a European network for environmental education. The Italian WEEC Network was developed thanks to the will of

[132] **SNPA** is the scientific and technical network established by law 132/2016 and made up of ISPRA as coordinator - Public Research Body under the vigilance of the Ministry of Environment and Energy Security, and 21 Territorial Agencies (ARPA/APPA)

professionals of environmental education in Italy to network and share experiences, to cooperate in projects, create synergies and support in the educative action. In 2021 WEEC Italy also participated with a relay event to the initiatives of All4Climate-Italy2021, a great number of events, better explained in the paragraph public awareness of this chapter, which took place throughout Italy in 2021 the year in which Italy was the Country coordinating Climate COP 26.

EDUCATION: List of initiatives and projects carried out since 2018

Organisation/ Promoter/	Name of the activity	Short Description	Indicators/Number
ISPRA (Italian Institute for Environmental Protection and Research)	**ISPRA Programme of environmental education and sustainability initiatives** School years: 2017/2018; 2018/2019; 2019/2020; 2020/2021; 2021/2022; 2022/2023 (ongoing)	ISPRA Programme of environmental education and sustainability initiatives is addressed at schools of all levels. It is intended to contribute to the development in the younger generations of responsible behaviours, inspired by knowledge and respect for the environment. The "Programme" includes, for each year, a variable number of educational projects on different environmental themes, carried out by the means of face-to-face team's activities and laboratories. Climate change is one of the topics that are directly or indirectly dealt with the subjects of the initiatives, namely by the impacts and adaptation point of view, for their several links to our daily life (energy, mobility, food, threat to biodiversity, air and sea pollution, circular economy and so on). https://www.isprambiente.gov.it/it/attivita/formedu cambiente/educazione-ambientale/programma-di-iniziative-per-le-scuole	S.Y.:2017/2018: N. initiatives: 7 N. schools: 16 N. classes: 90. S.Y.: 2018/2019: N. initiatives: 9 N. schools: 40 N. classes: 260. S.Y.: 2019/2020: N. initiatives: 10 N. schools: 80 N. classes: 135 (date influenced by the pandemic emergency). S.Y.: 2020/2021: N. initiatives: 4 N. schools: 6 N. classes: 17 (date influenced by the pandemic emergency). S.Y.: 2021/2022: N. initiatives: 17 N. schools: 50 N. classes: 255
ISPRA (Italian Institute for Environmental Protection and Research)	**Island of Sustainability** 2018 **–** 2019	**Island of Sustainability** is a national project carried out by the "Association of Social Promotion" in which public institutions, research institutes and associations meet young generations on sustainable development issues. The activities are addressed to students of all levels, families and sector technicians. The final year's event of the campaign was placed in Rome in the mounth of December of each year, at a large exhibition place in Testaccio quarter. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2019/12/island-of-sustainability	
ISPRA (Italian Institute for Environmental Protection and Research) and SNPA Agencies	**Cleanair@school Project** 2019 – 2021	**CleanAir@School** is a Citizen Science and environmental education initiative of the EPA Network (the network of European environmental agencies), coordinated by the EEA (European Environment Agency). ISPRA was the lead entity of the project for Italy, in which have been involved the Agencies of the SNPA (National System for the Protection of the Environment) participating in the initiative. The aim of the was to involve schools in European cities in the process of raising awareness of one of the most important environmental issues for the health of citizens, air quality. The project envisaged environmental education and student training activities through the monitoring of Nitrogen Dioxide, one of the main pollutants in urban areas, largely determined by vehicle traffic. The results of the monitoring were published on the	69 italian schools 30 italian municipalities 15 Regional Environmental Agencies of SNPA More than 5.000 italian students

		website https://discomap.eea.europa.eu/cleanair	
ISPRA (Italian Institute for Environmental Protection and Research)	**Life SEPOSSO** 2019-2022	**LIFE SEPOSSO Project** - Supporting Environmental governance for the POSidonia oceanica Sustainable transplanting Operations -, carried out with the contribution of the European Commission – LIFE Programme, aims to improve the Italian governance of *Posidonia oceanica* transplants, a priority marine habitat, to compensate the damage caused by anthropic activities and coastal infrastructures. The project is led by ISPRA and has involved several partners. Together with the scientific activities made for the Posidonia transplants and monitoring, a didactical kit for primary and secondary schools, a cartoon and a documentary have been realized, to raise awareness on the importance of the ecological role of Posidonia seagrasses in preventing global warming and coastal erosion. Link to didactical kit: https://lifeseposso.eu/?page_id=8814	1500 students in 2 years were involved in the educational activities
ISPRA (Italian Institute for Environmental Protection and Research	**Walking through the environment** 2022	Walking through the environment is a publication by ISPRA aimed at an audience of young students and non-experts. The Ministry of education recognizes it as a contribution to the "ReGeneration School" National Plan. The virtual walk stretches through six environmental paths: Crossing the city; Trip to the countryside; Towards the sea; Going up the river; Back home, it comes full circle; Education, a sustainability agenda. It is a valid supporting tool for School teachers in addressing the environmental and sustainability themes in a critical and cross-cutting way including climate change issue. It is also translated in a multimedia version, accessible from the web platform. https://www.educazionedigitale.it https://www.isprambiente.gov.it/it/pubblicazioni/pubblicazioni-di-pregio/passeggiando-nellambiente	
ARPA Sardinia	**Environmental Education on Climate Change and Sustainability** 2018-ongoing	Educational interactive laboratories and workshops carried out by the officers of the Agency for Environmental protection of Sardinia on the following topics: Weather and Climate (primary schools), Climate change and Sustainable Development (secondary schools).	In 2018-2022 about 10 workshops with Primary school students and about 15 with high school students, both in presence and online were organized
ARPA Sardinia	**ARPAS Opens to Schools 2018-ongoing** 1 day (Earth Day April 22nd)	One of the Earth Day official national initiatives, "ARPAS Opens to Schools" offers the possibility to school students to visit ARPA Sardinia departments located in the main cities of the island. Educational interactive laboratories are carried out on several topics on environmental sustainability. At least two/three workshops are dedicated each year to climate change and related issues at several Departments of the agency. https://www.sardegnaambiente.it/arpas/attivita/educazioneambientale/earthday/	In 2018-2022 about 10 workshops with students on Weather, Climate and Climate change were organized
ARPA Sardinia	**Let's save Water** 2018-2019	Let's save Water" is an integrated environmental education project on the beauty, preciousness and sustainable use of water. Dedicated to 4th and 5th Primary school classes, the two-year project is thought for and by the teachers in order to be developed in steps that deal with the importance of water in history, in religion for its several meanings, and the importance as a fundamental component in regulating ecosystem life and services. Water	4 classes 2 Primary Schools 100 students and 10 teachers ~~involved~~.

		footprint, drought and floods exacerbated by climate change, the recycle and the sustainable use of water are treated in the second year, within the framework of a climate changing world, arising awareness in the students about water vital importance and scarcity. https://www.sardegnaambiente.it/index.php?xsl=611&s=21&v=9&c=93315&es=4272&na=1&n=10	
ARPA Sicily – InFEA Sicily	**All4Climate- Italy2021** September 2021	The training seminar "Climate Change: Which Environmental Indicators?" is aimed at teachers of first and second grade middle schools in the territory of Sicily to illustrate which environmental indicators can be used to highlight the current impacts due to climate change, to provide with useful tools to raise awareness and guide students towards sustainable behaviour. https://www.arpa.sicilia.it/all4climateitaly2021/	30 teachers of secondary and high schools in Sicily
ARPA Sicily – InFEA Sicily - SiciliAmbiente Film Festival	**SiciliAmbiente and ARPA at School together !** II edition December 2021	The aim of the project is to make students aware of the contents and objectives set by the 2030 Agenda for Sustainable Development. Students will be involved through the viewing of audio-visual and multimedia material (documentaries, short films, animations, etc.) connected to the "objectives" of the 2030 Agenda focusing also on Goal 13 on climate action. https://www.arpa.sicilia.it/siciliambiente-e-arpa-a-scuola-insieme-oltre-3mila-studenti-per-il-convegno-di-chiusura-della-ii-edizione-del-progetto-di-educazione-ambientale/	
ARPA Sicily – InFEA Sicily – Marevivo	**Project "Halykòs"** May 2020	The project "Halykòs - Environmental Prevention and Enhancement of the Mouth of the Platani River" involved various actors of the local community like representatives of Municipalities, schools, companies, associations, tour operators and all citizens to collect information on some key topics in the territory of the River Platani (in Greek Halycòs) and in the province of Agrigento in general. The Halykòs project main objective is the prevention of environmental pollution and the enhancement of the mouth of the Platani river and the territory it crosses. Arpa Sicily coordinated the technical working group: "Environmental pollution: control and prevention. The measures adopted by the Sicilian Region and the value of environmental education "and together with Marevivo's volunteers carried out an environmental monitoring during 2020/2021. The results were shared with the students and teachers as part of a Path for Transversal Skills and Orientation (PCTO). http://www.marevivosicilia.it/2020/09/03/marevivo-agrigento-organizza-cinque-tavoli-tematici-su-territorio-e-ambiente/	4 teachers and 50 students of high schools in Sicily participated
ARPA Sicily – InFEA Sicily – Marevivo	**Project #Nauticinblu** May 2020	#Nauticinblu is a training course that involves students from nautical institutes throughout Italy with the aim of providing new skills to complete their training, including environmental protection and the sustainability of our marine resources. ARPA Sicily has collaborated with Marevivo Sicily with a series of lessons addressed to about 700 students of the seven Nautical Technical Institutes of Sicily on the main critical issues of Italian seas. The topics addressed concern the circular economy, the marine environment and the use of radar for environmental monitoring (accidental spills) and the rescue of boats in distress in the Sicilian channel https://marevivo.it/attivita/nauticinblu/ https://www.arpa.sicilia.it/nauticinblu-e-un-percorso-didattico-che-coinvolge-gli-studenti-degli-istituti-nautici-di-tutta-italia/	700 students of high schools in Sicily

ARPA Sicily – InFEA Sicily – CIRFDI	**Training course for PES children and updating of teaching staff "A manifesto for the new humanism".** September 2022	"A manifesto for the new humanism" is a training course aimed at students for the "European students' parliament" (PES) and for the updating of teaching staff, organized by the CIRFDI Association. ARPA Sicilia has collaborated on issues related to Sustainable Development, in particular to stimulate the interest of the participants in the themes of environmental sustainability, the circular economy and environmental education. https://www.arpa.sicilia.it/arpa-sicilia-nel-cuore-delle-madonie/	4 teachers and 30 students of high schools in Sicily
ARPA Sicily– InFEA Sicily– AssoCEA Messina APS	Project "Future Responsible Citizens 2.0" (FCR 2.0) 2021/2022	The project "Future Responsible Citizens 2.0" (FCR 2.0) was born from the collaboration between the Association for Sustainable Development and the Environmental Education Center of Messina (AssoCEA Messina APS), ARPA Sicily and other bodies and associations including the National Committee for Sustainability Education - Agenda2030 (CNESA 2030). The topics covered are the earthquakes of the past, good practices for the mitigation of seismic and hydrogeological risk, the biodiversity, trees and soil protection, the fight against desertification and climate change. As part of the project, a competition was launched which led to the creation of 48 papers / videos with which the students explored territorial issues. The project won for the second consecutive year the "Filippo Basile Award" as best practice in the Sicilian territory, in the 'Training Networks / Training Systems' section of the 'Training in Public Administration' sector. https://it-it.facebook.com/ceamessinaonlus/	Over 2000 students from 17 schools
ARPA Sicily – InFEA Sicily	**Citizen science as an environmental education tool** 2021-2022	In the context of monitoring beached waste and monitoring olfactory perturbations in areas with a high risk of environmental crisis present in the Sicilian territory. A group of students, with experts in the Marine Monitoring sector, on the World Environment Day (2021), carried out a monitoring of beached waste according to the protocol provided by the Marine Strategy Directive (in collaboration with the Municipality of Capaci). Another group of students took part in a course for the use of a web-app, developed by CNR_Bologna and ARPA Sicilia to denounce the olfactory harassment deriving from industrial settlements. https://www.arpa.sicilia.it/giornata-mondiale-dellambiente-arpa-sicilia-punta-sulla-scienza-partecipata/ https://www.arpa.sicilia.it/temi-ambientali/aria/nose-network-for-odour-sensitivity/ approvazione-schema-convenzione-tra-direzione-didattica-del-liceo-scientifico-e-linguistico-statale-e-vittorini-di-gela-cl-e-arpa-sicilia-progetto-ptco-liceo-e-vit/	**2021** 50 students from various schools **2022** 40 students from high school
Regional Environmental Protection Agency of Veneto (Arpav)	**Project: Let's tell us stories... Collection of stories on the environment** 2018/19 2019/20 2020/21 2021/22	The project involves nursery and primary schools of the regional territory with the aim of involving children in the environmental topics described in the Guide "Let's tell us stories…" through the development and implementation of several interactive educational activities (readings, games drama, outdoor education). Among the topics addressed, air and meteorology. http://www.arpa.veneto.it/serviziambientali/educazioneperlasostenibilita/educazioneambientale/racconti	Target: Nursery school, Primary school **Year** **2018 – 19** 32 schools 32 classrooms 192 hours 800 students **2019/20**

		amocilefavole	21 schools 34 classrooms 210 hours 680 students **2020/2021** 18 schools 24 classrooms 138 hours 481 students **2021/2022** 65 schools 83 classrooms 383 hours 1660 students
Regional Environmental Protection Agency of Veneto (Arpav), Regional School Office of Veneto Region – MUR, Veneto Region Regional Group "Health in every Policy"	**QUALe idEA! Contest** 2017/2018 2018/2019 2019/2020 2021/2022	This competition aims to promote 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 initiative aims at raising awareness and responsibility on environmental issues and suggesting sustainable behaviors and lifestyles to girls, boys and families, to reduce individual ecological footprint and achieving the strategic objectives of the UN 2030 Agenda~~. A d~~igital platform is used by the schools with various contents on Climate Change like – documentaries and films selected in collaboration with Cinemambiente, videos and teaching materials, learning verification tests. The best projects have been awarded with prizes dedicated to environmental education and published on ARPAV website and Regional School Office of Veneto Region website. Among the topics proposed "Climate Change: I reduce CO2 and my ecological footprint" https://www.arpa.veneto.it/servizi-ambientali/educazione-per-la-sostenibilita/educazione-ambientale/concorso-quale-idea https://www.arpa.veneto.it/servizi-ambientali/edificazione-per-la-sostenibilita/edificazione-ambientale/qualeideaquiz-2022	Target: Nursery school, Primary school, Lower and Upper secondary school **Years** **2017/2018** 40 schools 2200 students **2018/2019** 130 classrooms 3250 students **2019/2020** 34 classrooms 850 students **2021/2022** 103 classes 2500 students
Regional Environmental Protection Agency of Veneto (Arpav)Treviso Municipality (It) University Aristotele Salonicco (Gr) Istituto Superior Tecnico di Lisbona (Pt) University Siviglia (Es) Città	**Remedio** January-October 2018	The Environmental Education Office of ARPAV planned and supervised an articulated educational program with children and students of primary and secondary schools in a pilot road in Treviso. The educational activities have been implemented in cooperation with the ISIDE network (http://www.reteisideambiente.it). Lessons at schools, guided visits in the neighbourhood of the pilot area, experiential workshops for the youngest and frontal lessons with ARPAV technicians, experts on air and acoustic pollution have been realized in the first half of 2018. https://www.arpa.veneto.it/servizi-ambientali/educazione-per-la-sostenibilita/educazione-ambientale/remedio/remedio-interreg-med-azioni-di-educazione-ambientale-nelle-scuole-di-strada-	**2018** 20 educational paths 11 school 20 classes 500 students 245 hours

Metropolitana Salonicco (Gr) Comune di Spalato (Hr) Comune di Loures (Pt)		ovest-treviso-e-villorba	
Regional Environmental Protection Agency of Veneto (Arpav) and other partners (see web site project)	**Prepair** 2018/19 2019/20 2020/21 2021/22	Life PREPAIR+ is a project aimed to harmonize, support and strengthen the measures established in the regional plans and within the Po Valley agreement at a larger scale with the final aim to ensure sustainability of results and empowerment of regulatory agencies. PrepAIRed! is the name of action E5 inside PREPAIR, aimed at designing, testing and implementing different educational target-oriented paths addressed to awareness raising and knowledge strengthening in primary and secondary school systems (teachers and students) on air quality issues dealt with by the project. All the themes are connected and oriented to reduce carbon footprint and Co2 emissions. https://www.lifeprepair.eu/?lang=en	**Schools of Veneto Region:** **2018/19** 2 schools 3 classes 70 students **2019/20** 2 schools 7 classes 145 students **2020/21** 5 schools 22 classes 440 students **2021/22** Primary School 9 Lower Secondary School 7 Upper Secondary school 7 Classes 26 Students 650
Regional Environmental Protection Agency of Veneto (Arpav)	**At school for the environment and lifestyles** 2021/22	The project "At school of lifestyles" proposes activities and workshops in the classroom with professional educators on educational paths: ✓ Sustainable consumption ✓ Feeling good in the city: the air we breathe ✓ Reduce waste ✓ There is no water to lose ✓ Live and let live The activities follow the outline of the Arpav guide on the development of participatory and laboratory activities on environmental msustainability and the reduction of carbon footprint. https://www.arpa.veneto.it/servizi-ambientali/edificazione-per-la-sostenibilita/file-e-allegati/A%20scuola%20di%20stili%2008%2002_ok.pdf	Target: Primary school, Lower secondary school 42 School 44 classes 885 students

