



ISPRA

Istituto superiore per la protezione
e la ricerca ambientale



**Sistema Nazionale
per la Protezione
dell'Ambiente**

NATIONAL GREENHOUSE GAS INVENTORY SYSTEM IN ITALY YEAR 2018

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1. THE UN FRAMEWORK CONVENTION ON CLIMATE CHANGE AND THE KYOTO PROTOCOL

The United Nations Framework Convention on Climate Change (UNFCCC), adopted on 09/05/1992 and entered into force on 21/03/1994, was ratified by Italy in the year 1994 through law n.65 of 15/01/1994. On 11/12/1997, Parties to the Convention adopted the Kyoto Protocol, which establishes legally binding greenhouse gas emission limitation commitments in the period from 2008 to 2012, with reference to 1990 emission levels. Italy ratified the Kyoto Protocol on 31st May 2002 through law n.120 of 01/06/2002. The Kyoto Protocol finally entered into force on 16th February 2005.

The Kyoto Protocol has established emission limitation for Annex B Parties (i.e. industrialized countries and countries with economy in transition): in particular, the European Union as a whole is committed to an 8% reduction within the period 2008-2012, in comparison with base year levels. For Italy, the EU burden sharing agreement, set out in Annex II to Decision 2002/358/EC and in accordance with Article 4 of the Kyoto Protocol, has established a reduction objective by 6.5% in the commitment period, in comparison with 1990 levels. The first commitment period ended in 2012, with an extension, for fulfilling commitments, to 18th November 2015, the so called *true-up period*. The evaluation of the Kyoto Protocol, together with the commitments fulfilled by each Party, has been finalized by the UNFCCC Secretariat.

The 'Doha Amendment to the Kyoto Protocol, related to the period 2013-2020, was adopted on 8 December 2012. The amendment includes:

- New commitments for Annex I Parties to the Kyoto Protocol who agreed to take on commitments in a second commitment period from 1 January 2013 to 31 December 2020;
- A revised list of greenhouse gases (GHG) to be reported on by Parties in the second commitment period; and
- Amendments to several articles of the Kyoto Protocol which specifically referenced issues pertaining to the first commitment period and which needed to be updated for the second commitment period.

During the second commitment period, Parties committed to reduce GHG emissions by at least 18 percent below 1990 levels in the eight-year period from 2013 to 2020.

The EU and its Member States have committed to this second phase and established to reduce their collective emissions to 20% below their levels in 1990 or other chosen base years; this is also reflected in the Doha Amendment. The target will be fulfilled jointly with Iceland.

The EU submitted a pledge to reduce its GHG emissions by 20% compared to 1990 levels. As this target under the convention has only been submitted by EU-28 and not by each of its Member States (MS), there are no specified targets for single MS. Due to this, Italy as part of the EU-28, takes on a quantified economy-wide emission reduction target jointly with all Member States.

With the 2020 climate and energy package the EU has set internal rules which underpin the implementation of the target. The 2020 climate and energy package introduced a clear approach to achieving the target. This reduction objective is divided between two sub-targets, equivalent to a split of the reduction effort between the sectors included in the EU emissions trading system (ETS) and non-ETS sectors.

Legally binding target trajectories for the period 2013-2020 are enshrined in both the EU-ETS Directive (Directive 2003/87/EC and respective amendments) and the Effort Sharing Decision (Decision No 406/2009/EC). These legally binding trajectories not only result in a 20% GHG reduction in 2020 compared to 1990 but also define the national annual target pathway to reduce EU GHG emissions from 2013 to 2020. The Effort Sharing Decision sets annual national emission targets for all Member States for the period 2013-

2020 for those sectors not covered by the EU-ETS, expressed as percentage changes from 2005 levels. In March 2013, the EU Commission formally adopted the national annual limits throughout the period for each Member State: 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. By 2020, the national targets will collectively deliver a reduction of around 10% in total EU emissions from the sectors covered compared with 2005 levels. The emission reduction to be achieved from the sectors covered by the EU ETS will be 21% below 2005 emission levels. Starting from 2013 aviation is in the scope of the EU-ETS, it means that CO₂ emissions from all flights falling within the aviation activities listed in Annex I of the EU ETS Directive which depart from an airport situated in the territory of a Member State and those which arrive in such an airport from a third country, excluding small commercial emitters.