Regional Environmental Protection Agency of Veneto (Arpav), Veneto Region	**Youth Forum for sustainability** 2020 2022	The Youth Forum for sustainability offers young people to get involved and try to think about the most important actions to reduce their footprint on the planet and to achieve the Goals of the 2030 Agenda. It was designed to listen to the voice of students on problems that affect all generations. https://sites.google.com/regione.veneto.it/forum-giovani-2030/	Target: Upper secondary schools **2020** 17 School 34 Classes 750 Students **2022** 7 School 14 Classes 250 Students
Regional Environmental Protection Agency of Veneto (Arpav)	**Arpav in classroom** 2018-2019-2022	ARPAV organizes educational lessons in schools with the aim of developing in students, who will be the citizens of tomorrow, processes of attention and respect for the environment and make them know what the Agency carries out daily for the control of environmental matrices aimed at protecting the environment and the safety of the territory and the communities that inhabit it. Themes are selected by teachers regarding different environmental matrices, among which climate changes, in particular after the Vaia event. The Vaia storm was an extreme weather event that affected the north-east of Italy (the mountain area of the Dolomites and the Venetian Pre-Alps). Target: Nursery school, Primary school, Lower and Upper secondary school To Know more	**2018** 16 classes 32 hours **2019** 20 classes 40 hours **2022** 5 classes 10 hours
Regional Environmental Protection Agency of Veneto (Arpav), Veneto Regione, Regional School Office of Veneto Region – MUR	**#arpaVideo Contest** 2019-2020-2021-2022	The competition promotes sustainability through the images and creativity of young videomakers who have told the importance of concrete actions with their works. The fight against litter, creative recycling, sustainable mobility or the reduction of waste and water consumption told by the winning videos are examples that everyone can follow to achieve the goals of the 2030 Agenda and of the Veneto regional strategy for sustainable development. Target: Upper secondary school, Young (max 24 years old)	**2019** 35 classes 800 students **2020** 20 classes 400 students **2021** 37 classes 500 students **2022** 30 classes 38 videos 750 students
APPA Trento (Environmental Agency of the Trento Autonomous Province)	**Green Game** 2019	Green Game is a tournament dedicated to lower and upper secondary schools, promoted and organized by the Provincial Agency for the Protection of the Environment of the Autonomous Province of Trento. The initiative ~~will~~ involve 20 classes from all over the province who ~~will~~ compete with puzzle games and quizzes aimed at making students think about environmental issues including climate change.	**2019** 20 classes
APPA Trento (Environmental Agency of the Trento Autonomous Province)	**Seventh Annual Conference of the Italian Society of Climate Sciences (SISC)** 2019	The conference aims to involve and bring together scientists, researchers, economists, professionals, business leaders and policy makers, whose activities focus on different aspects of climate change, its impacts and related policies. APPA Trento participates in the event as part of the initiatives aimed at schools of all levels, with new educational projects.	
Appa Trento (Environmental Agency of the Trento Autonomous Province)	**Radio Pianeta3** 2022	Radio Pianeta3 is the new "media education" path proposed by the provincial agency for the protection of the environment of Trento, created to tell the relationship between human beings and the planet in which we live together with the students of the Trentino secondary schools.	
ARPAE Emilia-Romagna	**8 Webinars 'Climate Crisis and Urban**	A Training program for teachers and educators. - The first cycle of seminars was dedicated to the	More than 300 participants

(ARPAE-Regional Agency for Prevention, Environment and Energy)	**Resilience'** 2020-2021	climate crisis, with an in-depth analysis of aspects relating to impacts and possible actions and measures for the containment of GHG emissions in various sectors and the role of environmental resources (soils and forests) in the assimilation and storage of CO_2. - The second cycle, which was preparatory to educational courses dedicated to schools, was focused on the relationship between the cities, climate change and cc impacts on urban areas. https://www.snpambiente.it/2021/01/12/i-giovedi-del-clima/ https://www.snpambiente.it/2021/03/17/i-giovedi-del-clima-disponibili-i-materiali-multimediali-e-documentali/	(teachers, educators and others) 3168 subsequent views of the lessons, from the youtube channel.
ARPAE - Regione Emilia-Romagna	**Schools program 'Resilient cities'** 2020-2022	The program is an active learning process based on the simulation gaming method, which includes: frontal lesson on climate change in the city; study visits outside the school; debriefing moments in order to share the observations made; and the game 'sos4cities' on Trees and Nature-based Solutions. Main goals: strengthen different components of youth awareness of climate change; develop skills in those who will be tomorrow's decision makers with effective educational methods; provide methods capable to favour the active participation of students, and their commitment to act as a community. https://www.arpae.it/it/temi-ambientali/educazione_alla_sostenibilita/azioni-educative/progetti-e-azioni-di-sistema/resilienza-e-sostenibilita-urbana-1	n°50 High school classes involved; more than 1,250 students; By the end of Programme (2023) further 75 classes, more than 1870 students involved
ARPAE - Regione Emilia-Romagna	**Exhibition 'Cities for people'** 2021-2022	The exhibition 'Climate-proof cities are also Cities for people, aims to illustrate the problems that climate change effects can cause to urban environments and suggesting possible solutions, Nature based Solutions (NbS) and best practices, mainly in Europe. Extreme climate phenomena and their impact on urban areas, as well as efficient solutions for improving the urban drainage system, microclimate and environment are presented. Mostra Città per le Persone — Arpae Emilia-Romagna	N. 4 hosting cities of the Exhibition till now; additional 10 cities by the end of Programme (2023)
ARPAE – Regione Emilia-Romagna	**Project "Data: how to read and make good use of them"** **Social media campaign "I Lunedati" (Means "Monday data")** 2022	This project is aimed at presenting environmental data in a simple graphic-informative way (infographic) through the web and within social media, to make scientific data available for citizens, young digital native generations and educational area professionals. A series of data focused on climate change (4 posts on social media: Facebook, Instagram, Linkedin) https://www.snpambiente.it/2021/04/20/nascono-i-lunedati/	Facebook: 28,000 views, more than 2,200 interactions Instagram: 24,000 views, more than 1,000 interactions Linkedin: more than 1,000 views

ARPAE - Regione Emilia-Romagna	**'Education on tree'** 2020-2022/23	It is a Facebook communication campaign on the role of trees and green infrastructure in reducing summer heat, air pollution and for a more sustainable management of urban rainwater, Activities: Seminars, outdoor event with plants distribution in public open spaces of Emilia-Romagna cities, educational walks. FB page More information about the events	16 FB posts, 206,984 views, 15,641 interactions; 1 seminar. By the end of the programme: 8 Seminars; 11 Event with plants distribution in public open spaces. 11 educational walks
Arta Abruzzo –	**Well-being gloCAL 2021. Water and fire** 2021	Together with Arta technicians, students have dealt with the issues of sustainable water management and the fight against climate change through in-depth studies, images, videos, web links and references to the monitoring of rivers and sea and analysis of drinking water that the Agency carries out for the prevention of environmental pollution and the protection of human health. https://www.artaabruzzo.it/newsreader.php?id=989	**2021** 130 students of the "Comprehensive Institute 10" School of Pescara
ARTA ABRUZZO	**Descovering Pescara river** November 2021	An event organized by the environmental agency of Abruzzo aimed at observing and analysing sample of the river to assess its quality. Students rediscovered the Pescara river with the technicians of Arta Abruzzo, addressing the issues of sustainable water management and the fight against climate change through insights, images, videos, web links and references to the monitoring of rivers and seas and the analysis of drinking water that the Agency carries out for the prevention of environmental pollution and the protection of human health. https://www.snpambiente.it/2021/11/19/gli-studenti-riscoprono-il-fiume-pescara-con-i-tecnici-di-arta-abruzzo/	130 students participated
APPA Bolzano (Environmental Agency of the Bolzano Autonomous Province)	**Journey into the climate** 2019	"Journey into the climate" is one of the projects of the "Scuola.Ambiente" package that Appa Bolzano offers every year to all South Tyrolean schools. The interactive exhibition "Journey into the climate" illustrates the complex phenomenon of climate change to children in a very clear way. https://www.snpambiente.it/2019/05/16/sulle-tracce-del-cambiamento-climatico/ https://ambiente.provincia.bz.it/progetti/viaggio-clima-laboratorio-secondaria.asp	
Appa Bolzano (Environmental Agency of the Bolzano Autonomous Province)	**Steps for the climate** 2019 – 2020	The initiative "At school without a car, we collect steps for the climate", promoted by the Appa Bolzano as part of the European Mobility Week, is one of the projects of the Scuola.Ambiente package. https://ambiente.provincia.bz.it/progetti/passi-clima-iniziativa-settimana-europea-mobilita.asp	**a.s.-2019/2020** 4.433 students

ArpaCal (Environmental Protection Agency of Calabria Region)	**World Air Day** 2019	On World Environment Day, Arpacal realized a video tutorial dedicated to air that the agency's technicians presented in meetings with Calabrian schools during the training and information days organized by Arpacal on the regional territory. http://www.arpacal.it/index.php/46-eas/2305-giornata-mondiale-dell-ambiente-iniziano-da-reggio-calabria-gli-eventi-arpacal	
Arpa Lombardia-Lombardia per l'Ambiente Foundation-Regional School Office-Lombardy Region	**AmbientiAMOci** 2018 – 2020	The project, developed by Arpa Lombardia and the Lombardia per l'Ambiente Foundation, in collaboration with the Regional School Office and the Lombardy Region, is divided into a series of booklets and multimedia tools to promote environmental education issues in the schools of Lombardia Region. The fifth booklet is dedicated to climate change titled Let's study climate and climate changes and it deals with the following topics: Meteo and climate: let's clear our minds; How to study climate change; Is there an only climate on the erath? Climate Change; What and how climate is changing; Global strategies; the Regional Environmental Protection Agency and climate. https://www.arpalombardia.it/Pages/Educazione%20Ambientale/Progetto-Ambientiamoci.aspx# Ambientiamoci_libretto_n5-Clima.pdf (arpalombardia.it)	
Arpa Piemonte (Regional Environmental Protection Agency of Piemonte) - City of Turin-City of Casale Monferrato-Earth Day Italia-Regional School Office for Piedmont	**A video for the Climate song** 2018	"A video for the Climate song"competition, was also promoted and supported at national level by the Ministry of University and of Research (MUR). Following the participation to Climathon world competition to raise awareness on climate change for which ARPA Piedmont together with the students produced the climate song , this competition was addressed to lower and upper secondary school students called to create a video clip accompanying the musical piece. http://www.arpa.piemonte.it/approfondimenti/educazione-ambientale/musicadambiente/climatesong	1617 visualisations of the winning video
ARPA Friuli Venezia Giulia - Laboratorio Regionale di Educazione Ambientale (LA.R.E.A.) (Environmental Protection Agency of Friuli Venezia Giulia Region – Regional Laboratory of Environmental Education – LA.R.E.A.)	**EnergEticamente Exhibition – Laboratory** 2018 - 2022	"Energeticamente' is a mobile exhibition, composed by 21 didactical and interactive modules, which allow to observe, experiment and understand natural phenomena that are part of our daylife. The project, started in 2006 and , is under continuous renovation and updating, based on new scientific knowledges and also on the suggestions of teachers and students. The central element is the Sun, primary energy source. The exhibition is structured in five sub-themes: greenhouse effect; our friend the Sun; electricity; energy efficiency and- alternative energy sources. The exhibition is granted for free for one month to local administrations, schools and associations. The experts of LA.R.E.A. support them in assembling the exhibition and the educators to lead an introductory seminar to explain the instruments and the experiments included in the exhibition. http://www.ea.fvg.it/attivita-e-progetti/mostre/energeticamente/	N. schools involved: 40; n. teachers: 100; n. students: 5000

Kyoto Club	**"Use the Mind Protect the Environment!" School for Kyoto Programme** 2019-2020 2020-2021	This programme is addressed to students and teachers of secondary and high schools focused on the theme of sustainability applied to human activities particularly in urban areas with attention to what can and must be done in periurban and rural contexts. The programme subjects are: energy efficiency, renewable energy sources, sustainable mobility, waste, redevelopment of the urban and periurban territory, adaptation to climate change and sustainable agriculture. More information	
Italian Ministry of Education and International Volunteer for Sustainable Development (VIS)	**Competition** 2019/2020	The Italian Ministry of Education (MUR) and the International Volunteer for Sustainable Development (VIS) organized this contest addressed to primary and secondary schools with the aim to promote actions and reflections to deepen environmental and social issues on climate change and biodiversity protection promoting activities oriented to create a "common sense" on cure and attention to life styles and to stimulate children to choose a different relationship with nature, global different and inclusive. To participate to the contest children were supposed to prepare elaborates. More information	
WEEC Italian Network	**A relay for the climate from Sicily to Lombardy** March 2021	The relay includes 24 events disseminated in 14 italian regions consisting in informative meetings, round tables, workshops, contests, exhibitions, discussions for the presentation of pilot projects, good practices, case studies on education to climate change (Article 12 of Paris Agreement) aimed at introducing a gradual introduction of such topics on school curricula and on education paths for all ages. https://weecnetwork.it/staffetta-per-il-clima-la-rete-weec-passa-il-testimone-da-sud-a-nord-toccando-tutta-litalia-2/	24 events
Italian Climate Network Onlus	**"Progetto Scuola" ("School Project")** 2013 – ongoing	Italian Climate Network's School Project is mainly offered to secondary schools (students aged 14 – 19) and it is focused on the climate change issue., 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 courses among "climate and energy", "climate negotiations", "climate and human rights", "climate and health", "climate and waste management". Since the school-year 2019-2020 insights on energy have been included in the programme thanks to the support of Behind Energy The Project reached over 1,400 students across 9 regions. http://www.italiaclima.org/at tivita/conlescuole/	More than 1000 students per school year attended the courses
ICCG International Center of Climate Governance	**Environmental Education Intiatives on climate change with schools** Ongoing	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. http://www.iccgov.org/categ oriesevents/perlescuole/	

Italian WEEC Network	**Italian participation to WEEC Congress** (World Environmental Education Congress) 2021	The Italian WEEC Network has developed thanks to the will of professionals of environmental education in Italy to network and share experiences, to cooperate in projects, create synergies and support in the educative action. In 2021 WEEC Italy also participated with a relay event to the initiatives of All4Climate-Italy2021, a great number of events which took place throughout Italy in 2021 the year in which Italy was the Country coordinating Climate COP 26. https://www.weecnetwork.it	
CMCC (Euro-Mediterranean Center on Climate Change Foundation)	**Change game – Play with the planet** 2021	Change Game is a video game that confronts the complexity of climate change, and how it interacts with society and natural ecosystems. Players find out how the choices they make affect both their environment and other people. By creating a city from scratch, they discover how the decisions they take have an impact on climate change. The Best Applied Game 2021 gives the award for the best Italian video game designed with a purpose other than simple entertainment. The jury gave a special mention to Change Game – Play with the planet video game designed by the CMCC Foundation, and developed in collaboration with Melazetato helpsunderstanding the complexity of climate change". In 2021, as part of the National Geographic Festival of Science, the CMCC Foundation organised digital workshops for students of the secondary schools Through the video game, students will be in control of a city and will have to decide which and how many resources to use to advance their civilization, but also face the consequences of their choices. Different challenges will be set as the goal of the game session to achieve different key citizenship competences. In a playful way and with a solid scientific basis, change game increases basic knowledge about climate change and promotes sustainable social behavior.	2020: Launch on App Store and Google Store 2020: presentation at Web Marketing Festival 2021: Digital Workshops for more than 500 students

9.2 Public awareness

According to what reported by the Italian Institute of Statistics in 2021, climate changes are confirmed in the first place among concerns for environment for half the Italian population from 14 years and over (51,5%). In particular, extreme attention has been addressed to the impacts of climate changes on forest ecosystems, forest fires and drought, all delicate matters for the Country.

At national level, the Italian Ministry of Environment organized several communication campaigns aimed at raising awareness 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. In particular, in 2020, the European Mobility Week focused on 'Zero-emission mobility for all'. The theme reflected the ambitious targets of a carbon-neutral continent by 2050.

The year 2021 represented a very important moment for the global action to address climate emergency with the international community called to review the climate targets. In 2021 Italy as co-organizer of COP 26, has hosted in Milan a ministerial preparatory event (28 September- 2 October 2021) together with an international and remarkable event dedicated to young people Youth4Climate.

In 2021, responding to a growing engagement of young people as the driving force behind a new awareness of environmental issues that has spread all over the world, the Italian government, in collaboration with the office of the Youth Envoy to the United Nations, Connect4Climate and the United Nations secretariat for climate change, hosted the first edition of Youth4Climate, an unprecedented initiative, as part of its COP26 co-presidency of the UNFCCC. The Youth4Climate event was held in Milan, Italy for the occasion of Pre-COP26, which ran from 28 to 30 September 2021, and represented an opportunity for young people from all over the world to pool their ideas, participate in debates, and map out action on urgent issues.

The resulting Youth4Climate Manifesto, drawn up by the young delegates themselves after two days of in-person work and months prior of remote collaboration, underscores the pressing need for the significant and lasting involvement of young people in decision-making processes, especially young people from more marginalized and vulnerable communities. It demands that the necessary support be provided to achieve this, including novel capacity-building mechanisms. Before returning to their home countries, the approximately 400 young people who gathered in Italy from all over the world were able to present their proposals to the environmental ministers of more than 40 countries representing the international community.

The Manifesto was later officially presented at COP26. Following the successful impact generated, the Youth4Climate initiative has been evolved into a long - term vision initiative, co-led by the Italian Ministry of Environment and the UNDP, to enhance intergenerational dialogue. Reducing inequalities, involving young people in decision-making processes, and promoting a public-private aid program are among the components of the Youth4Climate Hub initiative which aims at:

- promoting climate action and sustainable development through the identification and support of concrete, innovative, youth-led solutions, starting with those contained in the Manifesto;
- allowing the sharing of knowledge, opportunities, training, experiences, and resources (dedicated spaces, funding, showcases) through a custom-made virtual space where young people can cultivate a rich community and a multi-stakeholder perspective of the climate crisis;
- fostering the development of inclusive, sustainable climate solutions by drawing fully on the plurality of skills and experiences of the world's most vulnerable and indigenous communities at the national, regional, and multilateral levels.

A second event "Youth4Climate: Powering Action" was held in New York on September 2022, organized in collaboration with the communication program on climate change of the World Bank, Connect4Climate, representatives of YOUNGO - the youth constituency accredited by the United Nations Secretariat on Climate Change - the representatives of the Advisory Group of the United Nations Secretary-General on Climate Change, the United Nations Secretariat on Climate Change (UNFCCC) and the participants of the 2021 edition themselves. During the event in New York, Youth4Climate has been launched formally as a global long-term initiative, with a secretariat in Rome at the Rome Center for Climate Action and Energy UNDP, to support youth participation in internal processes on climate and sustainable development.

In order to ensure maximum participation, a virtual platform for sharing knowledge, training opportunities, experiences and resources was created and launched "https://youth4climate.info" as a tool available to young people from all over the world together with about fifteen calls for funding made available through the UNDP Innovation Challenge program. These calls will guarantee the realization of projects on issues related to urban resilience, sustainable food systems, energy and education, starting from the proposals contained in the Youth4Climate Manifesto.

Beside a partnership with the United Nations Framework Convention on Climate Change's secretariat (UNFCCC) to establish a training program (further described in the "training" section of this chapter) Partners were contacted with a request to contribute to the Youth4Climate initiative in at least one of the following ways:

- Support the selection process for individual grants.
- Support the mentoring and training process.

- Financial or in-kind support offering professional development opportunities (eg. internships, bootcamps, work experience).

In July 2022 a natural disaster event regarding the collapse of the Marmolada Glacier strongly impacted people consciences in Italy and generated a strong awareness raising momentum about climate change and about the state of health of our glaciers extremely sensitive to the climate crisis. This event catalyzed the attention of the National State broadcasting and there was a lot of media communication about it. Civil society strongly motivated actively participated with some public awareness initiatives like the proposal of a mountain Manifesto which was an appeal from scientists and public figures.

Particularly active in raising awareness and to active participation of citizens on climate change have been the Associations, and NGO's. Among them for the active participation of young people is Fridays for Future Italy which has strongly encouraged people to actively participate through digital global strike without stopping even during the pandemic times where the right to protest could not be exercised. It experimented other tools to let young people express online like, appeals, manifestos and crowdfunding. Since its creation in 2018, the Fridays For Future movement has rapidly spread and climate strikes took place in 206 countries across the world.

A strong encouragement to raise awareness and to take action also came from the Vatican City especially in the wake of the release of Pope Francis encyclical on the environment, "Laudato Si" based on a new vision of sustainability and a new model founded on solidarity and responsibility and to share the commitment opening to the dialogue. Particularly significant has been the address of his holiness Pope Francis to the participants in the meeting "Religion and Science: towards COP26" from the Hall of Benediction, in the Vatican with the participation of Pope Francis. On 6th July 2022 the Vatican city Permanent Observer to the UN, deposited before the Secretary-General of the United Nations the Instrument with which the Holy See, in the name and on behalf of Vatican City State, accesses to the United Nations Framework Convention on Climate Change (UNFCCC). At the earliest possible date, considering the legal requirements of the Paris Agreement, the Holy See, in the name and on behalf of Vatican City State, will deposit the instrument of accession to the latter.

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 of Environment of the Government of Italy keeps supporting the Communication for Climate Change MultiDonor Trust Fund (CCC MDTF) at the World Bank, established back in January 2009.

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.

Connect4Climate (C4C) 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 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 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 2021, the "All4Climate – Italy 2021" communication campaign was organized to encompass the full lineup of live-streamed climate events that took place in Italy in conjunction with preCOP26. The goal of the program was to make 2021 a landmark year for climate ambition. Launched by the Italian Ministry for Environment in collaboration with the World Bank Group's, Connect4Climate and with the participation of the Lombardy Region and the Municipality of Milan, All4Climate fostered proactive dialogue on the

challenges of the climate crisis, providing a unique opportunity for climate champions around the world to contribute directly to the September's Pre-COP meetings in Milan as well as November's COP26, hosted by the UK in partnership with Italy.

The #Youth4ClimateLive Series, hosted by the Italian Ministry for Environment in collaboration with the World Bank Group's Connect4Climate and the Office of the UN Secretary-General's Envoy on Youth, sought to build momentum on climate action ahead of the Driving Ambition event and Pre-COP26 in Italy. Nine episodes were streamed live to a global audience of over 10,000 young people between June 2020 and February 2021, themed around topics such as Sustainable Recovery, Nature-Based Solutions, and Youth Action. Each session brought together a diverse group of unstoppable youth at the forefront of creative climate action for intergenerational and interactive conversations with policy makers and experts.

Besides National initiatives, at local level the Regional and Provincial Environmental Agencies (ARPAs/APPAs) played a key role in raising citizens' awareness to climate change through specific communication campaigns and the organization of initiatives involving local community even with citizen science initiatives in cooperation with schools, municipalities and local stakeholders. Many Italian cities have been involved through Municipalities, Regional and Provincial Administrations and Regional Environmental Agencies (ARPAs) with the organization of important initiatives aimed at raising the awareness of young and adult citizens to climate change issues also through specific Communication Campaigns.

PUBLIC AWARENESS: List of some initiatives carried out since 2018

Organisation/ Promoter	Name of the activity	Short Description	Indicators/ Num bers
The Vatican City	**"Religion and Science: Towards COP26" Pope Francis** Vatican, Hall of Benediction 4 October 2021	The address of his holiness Pope Francis to the participants in the meeting "faith and science: towards cop26" from the Hall of Benediction, in the Vatican, the meeting "Religion and Science towards COP 26" with the participation of Pope Francis. 4 October 2021 "Religion and Science: Towards COP26" Pope Francis - YouTube https://www.youtube.com/watch?v=eVOoncpD-X0&t=54s	14.371 visualisations
Connect4Climate and the Italian Ministry of Environment and Energy Security	**All4Climate** 2021	An initiative which empowered representatives from civil society, academic institutions, and the private sector to join the climate conversation in the months preceding COP21 in Milan https://www.mite.gov.it/pagina/all4climate-italy2021-incontri-e-iniziative-tutta-italia-fare-del-2021-l-anno-dell-ambizione Calendar of events https://all4climate2021.org	over 500 hand-selected events
Italian Ministry of Environment and Energy Security in collaboration with the World Bank Group's Connect4Climate and the Office of the UN Secretary-General's Envoy on Youth	**#Youth4ClimateLive Series** 2020-2021	Nine episodes were streamed live between June 2020 and February 2021, themed around topics such as Sustainable Recovery, Nature-Based Solutions, and Youth Action. Each session brought together a diverse group of unstoppable youth at the forefront of creative climate action for intergenerational and interactive conversations with policy makers and experts. https://youth4climate.live/	A global audience of over 10,000 young people

Fridays for Future Italy, in cooperation with Greenpeace Italy, WWF Italy, Legambiente,Terra!, Stop TTIP Italy	**"Back to the future Campaign" #DigitalStrike** 24 April 2022	This campaign has been developed on the occasion of the fifth digital Fridays for Future Global Strike and focuses on 7 points: 1. relaunch the economy investing on ecological reconversion 2. reaffirm the public role in the economy 3. achieve climate and social justice 4. to rethink the agrifood system 5. to protect territory, health and the community 6. to promote democracy, instruction and research 7. to build Europe of reconversion and of people During the campaign a letter to Italy has been developed, a virtual flashmob, and a crowdfunding were organized. https://ritornoalfuturo.org/la-campagna/	10.000 people signed A "letter to Italy" written together with scientific community and academia
ISPRA	**Report Climate State and Trends in Italy** 13 July 2021	Ispra Report "Climate state and trends in Italy" , illustrates the climate trend in 2021 and updates the estimate of climatic variations in recent decades in Italy . The Report is based on climate data and indicators derived largely from the National System for the collection, processing and dissemination of Climatological data of Environmental Interest (SCIA, www.scia.isprambiente.it) and is produced by Ispra in collaboration with and with the data of the National System for the Protection of the Environment and of the other observation networks present on the national territory. The report was launched on 13 July with a dedicated in-depth analysis to climate change and the measures to be implemented with a series of webinars with national and international experts. https://www.isprambiente.gov.it/it/news/il-clima-in-italia-nel-2021-caldo-anomalo-a-febbraio	
ISPRA (Italian Institute for the Protection of the Environment)	**"Life Sic2sic - By Bike Through the Italian Natura 2000 Network" Project** 2018 - 2020	LIFE Sic2Sic Project intends to promote an active and conscious participation of citizens in the protection of biodiversity in the sites of the Natura 2000 Network. The project is co-financed by the European Union LIFE programme. The workshop is the final meeting moment of the Sicilian tour of the LIFE Sic2Sic communication project, which was supported by Ispra experts and partners (Ares 2.0, Enne3 Incubatore Università Piemonte Orientale and Italian Federation of the Environment and Bicycle, FIAB)Participants cycled for 4 weeks through an ideal "network" of connection between the sites of the Natura 2000 network. https://lifesic2sic.eu/ https://www.isprambiente.gov.it/en/archive/ispra-events/2020/10/workshop-life-project-life-sic2sic-by-bike-through-the-italian-natura-2000-network-nature-in-sicily	
Kyoto Club with the contribution of the European Commission (DG-AGRI – Agriculture and Rural Development)	**F-FAIRCAP Project (Future Farmers Awareness-raising and Information for a Resilient CAP** 1 August 2022 – 31 July 2023	The objective of this project is to inform about the Common Agricultural Policy (PAC) and on its support, raising awareness on its key topics with particular attention to the new programming period for a transition towards an agricultural sector with zero emissions. F-FAIRCAP project provide citizens, students, farmers and others an insight to the contribution of the PAC to support mitigation and adaptation to climate change. It is about informand raise awareness on PAC measures (2023-2027) to	1 kick off meeting 20 thematic webinars 20 seminars 1 contest dedicated to 30 schools 1 final event

		small and medium enterprises and on the fact that environmental sustainability is the most competitative measure to diversify the income. Website: Kyoto Club | F-FAIRCAP	
Kyoto Club with the contribution of the European Commission (DG-AGRI – Agriculture and Rural Development)	**Climate Neutral CAP (CNC) Project** 1st August 2020 – 31st July 2021	The reference context of the project is the post-2020 CAP (Common Agricultural Policy) of the European Commission for climate resilience and soil protection. Objectives: the overall objective of the action is to improve information level of the CAP's benefits for social, economic and environmental dimension of EU territory, especially among young people of urban areas. CNC – Climate Neutral CAP is a project implemented in all Italian regions, replicable in all European areas. The project plans to introduce innovative aspects in promoting the CAP's objectives thanks to the involvement of young farmers, in order to start a dialogue on the critical issues of the integration of rural areas and to collect proposals to find intelligent solutions to be proposed to Regional governments. Website: Kyoto Club | CNC – Climate Neutral CAP	1 kickoff meeting 20 thematic webinars 20 seminars 1 Show cooking workshop: an evening seminar aimed at entrepreneurs, in particular young farmers interested in the food and wine sector. 1 final event
Kyoto Club with the contribution of the European Commission (DG-AGRI – Agriculture and Rural Development)	**CAPsizing Project** June 2018 – June 2019	CAPsizing – For climate resilience had the patronage of the Ministry of Agriculture and Forestry and the Ministry of Tourism. It is a pilot activity of Kyoto Club and it is replicable to other EU Regions. Objectives: to raise awareness about PAC among students of the Agrarian Faculty collecting proposals to develop the topics of fight against climate change and to promote safe and healthy eating habits. Within this project 21 webinars have been organized on climate resilience with the collaboration of the Italian Ministry of Agriculture and Forestry Website: Kyoto Club | CAPsizing	1 kickoff meeting 21 webinars on climate resilience with 2.145 visualisations 5 webinars "Fridays for Climate" with 1.576 visualisations 1 seminar in a smart farm 1 final event
Kyoto Club Federparchi-Europarc Italia, Kyoto Club and Legambiente	**Parks for Kyoto Project** **2007-ongoing**	Parks for Kyoto Project is a reforestation project promoted by the Committee Parks for Kyoto and aims at achieving greenhouse gas emission reduction targets fixed by the Paris Agreement and by the European climate targets. Parks for Kyoto Project participates to UNEP (United Nations Environment Programme) Campaign "Plant for the Planet". www.parchiperkyoto.it	28 reforestation interventions in parks throughout Italy 91.000 trees planted Abatment of more than 63 millions of CO2

Federparchi – Europarc Italia, Kyoto Club and Legambiente – ex C&A Foundation	**World Day Action for Climate 2021** 2021	The objective of this campaign is to reforest a central area of Rome City on the occasion of the world Action for Climate Day to fight climate change to increase local biodiversity and the habitat quality recreating the Mediterranean bush. This initiative is within the Campaign Inspiring World 2019 promoted by the Committee Parks for Kyoto.	More than 500 trees planted in the urban park Parco del Pineto
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 Museum tridentino of natural sciences 5. Bruno Kessler Foundation 6. Trentino glaciology committee	**Conference of Young People on Climate** 2021	The Conference of Young People for Climate (COY Trentino Alto Adige) has been organized in Trento by The Trentino Observatory on climate established by the provincial junta. Since 2010 it 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. Fourty young people have been selected to share a path of discussions and participation to climate change issues aimed at the production of a policy document with insights and inputs to be shared with stakeholders. Several preparatory events were organized culminating into a Conference within the Trento Film Festival also aimed at the participation of the pre-COP 26 and the National Event Youth for Climate in Milan. http://www.climatrentino.it/	40 young people partcipated (15-29 years old) 3 online meeting A document on policy recommendations in Trentino A multi-stakeholder dialogue 8 Young people delegation from Trentino to Glasgow COP26 4 young people to prallel events of Youth4Climate2021 in Milan
APPA Trento Provincial Agency for the Protection of the Environment	**Climatrentino - Days of Galciers** 13 September 2022	A cycle of periodic meetings on Glaciers promoted by the National Steering Committee on protected areas and glaciers in the Stelvio Park and organized by the provincial Agency for the Protection of the Environment - APPA Trento. The first appointement was focused on "Glaciers and Cliamte Change: environment mountain and safety". https://www.parcostelviotrentino.it/it/cosa-facciamo/giornate-dei-ghiacciai/157-124659.html	

Italian Association of Atmospheric Science and Metereology (AISM) of University of Trento , Municipality of Rovereto, Civic Museum of Rovereto Foundation	**Festival of Metereology** 18-20 November 2021	The title of the seventh edition of this Festival on Metereology is Metereology between science and art". It represents a unique experience at national level to present with scientific rigor the metereology to all people. An opportunity of dialogue among all different stakeholders from metereological services to professionals, companies, research community, universities, schools. A rich programme of meetings, workshops laboratories and exhibitions. Festivalmeteorologia_2021_programma_SINGOLA.pdf (unitn.it)	
Natural Park Adamello Brenta Autonomous Province of Trento	**BioMiti project** May 2022	The Head of the Scientific Research and environmental dissemination of Natural Park Adamello Brenta explained the project "BioMiti" on life on Brenta Dolomites, a message to leave to posterity for the protection of the mountain and its biodiversity. https://www.pnab.it/?s=cambiamenti+climatici+ BioMiti "Alla ricerca della vita sulle Dolomiti di Brenta" - YouTube	352 visualizations
ARPA Veneto in cooperation with the Museum of Geography of the University of Padova, the Italian Glaciological Committee and Carovana delle Alpi Legambiente	**IV edition of the glaciological participated campaign on Marmolada** 27-28 August 2022	The glaciological participated campaign on Marmolada is an initiative open to all the population to deepen their knowledge on glaciers. In this edition of the campaign after the events of the 3rd of July the glacier has not been crossed but has been observed from the Padon Chain, along the geological path of Arabba on the side that faces the Marmolada. This campaign aimed at making a reflection on the state of health of the glacier and perceive the relations with the human presence and the surrounding area. During the excursion several experts each hour organized short conferences addressing different geographic, glaciological, morphological, economic and historical aspects. Experts from the Regional protection Agency of Veneto participated together with a representative of the Avalanche Centre of Arabba to show to participants the first results of the climate evolution of the snowpack. To know more: Campagna glaciologica con Arpa Veneto per conoscere la Marmolada | SNPA - Sistema nazionale protezione ambiente (snpambiente.it)	
ASVIS (Italian Alliance for Sustainable Development)	**Radio Episode High Sustainability** 2020	During this episode a glaciologist from the University Milano-Bicocca intervened to speak to the general audience, an expert in geomorphology of the Italian Institute for Environmental Protection and Research, and a social psycologist from Sapienza University of Rome. https://asvis.it/radio-alta-sostenibilita/	1.067 visualizzazioni
Kyoto Club	**Kyoto Club Web Portal** http://www.kyotoclub.org/	Kyoto Club is a nonprofit organization which promotes awareness raising 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. http://www.kyotoclub.org/	

Italian Order of Journalists	**Climate change and information: roles and actions of Institution, citizen and mass-media** May 2019	This initiative was organized by the Italian Journalists Order and the Emilia-Romagna Journalists Foundation together with the Press Office of the Municipality of Ferrara and in collaboration with ISPRA and the Civic Museum of Natural History of Ferrara. The seminar aimed to promote knowledge and awareness of the current environmental situation with climate change as one of the biggest problems and to push citizens and decision makers at various levels to act promptly based on scientific indications. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2019/05/climate-change-and-information-roles-and-actions-of-istitution-citizen-and-mass-media	
SISC (Italian Association for sciences and climate) AISAM (Italian Association of atmospheric and metereological sciences)	**First National Conference on Weather and Climate Forecasts** June 2019	An event dedicated to present the competences and activities in the field of weather and climate forecasts in Italy today, both in the academic and research field, and in the operative services area (regional weather agencies). https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2019/06/first-national-conference-on-weather-and-climate-forecasts	
National Park of Sila	**Climate change - Protection and management of National Park of Sila resources** October 201)	This initiative was built to bring together the main players involved in the protection of Sila National Park and to talk about how to manage and preserve protected areas, biodiversity, forestry and agriculture from climate change through the optimization of strategic tools. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2019/10/climate-change-protection-and-management-of-national-park-of-sila-resources	
ARPA PIEDMONT	**Workshop Air and Climate: Today's Challenges and Future Prospects. The synergistic approach to air and climate policies: in-depth qualities and tools** October 2019	An event organized by the environmental agency of Piedmont within the Project "Climaera" to analyse environmental air-climate-energy policies to limit the deterioration of air quality and climate change. The discussions moderated by the climatologist Luca Mercalli focused on what actions are currently on progress by Valle d'Aosta and Liguria Regions with regard to climate and air quality and on how the Climaera Project can support the future regional planning. https://www.snpambiente.it/2019/09/25/il-10-ottobre-a-torino-parliamo-di-aria-e-clima/	
Italian Embassy in Nairobi, Italian Culture Institute in Kenya, World Agroforestry Centre (ICRAF) in Nairobi	**Climate Change, Forests and Food Security** December 2019	A symposium on "Climate Change, Forests and Food Security' was held at the headquarters of the World Agroforestry Centre (ICRAF) in Nairobi, promoted and organised by the Italian Embassy in Nairobi, the Italian Cultural Institute in Kenya in association with ICRAF, CIFOR (Centre for International Forestry Research) and Biodiversity International. ISPRA participated to the event to speak about the relation between climate change, loss biodiversity and safety food and the opportunity to address the issues using nature-based solutions, including the restoration of degraded ecosystems, coastal habitat reconstruction, agro-ecology.	