A new global agreement was reached in Paris in December 2015, for the period after 2020. The agreement aims to strengthen the global response to the treat of climate change by holding the increase in the global temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impact of climate change. On 5 October 2016, the threshold for entry into force of the Paris Agreement was achieved and the Paris Agreement entered into force on 4 November 2016.

As a Party to the Convention and the Kyoto Protocol, Italy is committed to develop, publish and regularly update national emission inventories of greenhouse gases as well as formulate and implement programs to reduce these emissions.

In addition, Article 5.1 of the Kyoto Protocol requires that the Parties included in Annex I to the Convention have in place a National System by the end of 2006 at the latest for estimating anthropogenic greenhouse gas emissions by sources and removals by sinks and for reporting and archiving the results.

Moreover, in the context of the Kyoto Protocol commitments and its amendment for the second Commitment Period, Italy adopted Law n. 79/2016, “Ratification of the Doha amendment to the Kyoto Protocol, establishing the National system for policies, measures and emissions projections.

2. DEFINITION OF NATIONAL SYSTEM

In the first Conference of the Parties serving as the Meeting of the Parties to the Protocol, held in 2000, the “Guidelines for national systems under article 5, paragraph 1, of the Kyoto Protocol” contained in the document FCCC/KP/CMP/2005/8/Add.3 were adopted by Decision 19/CMP1. A national system, as defined in the guidelines, includes all institutional, legal and procedural arrangements established within a Party included in Annex I for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information as reported (UNFCCC, 2005).

National Systems are set up to enable Parties included in Annex I to estimate anthropogenic greenhouse gas (GHG) emissions by sources and removals by sinks and to report these emissions by sources and removals by sinks in accordance with the Kyoto Protocol and the relevant decisions of the Conference of the Parties (COP) and/or the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (COP/MOP). In addition, they are arranged to facilitate the review of the information submitted and to ensure and improve the quality of the inventories.

The overall goal of national systems is to ensure the quality of the annual national inventory through planning, preparation and management of inventory activities. Inventory activities include collecting activity data, selecting methods and emission factors appropriately, estimating anthropogenic GHG emissions by sources and removals by sinks, implementing uncertainty assessment and quality assurance/quality control

(QA/QC) activities, and carrying out procedures for the verification of the inventory data at the national level, as described in the guidelines (UNFCCC, 2005). To this end, a national system should guarantee that a

Party compiles the national inventory fulfilling the quality principles of:

- transparency in methodologies, assumptions and references used;
- consistency in the methodologies throughout the time series;
- comparability among inventories following the methodologies and the form of presentation agreed on in the Conference of the Parties to the UNFCCC;
- accuracy in the calculation which should not result either in systematic over- nor under- estimations and should ensure that uncertainties are as small as possible;
- completeness in the sources or sinks and gases as specified in the relevant guideline;
- timeliness to the agreed annual schedule.

The national system guarantees that the data not only conform to the quality requirements, but they are also officially approved by governments.

3. GENERAL FUNCTIONS

In the implementation of its national system, each Party included in Annex I shall establish and maintain the institutional, legal and procedural arrangements between the government agencies and other entities responsible for the planning, preparation and management of the inventory. Parties shall ensure sufficient capacity for timely performance of the specific functions defined in the guidelines for national systems, including data collection for estimating anthropogenic GHG emissions by sources and removals by sinks and arrangements for technical competence of the staff involved in the inventory development process. A single national entity shall be designated with overall responsibility for the national inventory (UNFCCC, 2005). Parties shall prepare national annual inventories and supplementary information in a timely manner and provide information necessary to meet the reporting requirements in accordance with the Kyoto Protocol and the relevant decisions of the COP and/or COP/MOP.