		https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2019/12/climate-change-forests-and-food-security	
LegaAmbiente	**Climate has already changed** November 2019	A Facebook live event on the impacts, risks and policies adaptation of cities and territories to climate change. During the event the Legambiente Observatory "ClimateCity" was presented, an analysis of ten years of impacts monitoring on the Italian territory, particularly the impacts pf climate change on urban areas. The report presents a map of the territories affected by extreme metereological phenomena. More information	
ARPA UMBRIA	**Lake Trasimeno, an observatory on climate change** August 2020	A seminar on the importance of Lake Trasimeno, which due to its geological, geomorphological, and hydrological characteristics, represents a sort of natural thermometer capable of effectively recording temperature variations. https://www.snpambiente.it/2020/08/20/il-trasimeno-un-osservatorio-sui-cambiamenti-climatici/	
ARPA LOMBARDIA	**International debate on air quality and climate change** **Beijing** September 2020	The environmental agency of Lombardy Region participated with experts to the conference within the China International Forum for Metropolitan Clean Air and Climate Change Actions. This event represented an opportunity for different countries to share and discuss about strategies to reduce atmospheric pollution and to fight climate change. During the event experts from the environmental agency of Lombardy presented the climate change situation in the Italian region. https://www.snpambiente.it/2020/09/10/a-pechino-confronto-internazionale-su-qualita-dellaria-e-cambiamenti-climatici/	
SIGEA (Italian Society of Environmental Geology)	**Analysis and effects of climate change in the Mediterranean environment** November 2020	The seminar is organized by SIGEA, the Italian Society of Environmental Geology in cooperation with RemTech Expo and the National Council of Geologists. Four in-depth sessions: Geo-hydrological instability; Agriculture, forestry and animal husbandry; Quantity and quality of water, health and quality of life; Natural and cultural heritage, economy and tourism. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2020/11/analysis-and-effects-of-climate-change-in-the-mediterranean-environment	

Fondazione Ingegneri di Padova	**Study on Climatic variations and hydraulic governance of the territory** February 2020	The study focused on three of the most important components likely to affect the development and hydraulic safety of the Veneto region: the heavy rains at the origin of the risk of flooding , the storms potentially devastating for the coastal strip, the drought source of insecurity and limitation for agricultural production. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2020/02/climatic-variations-and-hydraulic-governance-of-the-territory	
ISPRA	**Emission in atmosphere in Italy videoconference** April 2020	This videoconference that described the emission trend in Italy: a global and detailed picture of the Italian situation on the trend of greenhouse gases from 1990 to 2018. The event focused on emissions from agriculture and livestock and the contribution of indirect effect gases and particulates matter. https://www.isprambiente.gov.it/en/archive/ispra-events/2020/04/the-emission-trend-in-italy	
Italy for Climate	**National conference on climate 2000: a roadmap for Italy** October 2020	The National Climate Conference was Italy for Climate most important event for the year 2020 An initiative promoted by the Sustainable Development Foundation and by a group of companies in preparation of COP26, with the patronage of the Ministry of the Environment, ENEA and ISPRA. The central topic of the 2020 edition of the Conference was the proposal to adopt a Roadmap for climate to be defined through the Recovery plan, following the indication of the European Council to allocate at least 30% of European funding to climate measures. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2020/10/national-conference-on-climate-2000-a-roadmap-for-italy	369 visualizations of the first session video
National Geographic	**Festival of sciences- Climate change and the sustainable future: from space to our home** November 2020	An initiative promoted by ISPRA within the Festival of Sciences in order to illustrate a series of data to know about the climate of the past, of present and of future at local and global level, to allow public and private decision makers to have tools to develop strategies and initiatives to successfully face climate change. More information	
SNPA	**Presentation of the SNPA Report "Air quality in Italy - first edition 2020"** December 2020	This Report is carried out as part of the activities of the National System for Environmental Protection (SNPA). It describes the state and trend of atmospheric pollution in Italy in the decade 2010-2019 and contains a series of in-depth monographs useful to understand the phenomena and trends in progress. https://www.isprambiente.gov.it/en/archive/ispra-events/2020/12/presentation-of-the-snpa-report-air-quality-in-italy-first-edition-2020	1.457 visualizations of the video of the presentation of the Report (

ISPRA	**i-waveNET project Kick-off Meeting** February 2021	This meeting presented the Implementation of an innovative system for monitoring the sea state in climate change scenarios. i-waveNET project which involves Italy and Malta developed a cross-border monitoring network based on the integration of different measurement technologies such as: HF radars, seismic and sea level sensors, wave buoys, weather stations. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2021/01/implementation-of-an-innovative-system-for-monitoring-the-sea	
Veneto Region	**Workshop on Climate change in the coastal and transition areas: scenarios and impacts on the Po Delta** April 2021	The Veneto region organized a meeting in the frame of the CHANGE WE CARE European project, in order to assess the climate change in the coastal areas. The project's target is to provide guidelines of integrated planning to respond to climate modification on the long period, especially in the Po Delta. More information https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2021/04/climate-change-in-the-coastal-and-transition-scenarios	
National Forum of Copernicus Users - European Conference of Copernicus Climate Change Service	**Workshop on How to manage climate change challenge in Europe** April 2021	From 18 to 20 May three afternoons of online presentations and debate on the latest developments in climate monitoring, with speakers and panellists from leading international research institutes, government services and private-sector innovators. The General Assembly was "virtually" hosted by Italy, in collaboration with the National Forum of Copernicus European programme. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2021/04/how-to-manage-climate-change-challenge-in-europe	
ARPA MARCHE	**Pollen and climate change: scenarios and perspectives Workshop** April 2021	This workshop aimed to promote and support the research activity conducted by Aerobiology as a fundamental discipline in the study of health and environmental issues, with the aim of promoting its widest dissemination, creating at the same time the opportunity to get in touch with the experience of the " POLLNET NETWORK "to explore its commitment and to promote its growth. https://www.snpambiente.it/2021/03/31/arpa-marche-il-9-aprile-un-seminario-su-pollini-e-climate-change/	
SNPA	**Climate trend in Italy** November 2021	This report was presented in a streaming modality,. It describes the climate trend in 2020 and updates the estimate of climatic variations in recent decades in Italy, largely based on climate data and indicators developed through the National System for Environmental Protection for the collection, processing and dissemination of Climatological Data of Environmental Interest (SCIA). https://www.isprambiente.gov.it/en/archive/ispra-events/2021/11/climate-trend-in-italy	189 visualizations 11 presentations

ISPRA	**Webinar Atmospheric emissions and characterization of the national energy system** April 2022	This webinar was dedicated to the presentation of data and information on the emission status with an in-depth study on energy efficiency in Italy. During the event, the main decarbonisation and energy efficiency indicators for total energy consumption and in the electricity sector in Italy were disclosed. https://www.isprambiente.gov.it/en/ispra-events/atmospheric-emissions-and-characterization-of-the-national-energy-system	846 visualizations 4 presentations
ISPRA	**Webinar The climate crisis** July 2022	A Webinar with authoritative experts from national and international organizations interviewed on the main causes of the global climate crisis also outlining scenarios. Three parallel sessions following the event wereorganized with presentations. ISPRA presented an update of indicators to describe the state and trend of climate change in Italy, the climate change mitigation interventions, the analysis of the impacts of climate change on the national territory and the interventions of adaptation.https://www.isprambiente.gov.it/en/ispra-events/the-climate-crisis	18 presentations during the 3 sessions
CMCC (Euro-Mediterranean Center on Climate Change Foundation)	**Presentation of the working groups' reports for the IPCC Sixth Assessment Report (AR6) organized by the IPCC National Focal Point** **2021**	The IPCC National Focal Point organized the official presentations in Italian language of the working groups' reports for the IPCC Sixth Assessment Report (AR6) with supplementary in-depth material in Italian. The IPCC National Focal Point can be considered as a meeting point between the IPCC, the scientific community and national public opinion with the aim to foster mutual exchange of information on ongoing activities. The IPCC National Focal Point participates in IPCC plenary sessions and meetings, represents the IPCC in its country and carries out communication and dissemination activities concerning IPCC activities. The current IPCC Focal Point for Italy is CMCC President Antonio Navarra since 2015.	WGII presentation – online event: 695 participants, 2483 Youtube visualizations WGIII presentation – online event: 783 participants, 1743 Youtube visualizations
CMCC (Euro-Mediterranean Center on Climate Change Foundation)	**Initiative "Italian series of Seeds"** ***Words that feed the future*** 2021	An activity developed within the IPCC Focal Point for Italy, it is collection of words with which we hope to plant the seeds of awareness, providing in depth definitions of some of the most pressing topics related to climate change. Because understanding the discourse that surrounds the climate crisis is the key to a sustainable future. The Italian series of ***Seeds*** can be accessed here: https://ipccitalia.cmcc.it/seeds/	14 Italian Seeds (words which plant the seeds of awareness)

CMCC (Euro-Mediterranean Center on Climate Change Foundation)	**Foresight Magazine**	Foresight is the CMCC digital magazine that collects ideas, interviews, articles, and multimedia to tell the stories of the future. It covers a large range of topics, focusing on oceans, pollution and health, transports and energy, migrations and climate change, distribution of natural resources and income, policy, art, and communication. In 2021, CMCC launched the series of articles "Seeds. Words that feed the future", a collection of words with which we hope to plant the seeds of awareness, providing in depth definitions of some of the most pressing topics related to climate change. In 2022, after a complete restyling of the website, CMCC launched the **Podcasts series** "Foresight – Deep into the Future Planet", produced by the CMCC and FACTA.	2020: 52 articles 2021: 27 articles, 5 Seeds 2022: 33 articles, 9 Seeds, 1 trailer, 2 podcasts

9.3 Public access to information

Public access to environmental information is one of the three pillars of the Aahrus Convention. In order to educate citizens aware of their rights, it is very 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 decision-making that may affect the environment; extending the conditions of access to justice.

Starting from the assumption that new technologies and global crisis like the pandemic 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.

Over the last years of pandemic crisis has grown exponentially the podcast phenomenon. The number of habitual podcast listeners is in a net growth, 28% of Internet users in 2021 claimed to listen to podcast. Podcast is easy to be downloaded and stored on mobile devices as the smartphone. According to what reported by askanews (Italian press agency specialized in providing multimedia news) in 2020 Italian podcasters registered have been almost 14 million, 15% more than 2019 and in the last three years much more with the push of the pandemic, podcast has grown in terms of number, quality, listeners and production. In October 2021 podcast listeners went up to 9,3 million. Italian "podcasters" are for 67-68% in the age group (18-34) and up to 55% over 55 people. Environmental Issues with climate change at the top seem to be the most selected topics from podcast listeners.

Several innovative and practical initiatives have been implemented at national and local level to improve citizen information on climate change issues. Web tools like observatories, platforms, webinars and social web pages, podcasts together with usual newsletters, electronic information systems, web sites, information desks, conferences and workshops have been at the core of the public access to environmental information including climate change most of them organized and promoted by the Italian Ministry of Environment and Energy Security and ISPRA.

An example of punctual and integrated access to environmental information at national level is the Newsletter "AmbienteInforma". This is the informative product of the 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. More than one hundred and twenty thousand people are registered to AmbienteInforma weekly newsletter.

A recent innovative information tool on environment is the EcoAtl@nte launched on 1st March 2022 by the Italian Institute for Environmental protection and Research ISPRA. It represents an absolute novelty in the environmental field. This tool allows to access information, to know and discover, visualize and share

environmental information at national and local level. It is addressed not only to experts but also to non-experts and beginners in environmental topics. It is not a simple website but rather a "journey" for the visitor that can find information collected by the Italian Environmental Informative System and it is accessible from personal computer, tablet and smartphones. The real novelty of this tool is the possibility to create personalized national and local maps with data, percentages, and SNPA trends also overlapping indicators on different topics to create a personal map and share it on websites, social, blog and so on.

Furthermore, in October 2022 the Ministry of Environment and Energy Security together with the Italian Institute for Environmental Protection has launched a very new information tool, the National Platform on Adaptation to Climate Change with the aim of informing and raising awareness of citizens and stakeholders on adaptation to climate change and to provide with data and tools to support Regions and local Institutions in the decision-making processes. It is about a very first edition that will be populated with more data and information from different sources and that will be periodically updated. The aim of the national platform on Adaptation to Climate Change is also to provide with information included in the National Adaptation Plan to Climate Changes.

Public access to information: list of some initiatives carried out since 2018

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 an editorial team composed by representatives of ISPRA and all the 21 ARPA and APPA. The aim of this Bulletin is to inform citizens about environmental topics and to promote the work of more than 10.000 people composing the Italian System for Environmental protection and daily committed to protect the environment. Climate Change is a burning issue of all AmbienteInforma editions. The bulletin aims at promoting initiatives and interviews with SNPA experts and key scientists.	About 120.000 recipients 366 editions published at the end of 2020
ISPRA	**ISPRA web site** http://www.isprambiente.gov.it/it **ISPRA Video Youtube channel** https://www.youtube.com/@ISPRAVIDEO	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 in which publications can be downloaded. ISPRA also manage a dedicated video Youtube Channel to disseminate information through videos, interviews and documentaries.	4.020.111 visualisations in 2018 4.069.342 visualisations in 2019 3.986.285 visualisations in 2020 5.248.779 visualisations in 2021 2.226.647 visualisations in the first semester 2022 ISPRA VIDEO Youtube Channel has got 3.620 registered people
ISPRA/SNPA	**EcoAtl@ante** **2022**	This communication tool represents a journey in the Italian Environment through very easy to read stories. Through a cartographic path discovering environmental data with an innovative way of navigating on-line, the story-maps data are organized in environmental topic dashboards,there are graphs to be queried interactively and maps and numbers. The EcoAtl**@n**te has a dedicated dashboard on climate change where you can find information about:	

		causes and effects, strategies to combat climate change, climate-altering emissions, climate indicators in Italy and impact indicators. https://ecoatlante.isprambiente.it/	
Italian Ministry of Environment and Energy Security and Italian Institute for Environmental Protection and Research	**National Patfom on adapatation to climate changes** October 2022	The national platform for adaptation to Climate Change has been published with the aim of informing and raising awareness of citizens and stakeholders on adaptation to climate change and to provide with data and tools to support Regions and local Institutions in the decision-making processes. This is a very first edition that will be populated with more data and information from different sources and it will be periodically updated. And the aim is also to provide with information included in the National Adaptation Plan to Climate Changes. http://climadat.isprambiente.it	
ISPRA	**Environmental Data Yearbook** Edition 2018 Edition 2019 Edition 2020 Edition 2021	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 and provincial environmental agencies (SNPA - National System for Environmental protection) that combines direct knowledge of the territory and local environmental issues with national policies for prevention and environmental protection. This Report has become an institutional and technical-scientific reference point for the whole Country. It 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. https://www.isprambiente.gov.it/en/publications/state-of-the-environment/the-yearbook-in-figures-2021	2019: 341 participants to the face-to-face presentation meeting 2020: 2.942 visualizations on you tube Ispra channel
SNPA	**Report on Urban Environment Quality** 2021 edition 2020 edition 2019 Edition on climate change 2018 edition	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 numerous topics dealt with (some also on the metropolitan scale) all represent fundamental aspects of the quality of life in urban areas: social and economic factors, soil and territory, green infrastructures, water, air pollution and climate change. The 2019 edition particularly focused on climate change updates a rich set of environmental quality indicators for 124 of the most populous cities in Italy and for the 14 metropolitan cities. It is about a set of core indicators for the analysis of the urban environmental quality and urban quality of	

		life in the Italian cities. https://www.snpambiente.it/2020/09/10/xv-rapporto-sulla-qualita-dellambiente-urbano-edizione-2019/	
SNPA	**Report on Urban Environment Quality** 2018 edition 2019 edition 2020 edition 2021 edition	The SNPA Report "Quality of the urban environment" has consolidated over the years as a national reference for citizens and administrators thanks to the numerous data presented and assessments relating to the most important environmental issues of contemporary cities. The 2019 edition updates a rich set of environmental quality indicators for 124 of the most populous cities in Italy and for the 14 metropolitan cities. The numerous topics dealt with (some also on the metropolitan scale) all represent fundamental aspects of the quality of life in urban areas: social and economic factors, soil and territory, green infrastructures, water, air pollution and climate change. https://www.snpambiente.it/2020/09/10/xv-rapporto-sulla-qualita-dellambiente-urbano-edizione-2019/	Edition 2018 50 participants Video of the speakers: 161 visualizations
SNPA	**SNPA Report "Cities in transition: the Italian capitals towards environmental sustainability"** July 2022	An online event has been organized by ISPRA for the presentation of the Report of the National System for Environmental Protection (SNPA) "Cities in transition: the Italian capitals towards environmental sustainability". This Report proposes, for the first time, a transversal reading of the quality of the urban environment through three different interpretative keys - livability, circularity and resilience to climate change - evaluating its evolution in recent years. It analizes for the first time the environmental trends of 20 capital cities and Bolzano over a five-year period. https://www.isprambiente.gov.it/en/ispra-events/presentation-of-the-snpa-report-cities-in-transition-the-italian-capitals-towards-environmental-sustainability?set_language=en	
ARPA FRIULI VENEZIA GIULA	**State of environment 2018 in Friuli Venezia Giulia** March 2018	The report is an important information tool that aims to support the debate on environmental issues and sustainable development. It also offers objective elements to assess on the "state of health" of waters, air, soils, ecosystems, recording the changes that have occurred in recent years due to the determinants, pressures and human behaviors. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/year-2018/march/state-of-environment-2018-in-friuli-venezia-giulia	

ISPRA	**Publication Greenhouse gas: emissions inventory, 2030 projections and climate strategies** May 2018	This document has been presented focusing in particular on the most recent news on national and international strategies and legislation for climate change mitigation. A focus was also dedicated to the state of international climate negotiations, aimed at implementing the commitments relating to the Paris Agreement, and to the scenarios of change, in synergy with the future multi-sectoral policies and strategies, which will be the basis of the Italian "roadmap for decarbonization". https://www.isprambiente.gov.it/en/archive/ispra-events/year-2018/may/greenhouse-gas-emissions-inventory-2030-projections-and-climate-strategies	100 people attended the presentation
ARPA EMILIA ROMAGNA (ARpAE)	**hydrometeoclima report 2018** May 2018	The Hydrometeoclimate Report 2018 was published, and produced by Arpae. Regional Climate Observatory. It consists of 97 pages describing the year 2018 in Emilia-Romagna, with detailed monthly and hydrological analysis, information on relevant hydro-meteorological events and all the anomalies with respect to the reference climate. https://www.snpambiente.it/2019/05/07/emilia-romagna-online-il-rapporto-idrometeoclima-2018/	
ISPRA	**National Report on greenhouse gas emissions: Indicators of efficiency and decarbonisation in main European countries** November 2018	In this report the national trends of some energy and economic indicators have been analysed in relation to greenhouse gas emissions and in comparison to those of the major EU countries. National indicators show high transformation efficiency and low intensity as compared to major EU countries. Altough the EU carbon intensity is lower than the national one however, the Italian fossil fuels carbon intensity is lower than most EU countries due to the higher share of natural gas compared to the average of the EU countries. This report has been presented with a press conference reserved to journalists and experts. https://www.isprambiente.gov.it/en/archive/ispra-events/year-2018/november/press-conference-ispra-report.-national-greenhouse-gas-emissions-indicators-of-efficiency-and-decarbonisation-in-the-main-european-countries	50 participants
ISPRA	**Sea Forest LIFE first conference: "Protect Posidonia oceanica to combat climate change"** September 2019	This conference was organized for the presentation of the project Sea Forest LIFE to combat the climate change. The event focused on the aims and objectives of the project, presenting the potential of Posidonia in Italian protected areas inside Natura 2000 network. These environments represent an opportunity for the environment and the community and good practices for their proper management were discussed during the conference. https://www.isprambiente.gov.it/en/archive/ispra-events/2019/09/sea-forest-life-first-conference-protect-posidonia-oceanica-to-combat-climate-change	30 participants

ISPRA	**Reticula monography on Forests, resilience and climate change** February 2021	A Special number dedicated to the issues of ecological connectivity, green infrastructures, ecosystem services and environmental governance, eco-sustainable planning of the territory and landscape https://www.snpambiente.it/2021/02/04/numero-monografico-di-reticula-dedicato-a-foreste-resilienza-e-cambiamenti-climatici/	
Fondazione Univerdi	**Water and Climate change conference** **(June 2021)**	On the occasion of the World Day to Combat Desertification, the conference "Water and Climate Change has been organized with the aim of presenting the official translation into Italian of the United Nations World Report on the development of water resources 2020. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2021/06/water-and-climate-change	
SNPA	**SNPA report on impact indicators of climate change** June 2021	The presentation conference was divided into 2 sessions both transmitted in a streaming format. The first was a discussion among stakeholders on climate change issues and on the actions to address consequences on Italian territories. The secondproposed a technical-scientific study which presented the main results of the Report. https://www.isprambiente.gov.it/en/archive/ispra-events/2021/06/presentation-of-the-snpa-report-on-indicators-of-the-impact-of-climate-change	
SNPA	**Seas and Alps to the test of climate change: first SNPA report on climate change impacts in Italy** June 2021	The Alpine environment and the Italian seas are the special observers in monitoring the possible effects of climate change in Italy. The " SNPA report on climate change impact indicators " provides an initial cognitive framework on the phenomena potentially connected to climate change in Italy and represents a dynamic and updatable system, also in function of any new scientific acquisitions. To monitor the phenomenon of climate change and measure the effectiveness of the adopted contrast and adaptation actions, Snpa has identified a first set of 20 national indicators and 30 regional pilot cases relating to 13 vulnerable sectors already identified as part of the National Strategy of Adaptation to Climate Change and the subsequent draft of the National Plan.The presentation event was organized online trough sessions. https://www.snpambiente.it/2021/06/30/rapporto-snpa-sugli-indicatori-di-impatto-dei-cambiamenti-climatici/	1.103 visualisations

Ministry of Environment and Energy Security	**Experimental program of interventions for adaptation to climate change in the urban environment** July 2021	This event aimed at increasing the resilience of urban centers to climate change, with reference to heat waves and drought phenomena. It was organized by the Ministry of Environment and Energy Security, in collaboration with ANCI and with the scientific contribution of ISPRA https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2021/07/experimental-program-of-interventions-for-adaptation-to-climate-change-in-the-urban-environment	
ISPRA	**Report on Climate indicators in Italy 2020** July 2021	The 16th report " Climate Indicators in Italy" describes the Italian climate in the year 2020 and updates the estimate of climate variations in the last few decades. It is based on climate data, indices and indicators derived from the "National System for the collection, processing and dissemination of climate data" (SCIA), developed by ISPRA in collaboration with national and regional meteorological monitoring networks. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2021/07/climate-indicators-in-italy-2020-edition-xvi	
Italy for climate	**National conference on climate 2021** December 2021	On 2 December, a few days after the closure of COP26 in Glasgow, the National Conference on climate was organized. It represents in Italy the main appointment for Climate to analyse every year on the progress made by the country with regard to the path towards climate neutrality and to discuss strategies to be implemented to achieve climate goals. The 2021 edition of the Conference took place in a virtual modality and involved representatives of institutions, companies and key national stakeholders. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2021/12/national-conference-on-climate-2021	
Italian Chamber of Deputy	**The Parliament role in the Italian climate governance** December 2021	This event has been organized by the Italian Parliament with the aim to involve Italian institution in the contrast of climate change. A reflection on the effectiveness of existing regulatory instruments and on the adequacy of the Italian climate governance system. A greater involvement of Parliament in determining Italian climate governance is necessary to provide the country with a specific regulatory instrument to set ambitious and binding objectives, which could be, following the example of other European countries, an Italian climate law. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2021/12/the-parlament-role-in-the-italiana-climate-governance	

University of Campania	**Climate crisis and the role of trees** December 2021	The webinar "Climate crisis and the role of trees" aimed to spread punctual information on the issue which was discussed during the international meetings G20 and COP26. The event focused also on ecosystem services and urban forestation actions". https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2021/12/climate-crisis-and-the-role-of-trees	
WWF ITALIA	**Deforestation and climate change Report** March 2022	Presentation of the report "Deforestation and climate change: the impact of consumption on natural systems", it is the new WWF report for the Day of Forests. This Report has been launched in view of Earth Hour, the global WWF mobilisation for nature and climate which invited everybody to switch off the lights for one hour like a symbolic gesture for a safer and sustainable future. https://www.wwf.it/cosa-facciamo/pubblicazioni/deforestazione-e-cambiamento-climatico/	
APPA TRENTO	**Trentino's contribution to climate change research Workshop** April 2022	A Workshop organized by the environmental agency of APPA Trento for the definition of the provincial strategy for mitigation and adaptation to climate change which will represent in the future the reference tool for guiding climate action in Trentino. https://www.snpambiente.it/2022/04/12/il-contributo-del-trentino-alla-ricerca-sui-cambiamenti-climatici-al-workshop-organizzato-dallappa/	
Rome Capital Metropolitan City	**Climate and environment in the Metropolitan City of Rome capital** May 2022	Metropolitan City of Rome Capital organized the conference "Climate and environment" to present studies and tools for planning and acting. ISPRA researchers contributed to the meeting with a speech on land consumption and implications for climate change. https://www.isprambiente.gov.it/en/news/climate-and-environment-in-the-metropolitan-city-of-roma-capitale	
AISAM (Italian Association of Atmospheric Sciences and Meteorology) and SISC (Italian Society for Climate Sciences)	**Second National Conference on Meteorological and Climate Forecasts** June 2022	The National conference was divided into 4 thematic sessions: Forecasts and warning systems for risk management and mitigation; Forecasts for planning and adaptation; Communicate forecasts and their uncertainty; The value of forecasts: different points of view and evaluation methods. https://www.isprambiente.gov.it/en/news/second-national-conference-on-meteorological-and-climate-forecasts	

ARPAT (Environmental Protection Agency of Tuscany Region)	**Days of Science "Climate change: to know to act can safeguard our future".** 2022-2023	ARPAT Days of Science – Climate change: know and act to safeguard our future is a communication and training project on climate change, promoted by ARPAT. The project, started in 2022 and will go on also in 2023, consisting of a series of montly lectio magistralis conducted by university professors and addressed to Agency's employees of all levels. The first three lessons realized were focused on the following topics: Fight against climate change: international legislation and climate justice; Extreme weather events and arboreal vegetation; Impacts of climate changes on marine ecosystems.	
Italy for Climate	**National climate conference 2022** July 2022	The third edition of the National Climate Conference, Italy for Climate presented a new roadmap to achieve an unprecedented acceleration of the ecological transition in Italy. ISPRA President attended the event. https://www.isprambiente.gov.it/en/news/national-climate-conference-2022	
ARPA PIEMONTE	**CLIMATHON** October 2018	Within Climathon initiative, Arpa Piemonte organized a plenary session "School for the environment" with 3 schools in the Region of Piemonte, with songs and lessons. https://www.snpambiente.it/2018/10/26/la-prevenzione-ambientale-passa-anche-dalla-formazione/	80 students Video of the event: 5.050 visualizations
ARPA VENETO	**Open door for the citizens** October 2018	The meeting was organized to make citizens aware of the activities of the meteorological center and the possible uses of the data collected daily by the networks of control units and sophisticated detection tools. https://www.snpambiente.it/2018/10/23/il-clima-sta-cambiando-se-ne-parla-il-27-ottobre-a-porte-aperte-allarpa-veneto/	
ANCI	**Climate, energy and sustainable mobility event** April 2018	An event organized to analyse the main topics related with environment and energy that have urban impacts. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/year-2018/april/day-event-for-the-climate-enery-and-sustainable-mobility	
ARPA FRIULI VENEZIA GIULIA	**Survey on climate change in FVG** May 2018	Presentation of the results of a survey with a sample of 3.400 people concerning climate change topics. The aim of this survey was to know the perception, the concerns, the expectations of the population regarding climate change which are fundamental to effectively set up the communication of such a complex issue: for this reason ARPA FVG - OSMER has carried out the survey "Climate change in FVG: what do you think?". It was conducted online; promoted on the arpa.fvg.it site, on the thematic site meteo.fvg.it and on the related social media, it was launched in November 2017, on the occasion of the World Climate Conference (COP23) held in Bonn and concluded in conjunction with the regional conference to present the study on climate change in FVG	3.400 people

		(Gorizia, 10 March 2018). https://www.snpambiente.it/2018/05/04/risultati-del-sondaggio-sui-cambiamenti-climatici-in-fvg/	
ISPRA	**Geoevents** **(Planet Earth week 2018 United Nations)** October 2018	For a whole week in October several initiatives were organized throughout the country, to spread scientific culture, called "Geoevents": excursions, walks in urban and historical centers, open doors in museums and research centers, guided tours, exhibitions, educational and experimental workshops for children and teenagers, musical and artistic activities, convivial tastings, conferences, conventions, workshops, round tables. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/year-2018/october/planet-earth-weekly-2018	
Climate Service Toscana	**Drought Observatory: a climate service to improve environmental resilience** January 2019	A web-based climate service for monitoring and seasonal forecasting of drought in Tuscany. A web-based climate service for monitoring and seasonal forecasting of drought. The Drought Observatory is an integrated and Open system to support decision makers, water authorities, researchers, farmers and other stakeholders. Up-to-date and freely available scientific information through WebGIS, Open Data and advanced functions to tackle a complex, increasingly frequent and harmful phenomenon. https://www.snpambiente.it/2019/01/09/osservatorio-siccita-un-servizio-climatico-per-migliorare-la-resilienza-ambientale/	
ARPA PIEMONTE	**Climate song Contest** March 2019	Target of the project was first and second grade secondary school students called to create a video clip to raise awareness on climate change. It was promoted and supported nationally by the Ministry of University and Research (MUR). The winner will become the official video of the Climate song and will be disseminated and promoted on all the institutional sites of the partners, as well as sent together with the song to the main radio broadcasters and proposed in the institutional events promoted by the partners. https://www.snpambiente.it/2019/03/21/concorso-per-le-scuole-un-video-per-la-climate-song/	about 100 students
WWF	**Earth hour** March 2019	Throughout Italy there have been hundreds of municipalities that have joined Earth Hour 2019 with symbolic events and shutdowns which, like every year, aim to draw the attention of public opinion and policy makers to the urgent need to act to stop climate change. https://www.snpambiente.it/2019/03/29/earth-hour-in-calabria-numerose-adesioni-allevento-del-wwf/	

Fridays for Future Perugia	**Perugia - climate march** March 2019	A global event to ask politicians to take actions against the climate change in Italy It was held in Perugia, Ispra experts joined the event to talk about how to protect biodiversity from climate changes. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2019/03/perugia-climate-march	
FRIDAYS FOR FUTURE Italy	**Global Strike for future** March 2019	The National System for the Protection of the Environment (SNPA), together with other Research Bodies and environmental associations, has joined this great event to raise awareness on a global level towards climate-related issues, making available data, information and activities that, as System are moving forward on climate change. https://www.snpambiente.it/2019/03/13/il-clima-non-puo-aspettare-snpa-aderisce-al-global-strike-for-future/	
Italian Alliance for Sustainable Development (ASviS)	**National Sustainable Development Festival** May 2019	The festival included 17 national events and hundreds of meetings are planned (conferences, seminars, workshops, exhibitions, shows, sporting events, book presentations, documentaries) linked to the Sustainable Development Goals. National events were also organized on the key issues of sustainable development and the various Agenda 2030 Objectives, organized by Alliance members, with the contribution of the ASviS working groups. Assisi, Genoa, Matera, Naples, Rome, Turin, Udine are the Italian cities that hosted these initiatives. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2019/05/sustainable-development-festival-2019	
REMTECH	**RemTech expo 2019** September 2019	Permanent international event dedicated to reclamation of contaminated sites, environmental and natural hazards, safety, maintenance and upgrading of the territory, climate changes and circular chemistry. Ispra participated with several sessions https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2019/09/ispra-participates-remtech-expo-2019	3 sessions 25 presentations of Ispra experts
Italian Alliance for Sustainable Development (ASviS)	**ASVIS "Saturdays for Future" initiative** September 2019	This initiative is addressed to stimulate a change in consumption habits and production module towards sustainable development, as expected in Goal 12 of Agenda 2030. . The Italian Alliance for Sustainable Development (ASviS) invites everyone to take part in the Saturdays For Future, a national day of mobilization on the themes of responsible production and consumption. https://www.youtube.com/watch?v=ZTasONbNolY	122 visualisations

ISPRA	**CleanAir@School project Launching event** November 2019	The CleanAir @ School project is an environmental education and Citizen Science initiative of EPA Network. Specifically, the project includes environmental education and training activities through the monitoring of Nitrogen Dioxide, one of the main pollutants in urban areas, largely determined by motor vehicle traffic. https://www.isprambiente.gov.it/en/archive/ispra-events/2019/11/cleanair-school-14-november-event-launch	participation : 50 people
ECOMONDO The green Technology Expo Rimini Fiere	**Ecomondo Expo 2019** November 2019 October 2021	International expo platform to offer an extensive program of conferences, workshops and seminars aimed at presenting evidence and new trends, national and international, linked to the circular economy in the various supply chains, from construction to packaging, from electronics to automotive. During the event, the major international experts in the sector come together to share ideas and experiences, present news and international best practices. Four days of great interest for the entire sector making Ecomondo the international hub of reference in the world of the green and circular economy. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2021/09/ispra-participation-in-ecomondo-2021 https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2019/11/ispra-will-participate-at-ecomondo-2019	3 days of event and initiatives Hundreds of participants
Naples Archeological Museum	**Culture and environment, show to fight global warming** October 2019	At the National Archaeological Museum of Naples, the exhibition "Understanding climate change - Experience Exhibition" was held, produced by OTM Company and Studeo Group, in collaboration with the National Geographic Society and with the scientific supervision of Luca Mercalli, member of the board scientist of Ispra and president of the Italian Meteorological Society. https://www.snpambiente.it/2019/10/24/cultura-e-ambiente-in-mostra-la-lotta-al-riscaldamento-globale/	
ITALIAN SOCIETY FOR CLIMATE SCIENCES / APPA TRENTO	**Green Game, a tournament for the Planet** October 2019	Initiative dedicated to climate change and the 17 goals for sustainable development of the UN 2030 Agenda https://www.snpambiente.it/2019/07/17/a-trento-la-conferenza-degli-scienziati-italiani-del-clima/	
ISPRA	**Emission trading online service** December 2019	The site offers support to users of the Registry by providing general information and detailed indications on the procedures to be followed to operate and participate in the emissions trading system. https://www.isprambiente.gov.it/it/archivio/notizie-e-novita-normative/notizie-ispra/2019/12/online-il-sito-del-registro-italiano-per-lemission-trading	

LEGA AMBIENTE	**Green Train dedicated to the Climate change** February 2020	This initiative promoted by Legambiente and Ferrovie dello Stato, with the patronage of the Ministry of Environment is dedicated to "Climate Change" and, from south to north, to talk about the climatic events of an extreme nature that have increased in recent years that are involving also Italy. https://www.snpambiente.it/2020/02/19/trenoverde-di-legambiente-il-direttore-generale-arpacal-dialogo-sempre-aperto-con-il-territorio/	
National Geographic	**Science Festival** June 2020	Optimism and science is the key topic of the XV edition of the National Geographic Science Festival in Rome which hosted in a live streaming modality on social channels and on the website dialogues and reflections, digital meetings conceived to demonstrate even in strong limited conditions, personal and geographiic the open and universal value, of scientific research, without barriers and completely devoted to the common health and wellbeing. https://www.isprambiente.gov.it/it/archivio/notizie-e-novita-normative/notizie-ispra/2020/06/national-geographic-festival-delle-scienze	50 leading exponents of the scientific and literary world for 6 hours of live broadcast 367 visualizations
Horizon 20202 project- EU, ISPRA	**NET project for the European Researchers' Night 2020** July 2020	A night of events in the whole Europe dedicated to the environment with the aim to raise arise awareness on environment and climate issues organized by national Research institutions. ISPRA participated at the event organizing initiatives with speakers and promoting videos of its activities. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2020/07/net-project-for-the-european-researchers-night-2020	Video 654 visualizations
European Commission, ISPRA	**European Mobility Week** September 2020	For the 2020 edition the theme was 'Zero-emission mobility for all'. ISPRA participated with several initiatives. The European Mobility Week, in 2020 achieved the 19th edition, it is considered a fundamental appointment for all administrations and citizens who want to commit themselves to the path of sustainability and improving the cities life quality. The central theme of the 2020 edition reflects the ambitious targets of a carbon-neutral continent by 2050, as laid out by Ursula von der Leyen, President of the European Commission, when presenting the European Green Deal. https://www.isprambiente.gov.it/en/archive/news-and-other-events/ispra-news/2020/09/european-mobility-week	