The National System for the Italian Greenhouse Gas Inventory was established by the Legislative Decree 51 of March 7th 2008 and confirmed by the Legislative Decree 30 of March 13th 2013. As indicated by art. 14 bis of the Legislative Decree, 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 single entity, ISPRA is responsible for all aspects of national inventory administration: collection and processing of activity data; selection of appropriate emission factors and estimating methodologies; reporting and quality management activities; archiving of the inventory results. In addition, ISPRA has to draw up annually a national system plan to be communicated to the Ministry for the Environment, Land and Sea.

The name of the national inventory focal point is Riccardo De Lauretis.

As for the official approval, the Ministry for the Environment, Land and Sea (MATTM) is responsible for the endorsement of the inventory and for its communication to the Secretariat of the Framework Convention on Climate Change and the Kyoto Protocol. The Ministry is also responsible for the approval of the annual National System plan. The inventory is also submitted to the European Commission in the framework of the Greenhouse Gas Monitoring Mechanism.

The Italian Atmospheric Emission Inventory and the Italian Greenhouse Gas Inventory are compiled and maintained by the Institute for Environmental Protection and Research. A specific unit of the Institute is responsible for the planning, preparation and management of the inventory in the framework of both the

United Nations Convention on Climate Change and the Convention on Long Range Transboundary Air Pollution. The whole inventory is compiled by the institute; scientific and technical institutions and consultants may help in improving information both on activity data and emission factors of some specific activities. All measures to guarantee and improve the transparency, consistency, comparability, accuracy and completeness of the inventory are undertaken. To this end, a QA/QC report is prepared annually by the inventory expert team including improvements in response to review processes and those planned for the next submissions.

The submission of the national GHG emission inventory is carried out through compilation of the Common Reporting Format (CRF) and the preparation of the National Inventory Report (NIR), according to the guidelines provided by the United Nations Framework Convention on Climate Change and the European Union's Greenhouse Gas Monitoring Mechanism.

Detailed information on emission figures and estimation procedures, including all the basic data needed to carry out the final estimates, is provided in the NIR in order to improve the transparency, consistency, comparability, accuracy and completeness of the inventory.

The national inventory is updated annually in order to reflect revisions and improvements in the methodology and use of the best information available. Adjustments are applied retrospectively to earlier years, which accounts for any difference in previously published data.

Emission estimates comprise the seven direct greenhouse gases under the Kyoto Protocol (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride, nitrogen trifluoride) which contribute directly to climate change owing to their positive radiative forcing effect and four indirect greenhouse gases (nitrogen oxides, carbon monoxide, non-methane volatile organic compounds, sulphur dioxide).

The CRF files, the NIR and other related documents can be found at the address <http://www.sinanet.isprambiente.it/it/sia-ispra/serie-storiche-emissioni>.

As single National Authority, ISPRA bears the responsibility for the general administration of the inventory, co-ordinates participation in reviews, and publishes and archives the inventory results. Furthermore, the Institute participates in work under the auspices of the UNFCCC, where guidelines for reporting are discussed and decided upon, as well as in the EU monitoring mechanism for inventories of greenhouse gases, where guidelines for reporting to the EU are regulated.

In order to complete the institutional framework, the national registry for carbon sinks and the national registry need to be outlined.

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 for the Environment, Land and Sea is responsible for the management of the National Registry for Carbon sinks. The Decree also provides that ISPRA and the State Forestry Service are involved by the Ministry as technical scientific support for specific activities as defined in the relevant protocol. ISPRA is responsible for the preparation of emission and removals estimates for the LULUCF sector and for KP LULUCF supplementary information under art.7.1 of the Kyoto Protocol.

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.

The National Registry for forest carbon sinks is aimed to:

- estimate, following the COP/MOP decisions and in accordance with the IPCC guidelines, the GHG emissions by sources and removal by sinks in the land subject to art. 3.3 and art. 3.4 activities
- account for the net removals in order to allow the Italian Registry to issue the relevant amount of RMUs.