ISPRA	**Public conference on Trend of atmospheric emissions and scenarios in Italy** April 2021	A Video streaming event dedicated to the data and information related to the emissions situation in Italy, to illustrate the trend from 1990 to 2019 of the greenhouse gases and other pollutants plus the scenarios until 2050. The focus was on road transport. https://www.isprambiente.gov.it/en/archive/ispra-events/2021/04	
ISPRA	**EMAS and climate change** June 2021	Dialogue on streaming with the public and interested parties on the main objective of the EC Regulation 1221/2009 EMAS. The Ecolabel Ecoaudit Committee, with the technical support of ISPRA, organized a discussion table on "EMAS and Climate Change" in order to offer organizations the opportunity to share experiences in the fight against climate change, highlighting the link with the EMAS Scheme, and to put forward any proposals / suggestions to strengthen its effectiveness. https://www.isprambiente.gov.it/en/archive/ispra-events/2021/06/emas-and-climate-change	
Italian Ministry of Environment (Youth4Climate)	**Youth4Climate** September 2021	From September 28th to Thursday 30th, Youth4Climate, the youth conference on climate, was held in Milan: an event organized by the Italian government. The latter is organizing the UN's annual climate conference, COP26, together with Great Britain for 2021. At Youth4Climate, four hundred young people from all over the world, two per country, will discuss the climate crisis and how to deal with it. ISPRA participated at the summit. https://www.mite.gov.it/pagina/towards-cop26-pre-cop-and-youth-event-youth4climate-driving-ambition https://youth4climate.live/	400 young people participated
LEGAMBIENTE	**#I support Climate Change Campaign** ongoing	Legambiente's new campaign, developed with the support of the Clean Air Task Force, was created with the aim of turning the spotlight on a subject as unknown as it is important: that of direct dispersion of methane gas into the atmosphere. https://changeclimatechange.it/campagne/	
ISPRA	**Tales of Biodiversity - Cycling and Climate Change** May 2022	An event organized by ISPRA to explore the forest ecosystem by bicycle. A video of the trip was produced. A boy meets ISPRA experts who ride their bicycles through one of the 200 sites of the Natura 2000 network in Italy. Together they saw how it is possible to explore the forest ecosystem in a sustainable way by following protected paths and green areas. Finally, the two researchers took stock of the problems relating to climate change and indicated some actions to be followed to mitigate its effects. https://www.isprambiente.gov.it/en/news/tales-of-biodiversity-cycling-and-climate-change	403 visualizations of the video

ISPRA-SNPA	**ECO@ATLANTE on Climate Change** June 2022	A virtual tool realized by Ispra and SNPA to promote climate awareness among citizens. Eco@Atlante has a dedicated session to climate change. This tool allows to access information, to know and discover, visualize and share environmental information at national and local level. It is addressed not only to experts but also to non-experts and beginners in environmental topics. https://www.snpambiente.it/2022/06/06/cambiamenti-climatici-una-mappa-tutta-mia/	
ISPRA	**Castelporziano for biodiversity: 30 years after Rio National Conference on Sustainable Development** Rome 22 June 2022 Tenuta di Castel Porziano	The "Charter for biodiversity education" was presented at the Presidential Estate of Castelporziano, in Rome The document aimed to promote innovative training courses and the commitment to spread a culture of sustainability oriented towards respect for nature and a conscious use of the planet's resources. ISPRA was present at the event with dissemination and environmental education products and a photographic exhibition. https://www.isprambiente.gov.it/en/news/castelporziano-for-the-biodiversity-30-years-after-rio	Event in streaming live: 1.047 visualization
University of Torino – UNITO	**Da clima a fondo podcast** 28 June 2021	This podcast has been awarded Menzione Speciale "Rossella Panarese" Climate Change Communication Award 2021. The goal, as the title "FROM climate to bottom" suggests, is to tell everything there is to know about the climate crisis in order to understand it and learn how to deal with it. The project was selected for its multidisciplinary approach, the attention paid to offering a diversity of voices and perspectives, its ability to transfer information and its technical quality. https://www.unito.it/ateneo/gli-speciali/lessico-e-nuvole/podcast-da-clima-fondo	
CMCC (Euro-Mediterranean Center on Climate Change Foundation)	**Webinar Series on climate sciences** 2018	Set up in 2018, the CMCC webinars series provides multidisciplinary insights on climate sciences and their interactions with socio-economic systems. With speeches and presentations given by experts from the CMCC research divisions and from other world-class institutions, the webinar series aims at involving the public at large in an interactive and comprehensive opportunity for a better understanding of the up-to-date scientific knowledge on climate change and its impact on the society, the environment, and the economics.	Webinar Series

CMCC (Euro-Mediterranean Center on Climate Change Foundation)	**Report "Risk Analysis. Climate Change in Italy"** 2020	The report contains the most up to date and advanced knowledge of the impacts and integrated risk analysis of climate change in Italy. The analysis was carried out by a team of 30 experts from CMCC. The analysis starts from climate scenarios that, through an advanced use of high-resolution climate models applied to the study of the Italian context, provide information on Italy's future climate. This information is then applied to risk analysis for a number of sectors of the Italian socio-economic system. What emerges is a framework where, in the coming decades, risk grows in many areas with significant economic and financial costs for the country. Furthermore, the impacts will affect disadvantaged members of society more severely and also involves all sectors, not least of which infrastructure, agriculture and tourism. https://www.cmcc.it/it/analisi-del-rischio-i-cambiamenti-climatici-in-italia	DOI: 10.25424/cmcc/analisi_del_rischio
CMCC (Euro-Mediterranean Center on Climate Change Foundation)	**G20 climate risk atlas** 2021	The study provides climate scenarios, information, data and future changes in climate across the G20 countries. A science-based tool that sheds light on the risks faced by the biggest economies, designed to support decision-making for well-informed climate action. The G20 Climate Risk Atlas is composed by 20 country factsheets featuring maps and infographics: a comprehensive picture of the most updated scientific knowledge on climate, associated risks, and impacts on the economics, the environment and the societies. https://www.g20climaterisks.org/	DOI: 10.25424/cmcc/g20_climaterisk
CMCC (Euro-Mediterranean Center on Climate Change Foundation)	**Report "Risk Analysis. Climate change in six Italian cities"** 2021	The report, prepared by CMCC, contains an integrated risk analysis aimed at providing information on the expected scenarios for six of Italy's largest cities and how they are preparing to cope with the expected risks. This study aims to provide a further scientific contribution to support the decision-making process of dissemination and dissemination of information to raise awareness on the issue of climate change risk in our cities. The report offers an up-to-date analysis of the climate, impacts, risks and tools that Bologna, Milan, Naples, Rome, Turin and Venice are equipping themselves with. For each of the six cities, the report proposes four specific sections: • Climate (future scenarios with very 2km resolution data) • Climate impacts • Risk assessment • Adaptation tools in place https://www.cmcc.it/it/rischio-clima-citta-2021	DOI: 10.25424/cmcc/analisi_del_rischio_2021

9.4 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 the Italian Ministry of Environment and Energy Security.

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 like coastal erosion. 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 a win-win participatory process to increase resilience of citizens to climate change.

Climate Change is one of the most selected topics for citizen science initiatives and projects and very often it results together with other topics like marine environment and biodiversity with the aim of raising awareness on the effects of climate change on marine ecosystems and on flora and fauna (biodiversity). Citizens are directly involved in the activities through the collection of information, instrumental measurements and the reporting of events while the passive participation of citizens consists often with the keeping (housing) of measuring instruments or other participative techniques. Most of citizen science projects requires a technical preparatory training, the collection of data is the prevalent activity in Citizen Science projects and initiatives. Data are often provided through websites or with specific Applications for mobile phone and devices and in some cases, they are reusable and easy to upload. This type of participation allows to replicate initiatives also in other contests and on different scales, regional or local for example as in the case of specific monitoring.

The replication of citizen science initiatives over the time is aimed at enhancing communicating and awareness raising of public opinion on climate change issue. However, one of the challenges which emerge from the participation of different players in citizen science initiatives is the promotion and in some cases, the verification of the scientific correctness and accuracy of information collected by citizens with measuring systems which are not the reference ones according to the regulations of the sector. On the other hand, among the opportunities to be seized, citizen science represents a formidable ally to encourage and close the gap between citizens and Institutions and to develop environmental policies including the change of lifestyles and the active participation of citizens committed to take care of their environment.

Concerning bottom-up 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 of the Ecological Transition. A national observatory has been launched, within the Ministry of the Ecological Transition to monitor and promote these instruments, and to trigger their potential contribution to the implementation of the measures identified at the basin level.

Public is also actively engaged through the participation to competitions, and it is worth to mention among them in 2021 the First edition CMCC Climate Change Communication Award "Rebecca Ballestra". It is an international competition promoted by the CMCC Foundation – Euro-Mediterranean Center on Climate Change to showcase and reward the best communication initiatives that spread awareness on climate change. With the CMCC Climate Change Communication Award "Rebecca Ballestra", the CMCC Foundation

launched a global platform that collects and rewards the best projects dedicated to communicating the greatest challenge of the coming decades and it received 150 applications. The projects of the first edition came from a large variety of countries and contexts, drawing an inspiring landscape of initiatives innovating climate change communication through various forms of art, theatre, video making, music, photography, journalism, gaming, education, data visualization, and the use of digital channels and tools.

The principle of inclusion is a key and essential element of the 2030 Agenda. The National Sustainable Development Strategy (SNSvS) adopted by the CIPE with Resolution 108/2017 and published in the Official Gazette (GU no. that the Ministry of Environment and Energy Security ensures the functioning of a Forum on the Sustainable Development Strategy open to civil society and experts in the various subjects, with multilevel consultations. To this end, the Ministry has created the Forum for Sustainable Development.

In December 2019, the Ministry of Environment and Energy Security organized and hosted three days of preparatory work dedicated to the operational start-up of the Forum's working groups. A specific moment was dedicated to the active participation of schools and youth organizations, mobilized on sustainability issues, also with the aim of stimulating their direct involvement in the operational management of working groups. On this occasion, the opportunity emerged to provide a "moment dedicated to young people" as part of the annual conferences that are an integral part of the Forum's work.

The Forum qualifies as a shared workspace where the subjects and practices of sustainability can emerge and affirm, according to a process of meeting public policies with social energies, having as reference the operating mode of the Multistakeholder Platform established on the initiative of the European Commission in 2017. The general objective of the Forum is to accompany the implementation of the SNSvS (and the 2030 Agenda) through the active contribution of the actors who promote actions and policies in favor of sustainability.

In parallel to the three-year SNSvS review process, the Ministry also launched the Project on "Policy coherence for sustainable development: integration of the sustainable development goals in Italian decision-making processes "(PCSD), with the aim of facilitating the inclusion of the various state and non-state actors, in the definition of a national action plan for the coherence of policies for the sustainable development, as a cornerstone of the implementation of the SNSvS.

In order to support the territorialization process and the implementation of the SNSvS, the Ministry of Environment and Energy Security has promoted several initiatives as part of the project "CReIAMO PA - Skills and Networks for Environmental Integration and for the Improvement of Public Administration Organizations", funded by the PON Governance and institutional capacity 2014-2020, the creation of a specific line of intervention (L2WP1) dedicated to the activities of "Implementation and monitoring of the 2030 Agenda". The project, which began in 2018, has a total duration of over five years.

The main objective of this line of intervention is to accompany the implementation of the strategic plan of the 2030 Agenda, as defined by the SNSvS, at national, regional and local level.

The ativities of the project are aimed at creating networks for a continuous comparison on sustainable development issues and sharing methodologies, solutions and experiences useful for overcoming criticalities encountered in the process of defining and implementing regional / provincial strategies and metropolitan agendas for sustainable development, thus creating a "network of activators", configured as a learning and permanent exchange community.

All the Regions, the 2 Autonomous Provinces and the 14 Metropolitan Cities have joined the training courses dedicated to the administrations. Furthermore, during the reprogramming phase, the activity was expanded to involve the members of the National Forum for Sustainable Development. ISTAT (National Institute of Statistics), ISPRA, and CISIS (Interregional Center for Geographic and Statistical Information Systems) have been involved in the accompanying paths to regional and provincial administrations on the topic of sustainability indicators; Agency for Territorial Cohesion and Evaluation and Analysis Unit for the planning of the Department of Cohesion Policies, for the integration of strategies with the programmatic process of the 2021/2027 period.

The accompanying paths to metropolitan cities were, on the other hand, developed in conjunction with ANCI and in synergy with the activities carried out as part of the **"Strategic Metropolis" project** financed by the PON Governance and institutional capacity. Furthermore, the Ministry of the Environment has signed

a collaboration agreement with the University of Roma Tre (lead partner), in partnership with La Sapienza and Tor Vergata, for scientific support to the work of the Forum and of the Discussion Tables activated with the Regions and Autonomous Provinces, as well as with metropolitan cities as part of the L2WP1 project. A collaboration is also active with the European Sustainable Development Network (ESDN) aimed at sharing and exchanging experiences with the Member States, within which two workshops funded by L2WP1 aimed at central administrations and regional.

Finally, with regard to the public participation to the drafting of the National Communication itself, even if it has not been subject to a wide open and specific consultation, it has involved the main key stakeholders for providing with data and information since the very beginning phase of the redaction, sharing point of view and contributions. The National Communication itself is part of a shared and consolidated methodology approach which considers mainly the involvement of institutional stakeholders at national and local level as in the case of the National System for Environmental Protection composed of 19 Regional and 2 Province's Environmental Protection Agencies, under the chairmanship of ISPRA.

The following table provides some examples of actions for promoting and facilitating public participation on climate change policies and related measures.

Public participation: list of some initiatives carried out since 2018

Organisation / Promoter	Name of the activity	Short Description	Indicators/Numbers
CMCC (Euro-Mediterranean Center on Climate Change Foundation)	**Climate ChangeCommunication Award "Rebecca Ballestra" Since 2021 every two years**	The **CMCC Climate Change Communication Award "Rebecca Ballestra"** showcases and promotes the best communication initiatives that spread awareness on climate change through education, advocacy, media production and social engagement activities. Every two years, CMCC launches a call for proposals to collect the best climate change communication projects, which are evaluated by a jury composed of highly qualified members representing the multidisciplinary nature of climate change communication. **The 1st edition** of the Award concluded with the Award Ceremony "Voices of the transition. Climate change communication for a sustainable future", held in Milan on September 30, 2021. The sculptures of FutureSHORELINE have been awarded as the best climate change communication project. It was organized under the patronage of the Italian Ministry of Environment and Energy Security, Consulat Honoraire de Monaco à Venise, Ca'Foscari University of Venice, All4Climate Italy 2021 and Rai per il Sociale, in partnership with BASE Milano, and in the context of the Sustainable Development Festival 2021 promoted by ASVIS. Media Partners: TGR and Rai Radio3. The initiative included a series of 4 live streaming events "Seeds. Words that feed the future": dialogues with experts on ideas and innovations to communicate and face the climate transition. **The 2nd edition** of the Award takes place in 2022-2023 and kicks off with the launch event "Foresight Deep into the Future Planet: climate narratives and media" held at COP27 in Sharm El-Shaikh on November 11, 2022. https://www.cmccaward.eu/winner/ cmccaward.eu	**1st edition:** 150 candidats, 108 admitted projects, from 30 countries 4 digital events 1 award ceremony 1 launching event

Italian Ministry of Environment and Energy Security	**Forum on the Sustainable Development Strategy** 2019	The Forum qualifies as a shared workspace where the subjects and practices of sustainability can emerge and affirm, according to a process of meeting public policies with social energies, having as reference the operating mode of the Multistakeholder Platform established on the initiative of the European Commission in 2017. The general objective of the Forum is to accompany the implementation of the SNSvS (and the 2030 Agenda) through the active contribution of the key actors who promote actions and policies in favor of sustainability. Call for interest	The forum is composed of more than 170 realities of civil society. From network organizations, to environmental associations, to the voluntary sector,
Italian Ministry of Environment and Energy Security – OECD project, as part of the 2017-2020 Structural Reform Support Program	**"Policy coherence for sustainable development: integration of the sustainable development goals in Italian decision-making processes "(PCSD)** 2018-2020	The project aims to facilitating the inclusion of the various state and non-state actors, in the definition of a national action plan for the coherence of policies for the sustainable development, as a cornerstone of the implementation of the SNSvS. https://www.mite.gov.it/notizie/sviluppo-sostenibile-relazione-2020-e-avvio-del-processo-di-revisione-della-strategia	This path involves central and territorial administrations, research centers and civil society.
Italian Ministry of Environment and Energy Security	**"CReIAMO PA - Skills and Networks for Environmental Integration and for the Improvement of PA Organizations"** 2018	The main objective of this line of intervention is to accompany the implementation of the strategic plan of the 2030 Agenda, as defined by the SNSvS, at national, regional and local level. Activities of the project are aimed at creating networks for a continuous comparison on sustainable development issues and sharing methodologies, solutions and experiences useful for overcoming criticalities encountered in the process of defining and implementing regional / provincial strategies and metropolitan agendas for sustainable development, thus creating a "network of activators", configured as a learning and permanent exchange community. Social communication channels	All the Regions, the 2 Autonomous Provinces and the 14 Metropolitan Cities have joined the training courses dedicated to the administrations.