Figure 1 describes the national registry for carbon sinks.

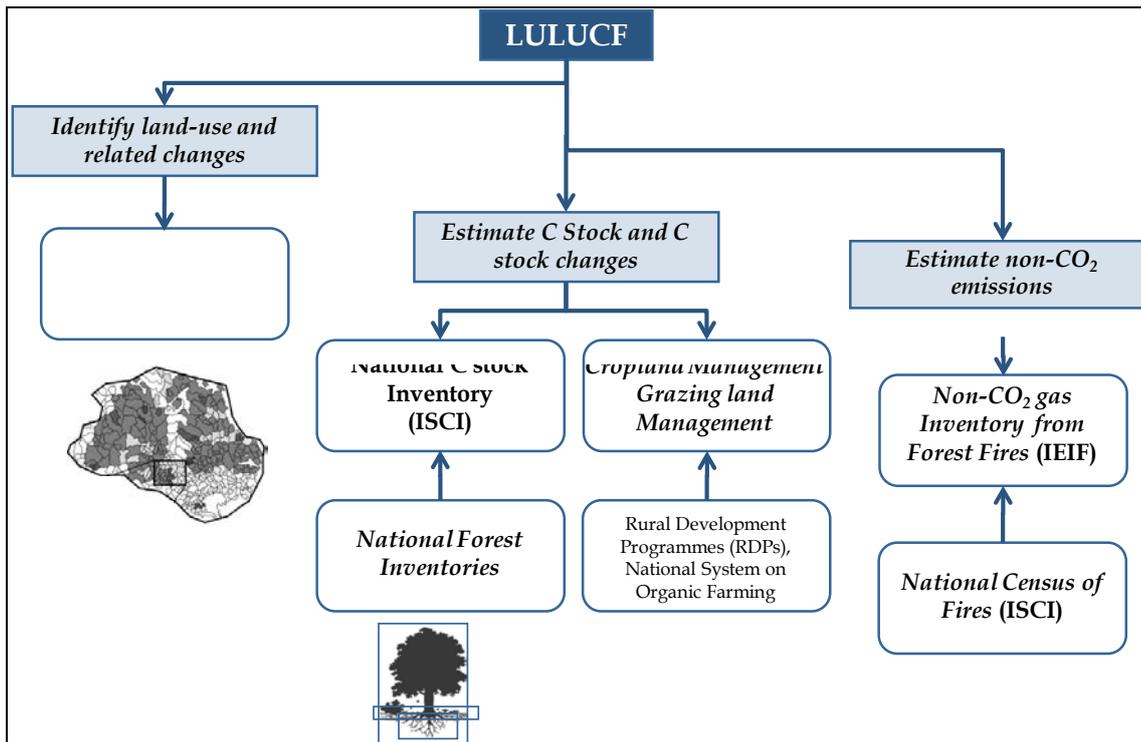


Figure 1. The national registry for carbon sinks

A detailed description on the registry and additional information on activities under Article 3.3 and Article 3.4 are reported in Annex 1 of this document.

With regards to the administration of the Registry, the Italian Government adopted Legislative Decree N. 30 of 13 March 2013 (eventually modified by Legislative Decree N. 111 of 12 July 2015) which enforces European Directive 2009/29/EC amending Directive 2003/87/EC. According to this Decree ISPRA is responsible for the administration of the national section of the Union Registry and the Kyoto National Registry; the Institute performs this task under the supervision of the national Competent Authority.

The Decree 30/2013 also establishes that the economic resources for the technical and administrative support of the Registry will be supplied to ISPRA by account holders paying a fee. The amount of such a fee has been regulated by Ministerial Decree of 25th July 2016. Detailed description of the national registry is presented in Annex 2.

Moreover, 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 and, in cooperation with the Ministry of Environment Land and Sea collects all the information and data from the competent Ministries. Article 1 of the Decree implementing Law n. 79 (9th December 2016) reports the list of information and data that are to be sent by the competent ministries to MATTM and ISPRA, defining also the timing for providing such information. 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. Further information is provided in Annex 3 of this document.