Lazio Region CMCC (Euro-Mediterranean Center on Climate Change Foundation)	**Regional Climate Adaptation Strategy** as part of the Regional Strategy for Sustainable Development 2022	The Lazio Region is working on the integration of a Regional Adaptation Strategy into the broader Regional Strategy for Sustainable Development. The CMCC was consulted both for the analysis of the present and future climate, and for supporting the consultation process to draft the main elements of the document: areas of interest, objectives and lines of action. The process was participatory, with the organisation of thematic focus groups, webinars, internal coordination meetings The project builds on the previous experience of participatory policy development carried out with the Focus Groups and the Webinars of the Regional Sustainable Development Strategy pathway, also carried out in collaboration with CMCC. https://www.lazioinnova.it/news/strategia-di-sviluppo-sostenibile-il-contributo-alladattamento-ai-cambiamenti-climatici/	
Molise Region CMCC (Euro-Mediterranean Center on Climate Change Foundation)	**Regional Climate Adaptation Strategy** as part of the Regional Strategy for Sustainable Development 2021-2022	The Molise Region is developing a Regional Climate Change Adaptation Strategy to be integrated into the Regional Strategy for Sustainable Development. The CMCC offered scientific support, both for the analysis of present climate and future scenarios, and for supporting the development of the document in a participatory manner. In particular, internal coordination within the regional administration was foreseen, as well as the involvement of external stakeholders, both to listen to their requests and to raise their awareness of climate change and adaptation. To Know more	
Municipality of Brescia CMCC (Euro-Mediterranean Center on Climate Change) Ambiente Parco Parco delle Colline	**"Un Filo Naturale" Project** Co-funded by Fondazione Cariplo 2021- ongoing	"Un Filo Naturale" aims at developing and implementing a "Climate Transition Strategy" for the city of Brescia The Climate Transition Strategy (approved in 2021) aims at achieving greater urban and social quality. It deploys about thirty pilot actions aimed at producing and enhancing strategies of adaptation, mitigation and resilience of the city, while also pursuing the wellbeing of its citizens. The project is built on an inclusive and participatory approach: citizens, stakeholders and policy makers are constantly engaged in the implementation of adaptation and mitigation actions. Actions in the Strategy include awareness-raising, climate literacy, activation of schools and young citizens. To Know more	

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 2018-2019-2020-2021-2022 (twelfth edition)	**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 of 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. Local sections of national organizations, regional associations and local groups participate to the campaign. http://iononrischio.protezionecivile.it/en/homepage/	103 cities where the campaign is carried out 751 organisations participate to the campaign
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 2018,2019,2020,2021,2022	Energy Saving Day is an annual national communication campaign dedicated to energy saving policies. It was launched for the first time on February 16th, 2005, sponsored by the Ministry of the Environment 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. The 18th Edition of the campaign was held on 11 March 2022 and focused on the propositive and transformative role of bicycle and plants and launched the project "A tree for the future" considering the plant of 50.000 trees in ten years with the aim of creating a widespread wood through Italy. Storia di M'illumino di Meno | Caterpillar | RaiPlay Sound http://caterpillar.blog.rai.it/milluminodimeno/	50.000 trees to be planted within 10 years
Coalizione Clima	**Climate March** Rome, St. Peter's Square 4 october 2018	The Climate march was organized ahead of the beginning of COP24. The initiative was promoted by the Coalizione Clima, an Italian coalition of over 200 members including NGOs, movements, youth organizations, trade unions and other entities https://www.coalizioneclima.it/cammino-clima-cs/	More than 200 organisations participating

Legambiente and the Italian Glaciological Committee	**The Carovan of glaciers Campaign** 17 August 3 September 2020-2021-2022	It is a journey organized by Legambiente at high altitude to testify the dramatic speed of glaciers retreat due to climate change. At each stage monitoring activities and events are organized stimulating a wide reflection on the future of the mountain and the Planet. https://www.legambiente.it/campagne-in-evidenza/carovana-dei-ghiacciai/	
ISPRA, AMP Egadi Islands	**Ecological beach and sustainable tourism Event** September 2021	This event organized by ISPRA within the projects BARGAIN, Med. Dé.Co.U.Plages and CoastSnap included a scientific workshop with citizens together with education activities on beached Posidonia and citizen science activities on the monitoring of the coastal environment with the direct participation of tourists and citizens through fixed coastsnap stations. Coastsnap is a global "Citizen Science" project to involve citizens in scientific research on the accretion and erosion of beaches. CoastSnap engage local community and tourists to capture images, using a simple installation comprising a holder for smartphones to ensure all pictures are taken from the same angle and position. The photos can be shared via social media (Twitter, Instagram, Facebook) or email, noting the date and time of the photo. All photo authors will remain anonymous. The project provides specially designed smartphone holders at fixed "CoastSnap stations" where anyone can place their smartphones to take a picture of the beach from a known, fixed location and orientation. All photos are collected into one large set, to be used by researchers to map the growth or erosion of target beaches The long-range datasets being collected by CoastSnap gives scientists and managers a much deeper understanding of coastal erosion and the impact of climate change. https://www.isprambiente.gov.it/files2021/eventi/favignana/programma-attivita-a4-ita.pdf	

9.5 Training

The training offer in Italy is nowadays very diversified and spread throughout the Italian territory from North to South of the peninsula: more and more widespread 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 2018, an Institutional Agreement was signed between ISPRA and Ministry of Environment, with the general aim to promote actions to strengthen the quality of the educational services in the Regional EES Systems, being part of the National Programme for Environmental Education, Information and Training (IN.F.E.A.), also by means of a better cooperation between Regional Systems and the SNPA Agencies in environmental and sustainability education activities. The realization of a training course, aimed at strengthening the professional competences of Environmental Regional and SNPA Educators, was proposed to the Ministry by ISPRA. It can be considered the first experimental attempt of a Training Course at

national level, addressed to this professional category.

The **Training Course "Environmental Education for Sustainability: competences learned; competences acted"** has been carried out in 2020, under the coordination of ISPRA and the collaboration of some Environmental Regional Agencies (Emilia Romagna, Friuli Venezia Giulia, Campania and Sardinia) together with experts of the Italian Association for Sustainability Science and of the Green University NGO of Bologna. Originally, the course was planned as a blended course, combining an e-learning phase on the learning platform of ISPRA (asynchronous training) and two face-to-face Training Laboratories, which were aimed at providing participants with practical and collaborative experiential learning, to deepen the training contents and to train to the use of self-evaluation tools. Due to the covid-19 emergency, the face-to-face activities were changed in four online Laboratories (eight hours of synchronous training). About one hundred participants attended the Training Course. The learners were from Environmental Education Centres, NGOs, Associations, Regional Offices and Environmental Agencies of SNPA.

Within the National System for Environmental Protection, the Environmental Regional Agencies (ARPAs) and ISPRA carry out specific training courses to promote technical information and increase specialist knowledge in the field of prevention, mitigation and adaptation to climate change.

Among the partnerships signed by the Youth4Climate initiative, already mentioned in the previous paragraph "Public Awareness", in order to to support the activities and the global youth mobilization, the Italian Ministry of Environment and Energy Security subscribed a memorandum of understanding with the United Nations Secretariat on Climate Change (UNFCCC) (https://unfccc.int/topics/capacity-building/workstreams/youth4capacity), to establish a capacity building programme open to all young people with particular reference to those from developing countries.

The aim of this new program called **"Youth4Capacity"** is to help develop the capacities of young people on climate change, also seeking to address the links between climate action and the implementation of the Sustainable Development Goals and the three Rio Conventions, in order to provide young beneficiaries with the capacity and knowledge to develop and implement actions in support of integrated and complementary approaches to support climate action in the context of sustainable development.

The programme has been officially presented and launched on August 31, 2022, in Libreville, Gabon on the occasion of the Africa Climate Week organized by the local government in collaboration with UNFCCC, UNDP and World Bank, in order to achieve the above objectives, focusing on the following activities which will be designed and implemented by the UNFCCC secretariat with the contribution of the Italian Government:

a) **Targeted virtual events, webinars or training sessions**, to be developed in collaboration with international and regional partners and, where appropriate, in collaboration with the PCCB and its network and in the context of the Glasgow work program on Action for Climate Empowerment. These events would also allow for a greater understanding of the actual needs and capacity gaps of young people in different regions and would provide a space for the exchange of lessons learned and experience on capacity building between representatives from the global south, together with actors from the north. of the world, with the premise that there are opportunities for mutual learning and capacity building among young people in developing and developed countries.

b) **Capacity building events in person** during Regional Climate Weeks and other relevant events organized by the UNFCCC Secretariat. These could be training sessions structured around the main topics, tools, technologies, etc. at the regional level over a series of days. These events could also benefit from collaboration with the Paris Committee for Capacity Building (PCCB) and its network and relevant activities being implemented under the Glasgow Work Program on Climate Empowerment Action.

c) **A "Tutoring Program", in collaboration with the Youth4Climate Initiative**, developed by the Italian Government in collaboration with UNDP, aimed at putting young people in contact with experts from non-party stakeholders through Ted Talk in person and / or virtual methods, where young people will be able to gain first-hand insights, knowledge and inspiration from experts representing various sectors such as the private sector, influencers, NGOs, academia, research organizations, etc. This mentoring program would benefit from the network and work already undertaken by the UNFCCC Secretariat as it relates to global climate action.

d) **The design and implementation of awareness channels**, to promote the theme of the fight against

climate change, activities relevant to strengthening the capacities of young people, including, but not limited to, the Youth4Climate initiative through social media, to provide a space for young people from the north and south of the world and other actors to exchange experiences, lessons and knowledge on capacity building.

In the table below are listed many of the Master Degrees, PhD Programmes and training initiatives promoted in Italy organized by Italian Universities as well as some relevant training events promoted by key national institutions.

Training: list of some initiatives carried out since 2018

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** 2008 ongoing	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. https://www.cmcc.it/sc hool_type/cmccgraduateprograms https://www.cmcc.it/sc hool_type/schools	

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	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. http://www.unive.it/nqc ontent.cfm?a_id=124319	
Italian Ministry for the Environment, SIOI	**Scholarships –** 2016/2018	The Italian Ministry for the Environment, funded 8 scholarships for a master degree on Sustainable development, geopolicy of resources and arctic studies" to the Italian Society for the International organization (SIOI)	8 scholarships
Molise Region (Department II - Regional Phytosanitary Service, Protection and Enhancement of Forest and Mountain Biodiversity and Sustainable Development)	**CReIAMO PA project** "Competences and Networks for Environmental Integration and the Improvement of Public Administration Organisations" - Line of Intervention 5 "Strengthening Administrative Capacity for Adaptation to Climate Change November 2019	CReIAMO PA Project, articulated in nine Lines of Intervention, provides innovative paths for strengthening the administrative capacity and technical skills of the actors involved in the integration of the principle of environmental sustainability in the actions of the Public Administration; Among the above-mentioned Lines of Intervention is Line 5 'Strengthening Administrative Capacity for Adaptation to Climate Change', expressly dedicated to strengthening the administrative capacity and technical skills of the Regions and Local Authorities in the area of climate change. It aims at spreading at regional and local level the culture of adaptation to climate change, to overcome, starting from the activation of a multilevel governance pathway, regional and local disparities in the implementation of climate change adaptation pathways. The Molise Region formally adhered to the activities of Line 5 of CReIAMO PA on 5 November 2019 (through the signing of a specific "letter of adhesion" prot. no. 0014550 of 05/11/2019, transmitted to the MASE by the Molise Region's Department II - Regional Phytosanitary Service, Protection and Enhancement of Forest and Mountains, Biodiversity and Sustainable Development), participating since 2018 in the various line initiatives and developing a constant comparison also with the other Regions active on the topic of climate change adaptation. https://www.mite.gov.it/pagina/iniziative-e-progetti-supporto-dell-attuazione-della-snsvs-progetto-creiamo-pa	Elaboration of methodological documents at regional and local scale for the definition and implementation of climate change adaptation plans/strategies, dissemination and training for regions and local administrations through territorial workshops, summer schools and coaching

University of Padua Centro Studi Qualità Ambiente (CESQA)	**Master in Strategic Environmental Management GAS** 2018-2022	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. http://cesqa.eu/	
Politecnico di Milano University	**Master Degree in Environmental and Land Planning Engineering** Milan, A.Y. 2018-2022	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. http://www.polinternational.polimi.it/educationaloffer/laureamagistraleequivalenttomasterofscienceprogrammes/environmentalandlandplanningengineering/	
Roma Tre University	**Master Degree in Environment and Development Economics** Rome, A.Y. 2018-2022	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 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. http://dipeco.uniroma3.it/default.asp?contenuto=academicyear20172018	
Alma Mater University of Bologna	**Master Degree in Resource Economics and Sustainable Development (RESD)** Rimini, A.Y. 2018-2022	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. http://corsi.unibo.it/2cycle/ResourceEconomicsSustainableDevelopment/Pages/default.aspx	

University of Turin	**Master Degree in Economics of the Environment, Culture and Territory** Turin, A.Y. 2018-2022	The course is aimed at developing specific expertise on global changes, including climate and biodiversity, urban pollution, energy, water, demography, natural resources management etc. https://en.unito.it/degree/courses/economicsenvironmentcultureandterrit ory	
LUMSA University of Rome	**MSDG Annual MSc in Management of Sustainable Development Goals** "Economic Growth, Demography and Climate Change"	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 http://www.lumsa.it /corsi_master_primo_livello_msdg http://www.lumsa.it /sites/default/files/didattica/master/171 8/call_for_application_MSDG.pdf	

Rete Clima® Clima Network (Information and action for sustainability and the fight against climate change)	**Environmental education and Environmental training on climate.** 2011 ongoing	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. http://www.reteclima.it/ educazioneeformazioneambientaleclimatica/	
ARPA Veneto	**Training Seminar "Presentation of projects results on Climate Change"** 2022	Overview of the projects in which ARPAV participates on the theme of climate change in order to share and disseminate the results, tools and methodologies.	Total hours: 3 Participants:50
ARPA Veneto and WMO	**Training course "Climatology and Climate Change"** 2021	The course is organized in 7 modules dealing with general and descriptive climatology, databases and data analysis, coastal climatology, climate variability and climate change, extreme events, climate modelling and services, adaptation, mitigation and Policies on climate.	Total hours: 39 Participants:50
ARPA Veneto and Ca 'Foscari University	**Training course "Agenda 2030"** 2020	The course provides an interdisciplinary approach on the topic of sustainable development through an in-depth study of the 17 Goals of the UN Agenda 2030 for Sustainable Development. The course is divided into 4 training units: what is Sustainable Development and what is the international commitment on this issue (Agenda 2030); reduce poverty, hunger and guarantee everyone the right to care, quality education and gender equality; natural capital, climate change and energy; economy and innovation, jobs, cities and sustainable communities	Total hours: 14 Participants:13
ARPA Veneto and Politecnico di Milano	**Training course "Introduction to climate change, greenhouse gas inventory and impact mitigation tools"** 2020	Overview of the latest international and European policies on climate change. Develop of knowledge on investigation (support for regional planning, VAS and VIA), on some tools to carry out an initial assessment of the impact of anthropogenic activities on the climate and on possible mitigation measures.	Total hours: 11 Participants: 46
ARPA Veneto	**Training course on "Climate and climate change"** 2019	Provide Knowledge elements for the Agency technicians on the climate change topic on a global scale and on the effects observed in recent years on the regional territory.	Total hours: 4 Participants: 60

ARPA Veneto	**Training course "Definition of extreme weather events"** 2018	Training and professional updating of technicians, meteorologists and climatologists of the Regional Department for Territory Security for their activity of evaluating the probability of occurrence (or return times) of extreme weather events	Total hours: 4 Participants: 37
ARPA Lazio/Regione Lazio	**Training course "Green Manager"** Edition 1 2018 Edition 2 2019 Edition 3 2020	Introduction of the role of Green Manager by training qualified professionals who, building on their technical and managerial expertise and competence, can develop relevant skills so as to interact with the top management of complex organizations in order to promote and carry out all possible actions targeted at environmental sustainability; waste reduction through waste sorting and full recycling of discarded materials; green purchasing, and water and energy saving strategies.	Edition 1 2018: Total hours: 70 Participants:32 Edition 2 2019: Total hours: 70 Participants:24 Edition 3 2020: Total hours: 70 Participants:34
Friulian Museum of Natural History	**Training course "Climate changes in FVG: from evidence to future scenarios** 2018	Training on global change addressed to teachers. Lesson about climate change in teachers' training course School teachers. This course foucuses on global climate change, causes, impacts, solutions and provides some ideas on perception, communication, needs and resources for teaching.	
University of Udine	**Lesson "Climate change: challenges and opportunities for Italy and Friuli Venezia Giulia"** 2019	Lesson about climate change addressed to economy students.	
ComPA Friuli Venezia Giulia	"Training **Course Local administrators for sustainable development"** 2021	Lesson about climate change and land management, included in a training course addressed to local administrators and local public authorities.	
Ministry of Environment and Energy Security - CReIAMO PA projects - Line 5 ARPA Friuli Venezia Giulia	**"Autumn school: public management of adaptation to climate change - the regions"** 2021	Two lessons on the structure and services of ARPA FVG on climate.	
Arpa Friuli Venezia Giulia	**Training course "Climate change in Friuli Venezia Giulia: from evidence to future scenarios"** 2021	The course, addressed to Public authorities, NGOs, high school students and teachers, companies, citizens, provided participants with a base knowledge on the topic of climate change, useful for understanding what is happening in our territory and in the rest of the world. The phenomenon causes, its effects and the actions to deal with it. The basic concepts and terminology, some cognitive elements useful for undertaking local adaptation paths. Notions, concepts, specific terminologies, methodological references to facilitate the participants in finding and interpreting climatic information.	Total hours: 2 h Participants: 97

University of Trieste	**Lesson "Climate changes in the Friuli Venezia Giulia"** 2022	Lesson about climate change for geology students.	
University of Udine	**Lesson "The climate changes in Friuli Venezia Giulia. From evidence to future scenarios, from local to global: knowledge and references at the basis of climate action"** 2022	Lesson about climate change for engineering students	
NAHR Workshop Milano -Lombardia	**Workshop "Monitoring of snow water equivalent. Water: vital flux, energy in transformation"** 2018	Water content of snow (Snow Water Equivalent, SWE) allows to know the total amount of water stored in the snow and its spatial distribution. This parameter is very important in the hydrological balance, because it represents a water reserve that has a slow and gradual release capacity	
ARPA Lombardia – Scuola per l'ambiente della Lombardia	**Seminar "Climate change: scientific evidence, international agreements and national and regional commitments, mitigation and adaptation scenarios with a view to possible contributions from local communities"** 2019	Provide administrators and technicians with information on the latest scientific evidence relating to the effects of sudden changes in the climate due to various factors and with a significant impact on territories and local communities	
ARPA Lombardia - Comitato Direttivo ARPA Lombardia	**Workshop "Climate change in Lombardy"** 2019	Analysis of the current climate trend in Lombardy.	
ARPA Lombardia - Scuola per l'Ambiente della Lombardia	**Seminar" Deglaciation: the impact of climate change on the availability of water reserves"**2019	Analysis of the effects of climate change on the Lombard glaciers and on the water reserve	
ARPA Lombardia	**Seminar "Climate change: scientific evidence, mitigation scenarios and objectives of the Paris Agreement"**	Highlights of the scientific evidence on climate change and the Paris agreement.	