4. SPECIFIC FUNCTIONS

4.1 Inventory planning

As part of its inventory planning, each Party included in Annex I shall designate a single national entity with overall responsibility for the national inventory, make available the postal and electronic addresses of the national entity responsible for the inventory, define and allocate specific responsibilities in the inventory development process, including those relating to choice of methods, data collection, particularly activity data and emission factors from statistical services and other entities, processing and archiving, and QC and QA. This last definition shall specify the roles of, and cooperation between, government agencies and other entities involved in the preparation of the inventory, as well as the institutional, legal and procedural arrangements made to prepare the inventory (UNFCCC, 2005).

The Party should elaborate an inventory QA/QC plan which describes specific QC procedures to be implemented during the inventory development process, facilitate the overall QA procedures to be conducted, to the extent possible, on the entire inventory and establish quality objectives. Besides, Party should establish processes for the official consideration and approval of the inventory, including any recalculations, prior to its submission and to respond to any issues asked by the inventory review process under Article 8 (UNFCCC, 2005).

As part of its inventory planning, each Party included in Annex I should consider ways to improve the quality of activity data, emission factors, methods and other relevant technical elements of inventories. Information obtained from the implementation of the QA/QC programme, the review process under Article 8 and other reviews should be considered in the development and/or revision of the QA/QC plan and the quality objectives (UNFCCC, 2005).

The Legislative Decree 51 of March 7th 2008 designated ISPRA, former APAT, as single national entity with overall responsibility for the national emission inventory. The Italian greenhouse gas inventory and the national inventory report are compiled annually by the Institute. According to the same decree, the Ministry for the Environment, Land and Sea is responsible for the official consideration and endorsement of the inventory and for the communication to the Secretariat of the 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. The submission of the inventory to the European Commission is by the due date of 15th January which can be extended up to 15th March; 15th April is the deadline for the national submission to the UNFCCC.

ISPRA is responsible for all aspects of national inventory preparation, reporting and quality management. Activities include the collection and processing of data from different data sources, the selection of appropriate emissions factors and estimation methods consistent with the IPCC Guidelines and guidance (IPCC 1997; IPCC 2000, IPCC 2006, IPCC 2014), 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 electronic address where all the information related to the inventory can be found is: <http://www.sinanet.isprambiente.it/it/sia-ispra/serie-storiche> .

Different institutions are responsible for statistical basic data and data publication, which are essential for ISPRA in order to carry out emission estimates. These institutions are part of a National Statistical System (Sistan), which provides national official statistics, and therefore are asked periodically to update 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 National Statistical System is coordinated by the Italian National Institute of Statistics (ISTAT) whereas other bodies, joining the National Statistical System, 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 who have specific characteristics determined by law.

The Italian statistical system was instituted on 6th September 1989 by the Legislative Decree n. 322/89, which established guiding principles and criteria for reforming public statistics. This decree addresses to all public statistical bodies and agencies which provide official statistics both at local, national and international level in order to assure homogeneity of the methods and comparability of the results. To this end, a national statistical plan which defines surveys, data elaborations and project studies for a three-year period shall be drawn up and updated annually, as established in the Decree n. 322/89. The procedures to be followed with relation to the annual fulfilment as well as the forms to be filled in for census, data elaborations and projects, and how to deal with sensitive information are also defined.

The plan is deliberated by the Committee for addressing and coordinating statistical information (Comstat) and forwarded to the Commission for the assurance of statistical information; the Commission adopts the plan after endorsement of the Guarantor of the privacy of personal data.

Finally, the plan is approved by a Prime Ministerial Decree after consideration of the Interministerial Committee for economic planning (Cipe). The latest Prime Ministerial Decree approved the three-year plan for 2017-2019, updated for 2018 and 2019 (GU Serie Generale n.66, 20/03/2018). Statistical information and results deriving from the completion of the plan are of public domain and the system is responsible for wide circulation.

Ministries, public agencies and other bodies are obliged to provide the data and information specified in the annual statistical plan; the same obligations regard the private entities. All the data are protected by the principles of statistical disclosure control and can be distributed and communicated only at aggregate level even though microdata can circulate among the subjects of the Statistical System.

Sistan activity is supervised by the Commission for Guaranteeing Statistical Information (CGIS) which is an external and independent body. In particular, the Commission supervises: the impartiality and completeness of statistical information, the quality of methodologies, the compliance of surveys with EU and international directives. The Commission, established within the Presidency of the Council of Ministers, is composed of high-profile university professors, directors of statistical or research institutes and managers of public administrations and bodies, which do not participate at Sistan.

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

The national emission inventory itself is a Sistan product.

Other information and data sources are used to carry out emission estimates, which are generally referred to in Table 1 in the following section.

ISPRA has elaborated an inventory QA/QC procedures manual (ISPRA, 2013) which describes QC/QC procedures and verification activities to be followed during the inventory compilation process which facilitate the inventory improvement. Specific QA/QC procedures and different verification activities which are implemented thoroughly the current inventory compilation, as part of the estimation process, are figured out in the annual QA/QC plans (ISPRA, several years [b]).

Quality control checks and quality assurance procedures together with some verification activities are applied both to the national inventory 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.

The quality of the inventory has improved over the years and further investigations are planned for all those sectors relevant in terms of contribution to total CO₂ equivalent emissions and with a high uncertainty.

A specific procedure undertaken for improving the inventory regards the establishment of national expert panels (in particular, in road transport, land use change and forestry and energy sectors) which involve, on a voluntary basis, different institutions, local agencies and industrial associations cooperating for improving activity data and emission factors accuracy. Specifically, for the LULUCF sector, 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 Ministry for the Environment, Land and Sea in cooperation with the Ministry of Agriculture, Food and Forest Policies. Following the election of Cropland Management and Grazing land Management activities under article 3.4 of the Kyoto Protocol, the Ministry for the Environment, Land and Sea (MATTM) jointly with the Ministry of Agriculture, Food and Forest Policies (MIPAAF) 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 under the Kyoto Protocol.

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.

QC procedures are also undertaken on the calculations of uncertainties in order to confirm the correctness of the estimates and that there is sufficient documentation to duplicate the analysis. Figures used to draw up uncertainty analysis are checked with the relevant experts and literature references and they are proved to be consistent with the IPCC Guidance and Guidelines (IPCC, 2000; IPCC, 2014; IPCC, 2006).

The inventory is also presented to a Technical Committee on Emissions (CTE), coordinated by the Ministry for the Environment, Land and Sea, where all the relevant Ministries and local authorities are represented; within this context emission figures and results are shared and discussed. Especially in the last years, there has been an intensification of these activities in order to establish national policies and measures to meet the 2020 EU target and implement national programmes for the post Kyoto period. In this regard, and as a basis for emission scenarios, the importance of the emission inventory is primary.

Moreover, from 2011, a report concerning the state of implementation of commitments to reduce greenhouse gases emissions, and describing emission trend and projections, is prepared by the Ministry of the Environment in consultation with other relevant Ministries. The report is annexed to the economy and financial document (DEF) to be annually approved by the Government.

A summary of all the main QA/QC activities over the past years which ensure the continuous improvement of the inventory is presented in the document ‘Quality Assurance/Quality Control plan for the Italian Emission Inventory’ of the current year (ISPRA, several years[b]).

4.2 Inventory preparation

As part of its inventory preparation, each Party included in Annex I shall prepare estimates, make a quantitative estimate of the uncertainty for each source category and for the inventory in total, identify key source categories, and ensure that appropriate methods are used to estimate emissions from key source categories in accordance with the IPCC guidelines and good practice guidance. Each Party shall also ensure that the inventory and any recalculations of previously submitted estimates of anthropogenic GHG emissions by sources and removals by sinks are prepared in accordance with the IPCC good practice guidance and relevant decisions of the COP and/or COP/MOP and that general inventory QC procedures (tier 1) are implemented in accordance with its QA/QC plan (following the IPCC guidelines) (UNFCCC, 2005).