	2018		
ARPA Lombardia, INFN Osservatorio Brera	**Seminar "Milano Brera: the centennial weather observatory"** 2022	The history of the Milan Brera weather station, active since 1763, and the analysis of its historical series. The climatic stripes of Milan and the record summer 2022.	
ARPA Campania	**Training course "Quantitative monitoring of groundwater: from theory to norm, to field practice"** 2018	Provide learners with theoretical and regulatory knowledge regarding sampling practices for quantitative monitoring of underground water bodies.	Total hours: 14 h Participants: 16
ARPA Campania	**Training course "Update day on CEMEC activities for the evaluation of the wind regime"** 2018	Provide learners with the necessary knowledge to evaluate the weather conditions in the field with the help of CEMEC products and portable instrumentation, with an in-depth study on the wind regime.	Total hours: 4 h Participants: 21
ARPA Campania	**Training course "Education and training on ordinary, preventive and corrective maintenance activities, calibration of measuring instruments in the context of air quality monitoring"** 2019	Training to update learners' knowledge on the applications used in the operational processes of maintenance, assurance and quality control of the measuring instrumentation present in the air quality monitoring network.	Total hours: 16 h Participants: 8
ARPA EMILIA ROMAGNA	**3 videos lessons on climate change** February 2019	Presentation of 3 video lessons in English that introduced some basic concepts on climate change, produced as part of the European Erasmus + project https://www.snpambiente.it/2019/02/13/da-arpae-tre-video-in-inglese-sul-clima/	First video: 1.472 visualization Second video: 843 Third video: not available
ARPA Campania	**Training course "Detection of marine weather data, training in the correct use of on-board instrumentation"** Editions 2020, 2021, 2022	Training to improve the theoretical and practical skills of learners in the acquisition of marine weather data relating to controls on quality bathing water by on-board instruments.	Total hours: 5 h Participants: 5
ARPA Friuli Venezia Giulia and ARPA Lombardia	**Interagency Seminar "Chemical characterization of atmospheric**	Two days of training on the main data processing techniques aimed both at the chemical characterization of PM10 and at identifying the contribution of the different sources.	Days: 2 Participants:180

	particulate” 2021		
ARPA Marche, SNPA, Municipality of Ascoli Piceno, Polytechnic University of Marche and University of Camerino	**National Seminar "Pollen and climate change: scenarios and perspectives"** 2021	Multidisciplinary seminar to have a complete view of aerobiological science and its applications in terms of environmental issues, health protection, air quality and climate change.	
Arpa Piemonte and University of Turin	**Seminar “The climate Change”** 2021	Periodic seminars on the topics of meteorology and climate, to share knowledge, experiences and research results, create synergies, identify possible joint activities and integrated development lines	Days: 2
Assoarpa, ARPA Marche and ARPA Friuli Venezia Giulia	**“Chemical characterization of atmospheric particulate”**	Study days on the topic of data processing techniques aimed at source apportionment. Analytical experiences during the lockdown. Case studies presented by various agencies.	Days: 2
Ricerca sul Sistema Energetico – RSE, ISPRA and SNPA	**Training course “Polluting emissions”** 2020	Training on the measurement of atmospheric emissions. Conducting evaluation tests – proficiency test – using the RSE LOOP system, a tool that simulates the operation of an industrial chimney and allows you to analyze the gases emitted with greater accuracy. This is a very new technology, available only in a few European countries.	
ARPAE Emilia Romagna	**Webinar “Climate adaptation in the city”** 2022	Webinar within the EU Project Adriadapt aimed at supporting the building of local and regional resilience by developing the knowledge base required to identify and plan appropriate climate change adaptation options.	Days: 2 Participants: 50
ISPRA	**Training course “Impacts, vulnerabilities and adaptation to climate change”** Editions 2019, 2020, 2022	to deepen the aspects related to the impacts, vulnerability and adaptation of climate change.	Total hours: 15 h Participants: 190
Italian Ministry of Environment and ISPRA in in collaboration with ARPAE Emilia Romagna, ARPA Friuli Venezia Giulia, ARPA Campania and ARPA Sardinia	**Training Course “Environmental Education for Sustainability: competences learned; competences acted”**	Training aimed at strengthening the professional competences on environmental education for sustainability, addressed to Regional and SNPA Educators.	Total hours: 21 h Participants: 240
ISPRA	**Path for Transversal Skills and Orientation (PCTO) on Climate change** edition 2021 edition 2022	Through the concepts and basic notions on climate change, the scientific issues will be addressed, also defining the institutional context of reference. Key concepts and definitions will be shared, starting from the analysis of emission sources and their quantification. It will deal with the response strategies, going so far as to analyze the variations of the climate in Italy. Finally, a "Change game" simulation game will be proposed (https://www.changegame.org/it/) developed by the Euro- Mediterranean on Climate Change (CMCC) which will make it possible to ascertain the effects, on planet Earth, of the choices of anthropization.	25 hours asynchronous distance learning Edition 2021: 126 students Edition 2022: 190 students
ISPRA and Higher education institute "G. Veronese - G. Marconi ", Chioggia (Venice) PCTO	**Training course Venice Lagoon - Monitoring of the environmental status (LIFE LAGOON REFRESH)**	This training course deals with the monitoring techniques of a lagoon environment, also through: direct experimentation in the field and the use of tools and equipment that are normally used for different types of sampling, analysis of samples in the laboratory and processing of the data collected during the monitoring activity.	School years 2021/2022 e 2022/2023 20 hours / year 25 students

	2021, 2022		
ISPRA and "Gioeni-Trabia" Nautical Higher Education Institute (Palermo) PCTO	**Climate change and alien species** 2018	Approach to the study of climate change and the phenomenon of the introduction and diffusion of non-indigenous species (alien species) in the Mediterranean, with reference to the main monitoring methods and, in particular, to that based on local ecological knowledge (LEK) with sea operators.	School year 2017/2018 9 students 41 hours
ISPRA and State Classical and Linguistic High School " ARISTOFANE" (Rome) PCTO	**ISP (i) R @ tion - Citizen science and climate change** 2018,2019	Study on sustainability and environmental issues, with particular reference to those related to climate change, through the use of the coding of geographic information systems (GIS).	School year 2018/2019 10 students 24 hours
ISPRA and Université Sorbonne - Paris	**Training course on climate change** 2021	A training course on Indicators for the development of adaptation strategies to climate change	Year 2021 700 hours One internship
ARPA Sicilia – InFEA Sicilia	**Audio-visual workshop (PCTO - path for transversal skills and orientation)** 2022	Audio-visual workshop "AGENDA 2030 FOR A SUSTAINABLE AND LASTING DEVELOPMENT" for students of the "Archimede" State High School in Acireale (CT) - The aim of the project is to address some issues of the 2030 Agenda by making a documentary with the support of cinema experts (script, editing and direction). Topics: marine-coastal pollution and migrants. Documentaries realized: "Sons of the same sea" and "Between land and sea". The documentaries made by the students (14) with the support of the teachers (Liceo Archimede - Acireale - Catania) were presented at the XIV edition of the SiciliAmbiente Film Festival (https://www.festivalsiciliambiente.it), namely the documentary "Sons of the same sea" was selected for the closing screening of the festival https://www.arpa.sicilia.it/29754-2/	
Arpa Friuli Venezia Giulia	**Internship Carbon footprint** 2022	Accounting of GHG emissions and ability to apply them to real cases	
Arpa Veneto and University of Padua	**Training courses on metereology and climatology** 2018,2019,2021	Meteorology and climatology: analysis of data from meteorological stations, Weather Climate, Nivo-meteorology and Meteorology.	Year 2021
CMCC (Euro-Mediterranean Centre on Climate Change Foundation)	**CMCC Graduate Programs, Summer and Winter Schools** 2008-ongoing	CMCC Graduate Programs were inaugurated in 2008, in collaboration with five Italian universities: Ca' Foscari University of Venice, Alma Mater University of Bologna, the University of Salento, the University of Tuscia and the University of Sassari. The objective is to promote and coordinate advanced studies on the impacts of climate change and climate policies. The five universities contribute to the Graduate Programs through six 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), Future Earth, Climate Change and Societal Challenges (Alma Mater University of Bologna), Science, Technologies and Biotechnologies for sustainability (Universit	

		of Tuscia), Biological and Environmental Sciences and Technologies (University of Salento) and Complex Systems Engineering (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 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. https://www.cmcc.it/education-programs/graduate-programs https://www.cmcc.it/education-programs/schools	

9.6 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. 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 towards a more systematic approach. Its priorities were directly connected to strengthening the financial support commitments in line with the objectives of the Paris Agreement.

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 project and thus described, when relevant, under chapter 7. The priority actions also for the period 2018-2022 are confirmed to be the promotion of renewable energy and energy efficiency.

Nevertheless as already mentioned in chapter 7, in 2020 following the spread of the Covid-19 pandemic, cooperation activities have come to a temporary halt with initiatives of capacity building and training being postponed and technical missions cancelled because of lockdowns both in Italy and in the partner countries and some of them shifted to virtual modality. The consequences of the pandemic have had a high impact on the overall cooperation.

In the analyzed reporting period of this National Communication the financial resources committed to bilateral cooperation almost doubled. From 2017 to 2020 Italy committed € 116,982,080 to bilateral cooperation (+ 48% compared to the financial resources committed from 2013 to 2016). The funds provided by the environmental cooperation of MASE were focused mainly on three geographical areas: Sub-Saharan Countries, North Africa/Middle East area (MENA) and Small Island Development States (SIDS/PSIDS).

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 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 MASE 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 now Ministry of Ecology and Environment 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.

Since 2003 MASE 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. Between 2019 and 2020, over 600 participants from all the provinces of China took part in the training program, with a total of 24 courses (in Italy and China).

In addition, in 2018 the Sino Italian Capacity Building for environmental protection (SICAB) started. This project ended in 2021 and it was dedicated to high-level training services in the fields of sustainable development and environmental management in the framework of Italy-China bilateral cooperation. The advanced training course provided an in-depth overview of climate change and related global and European policy framework, introducing the main scientific instruments and methods currently available for the production of high-resolution climate scenarios. From February 2018 to December 2021, 28 courses were organized with participants from all the provinces of China taking part in the training program in Italy and China.

In the timeframe 2017–2020, the Sino-Italian Center for Sustainability (SICES), supported by MASE and the University of Tongji (Tongji), was established. The Center aims at enhancing the collaboration between Italian Research centers and Chinese Research center on Greener Cities, to promote research and capacity building in Climate Change Adaptation/Mitigation, Energy Efficiency/Renewable Energy, Resource Efficiency/Circular Economy sectors.

A new phase of cooperation agreements was launched at the end of 2020 in Italy which not only expanded the areas of cooperation but increased importance to aspects like transparency, traceability, efficiency effectiveness and ownwership of the initiatives promoted.

At national level, in 2021 The Italian Ministry of Foreign Affairs and Development Cooperation launched a participative process opened to public and to all citizenship called National Conference on Development Cooperation **"Coopera Conference"** together with the Italian Cooperation Stakeholders and the National Council for the development Cooperation. The Conference Program is the result of close consultation with all Italian Cooperation actors, beginning with civil society organisations and their representative networks (AOI, CINI, and Link2007), and including the National Council for Development Cooperation. The discussions were focused on the most pressing issues with the highest representatives of Italian and international institutions, ranging from food insecurity to poverty, wars and the climate emergency, pandemics, inequalities, and human rights violations.

This Conference was convened by the Ministry of Foreign Affairs in accordance with law 125/2014. **Coopera 2022** focused on the 5 P's of 2030 Agenda of Peace, People, Prosperity, Planet, and Partnership. This

conference provided a meeting and dialogue platform for all stakeholders in the Italian cooperation system. Five primary categories, spawned by the UN 2030 Agenda, are interconnected and, ideally, will provide a gauge of the state of development cooperation and the paths forward, especially in light of two events that have distinguished the last two years: the pandemic and the conflict in Ukraine.

With specific reference to international cooperation activities strictly related to Education, Training and Public Awareness there are nevertheless some bilateral projects worth highlighting.

International cooperation: list of some initiatives carried out since 2018

Organisation/ Promoter	Name of the activity	Short Description	Indicators/Numbers
Italian Ministry of Environment Variuos Chinese Institutions (China)	**Advanced training program on environmental management and sustainable development** **(China)** From 2003 and ongoing	Since 2003 several Italian companies were visited during the study visits. Public and private institutions were involved, with a total of about 1000 speakers. Between 2019 and 2020, over 600 participants from all the provinces of China took part in the training program, with a total of 24 courses (in Italy and China).	over 600 participants between 2019 and 2020 to training programs 24 courses held in Italy and China
Italian Ministry of Environment Polytechnic University of Milan CMCC (Euro-Mediterranean Center on Climate Change) Italy-China Foundation Fondazione Politecnico di Milano Sapienza University of Rome	**SICAB – Sino-Italian Capacity Building for Environmental Protection** 2018-2021	Sicab aims at promoting the exchange of scientific and technological expertise on the issues of environmental management and sustainable development. It foresees a range of courses and academic lectures, as well as field visits and study of best practices. High-level directors and officials, researchers of numerous Chinese institutions are the beneficiaries of this program. SICAB organized 28 courses in the following thematic areas: • Climate change • Sustainable development • Environmental management • Pollution prevention and management (air, water, soil and urban areas) • Waste management and disposal • Green economy cmcc.it/it/projects/sicab-sino-italian-capacity-building-for-environmental-protection	From February 2018 to December 2021, 28 courses were organized

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)	**Italy-Tunisia SeaCrossing Programme CrossBorder Cooperation(CBC)** **European Neighborhood Instrument (ENI)** 2014-2020	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 https://www.italietunisie.eu/programme/objectifs-et-priorites-du-programme/objectif-2-soutien-a-leducation-la-recherche-le-developpement-technologique-et-linnovation/	
Italian Ministry of Environment and Tunisian Ministry of Energy, Mines and Renewable Energy	**Technical Agreement on Climate Change cooperation** 2017 -2022 Amount of founding: 2 MEURO	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 MASE. http://www.minambiente.it /pagina/tunisia	
Italian Ministry of Environment	**MEDREC Mediterranean Renewable Energy Centre** Established in 2004	The MEDREC, based in Tunis, was launched in 2004 by the Italian Ministry of Environment (MASE) 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 MASE. https://www.medrec.org/	

CMCC (Euro-Mediterranean Center on Climate Change Foundation) ENEA	**Interreg Euro-MED Academy** 2022	In the framework of Interreg MED Programme, the thematic projects joined forces to implement an education and awareness-raising initiative on the topics of the cooperation programme, called Interreg Euro-MED Academy. The Academy addresses citizens in the Mediterranean region and offers free courses to support the transition towards sustainability in the fields of energy efficiency, renewable resources, urban transport, tourism, blue and circular economy, creative economy In particular, CMCC and ENEA, as partners of Interreg MED's EFFICIENT BUILDINGS project developed a learning module within the "Green Living Buildings" Learning Programme. The module, aimed at public school administrators and students/citizens, shows how to make a simple but scientifically reliable assessment of a building's energy consumption in order to understand what measures should be implemented to reduce the building's emissions. https://www.interreg-euro-med-academy.eu/	
Italian Ministry of Foreign Affairs and Development Cooperation, Italian Cooperation Stakeholders and the National Council for the development Cooperation	**Coopera 2022 Conference II edition** National Conference on Development Cooperation 23-24 June 2022 Rome	Coopera is the National Conference on Development Cooperation, convened by the Ministry of Foreign Affairs and International Cooperation, in accordance with law 125/2014, focused on the 5 P's of 2030 Agenda of Peace, People, Prosperity, Planet, and Partnership Coopera 2022 served as a dialogue platform for all stakeholders in the Italian cooperation system. Five primary categories, spawned by the UN 2030 Agenda, are interconnected and, ideally, will provide a gauge of the state of development cooperation and the paths forward, especially in light of two events that have distinguished the last two years: the pandemic and the conflict in Ukraine. The conference was opened to the public and to all citizenship. The discussions were focused on the most pressing issues with the highest representatives of Italian and international institutions, ranging from food insecurity to poverty, wars and the climate emergency, pandemics, inequalities, and human rights violations. https://www.conferenzacoopera.it/en/home-eng/	https://www.conferenzacoopera.it/

9.7 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 of Environment 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 of the Environment 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 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 2014-2020.

Within the framework of the Action for Climate Empowerment (ACE) United Nations Framework Convention on Climate Change (UNFCCC) agenda item, it is worth to mention the **ACE Workshop in La Spezia in 2018**, organized in October 2018 by Italy, in collaboration with the UNFCCC Secretariat. A training workshop was held in La Spezia for national ACE focal points from EU countries and those of the Mediterranean area.

On the occasion of the same workshop, the Ministry of Environment also organized a public event open to civil society and the private sector entitled "Achieving the objectives of the Paris Agreement: a global challenge that passes through a local commitment ", open to the delegates participating in the workshop and to Italian civil society, involving representatives of both the private sector and subnational governments. The conference focused on voluntary climate action and the contribution of non-state actors to achieve the objectives of the Paris Agreement. It represented a moment of reflection with national experts and stakeholders on three levels of knowledge: the national and international framework and perspectives; how things change for those who work professionally and how each of us can contribute to sustainable development.

The event was intended to enhance the commitment of the private sector and municipalities in the fight against climate change and was the occasion for the presentation of a report created for the Italian context by the CDP (Carbon Disclosure Project), an international organization with which the Ministry signed a protocol to increase the number of companies that actively monitor and manage their climate-related risks and their impact, inviting 100 of the largest companies and major cities in Italy to answer the CDP questionnaires.

By keeping track of this monitoring, the government aims to stimulate sustainable and low-carbon economic growth, in line with the goal of fulfilling the Paris Agreement, nationally defined contributions (NDCs) and development sustainable goals (SDGs). In addition to the welcome speeches by the Mayor of La Spezia, a representative of the United Nations and the Ministry of the Ecological Transition, representatives of Confindustria, Enea and the Scuola Sant'Anna of Pisa participated in the conference.

Organisation/ Promoter	Name of the activity	Short Description
Italian Ministry of Environment	**Web page dedicated to environmental education within the Ministry's official web site** http://www.minambiente.it/pagina/educazioneambientaleeallosviluppposostenibile	Since 2016 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.
Italian Ministry of Environment	**ACE Workshop in La Spezia in 2018** 2018	Italy organized in October 2018, in collaboration with the UNFCCC Secretariat, a training workshop held in La Spezia and aimed at national ACE focal points from EU countries and those of the Mediterranean area.
Italian Ministry of Environment	**Public event "Achieving the objectives of the Paris Agreement** 2018	It is a public event open to civil society and the private sector entitled "Achieving the objectives of the Paris Agreement: a global challenge that passes through a local commitment ", open to the delegates participating in the workshop and to Italian civil society, involving representatives of both the private sector and subnational governments. This event has been organized on the occasion of the ACE Workshop in La Spezia.