In addition, each Party should apply source-category-specific QC procedures (Tier 2) for key source categories and for those individual source categories in which significant methodological and/or data revisions have occurred, in accordance with the IPCC good practice guidance. A basic review of the inventory should be provided by personnel that have not been involved in the inventory development, preferably an independent third party, before the submission of the inventory, in accordance with the planned QA procedures; a more extensive review of the inventory for key source categories, as well as source categories where significant changes in methods or data have been made, should be provided (UNFCCC, 2005).

Based on the reviews and periodic internal evaluations of the inventory preparation process, the inventory planning process should be re-evaluated in order to meet the established quality objectives (UNFCCC, 2005).

The Italian emission inventory is based on methodologies which are consistent with the IPCC guidelines, and the European EMEP/EEA guidebooks (IPCC 1997; IPCC 2006; IPCC 2000; IPCC 2014; EMEP/CORINAIR 2007; EMEP/EEA 2009; EMEP/EEA 2016); national emission factors are used as well as default emission factors from international guidebooks, when national data are not available. Development of national methodologies is supported by background reference materials. Quantitative estimates of uncertainty are calculated for source category at a detailed level and for the inventory in total following the IPCC Good Practice Guidance. The assessment of key categories is particularly important, as they should receive special consideration in terms of methodological aspects and quality assurance and quality control verification. The process of the inventory preparation takes over annually; in the year t final emissions are calculated for the year $t-2$: 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.

ISPRA has established fruitful cooperation with a number of governmental and research institutions 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 sources. Moreover, when in depth investigation is needed and a high uncertainty in the estimates is present, specific sector analyses are committed 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 completeness and transparency of the inventory.

Basic data, emission factors and methodologies used in the estimation process are consistent with the IPCC Guidelines and supported by national experiences and circumstances. Final decisions are up to inventory experts, taking into account all the information available.

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 the Agency. After each reporting cycle, all database files, spreadsheets and electronic documents are archived as 'read-only-files' so that the documentation and estimates could be traced back during the review process or the new year inventory compilation.

Activity data used in emission calculations and their sources are briefly described here below.

In general, for the energy and industrial sectors, emission data collected in the framework of the European Emissions Trading Scheme, the National Pollutant Release and Transfer Register (EPER/E-PRTR) and the Large Combustion Plant (LCP) Directive have yielded considerable developments in the inventory of the relative sectors. In fact, these data are always used either directly in the estimation process or as a verification of emission estimates, improving national emissions factors as well as activity data figures.

In particular, for the energy sector, basic statistics for estimating emissions are fuel consumption published in the Energy Balance and provided by the Ministry of Economic Development. Additional information for electricity production is provided by the major national electricity producers and by the major national industry corporation. On the other hand, basic information for road transport, maritime and aviation, such as the number of vehicles, harbour statistics and aircraft landing and take-off cycles are provided in statistical yearbooks published both by the National Institute of Statistics and the Ministry of Transportation. Other data are communicated by different category associations. The analysis of data from the Italian Emission Trading Scheme database is used to develop country-specific emission factors and check activity data levels.

For the industrial sector, the annual production data are provided by national and international statistical yearbooks. Emission data collected through the National Pollutant Release and Transfer Register (EPER/E-PRTR) are taken into account as a verification of emission inventory estimates for some specific categories. According to the Italian Decree of 23 November 2001, data from the Italian EPER/E-PRTR are validated and communicated by ISPRA to the Ministry for the Environment, Land and Sea and to the European Commission within October of the current year for data referring to the previous year.

In addition, final emissions are checked and verified also taking into account figures reported by industries in their annual environmental reports.

Both for energy and industrial processes, emissions of large industrial point sources are registered individually, communicated also in the framework of the European Directive on Large Combustion Plants, based upon detailed information such as fuel consumption. Other small plants communicate their emissions which are also considered individually.

For the other sectors, i.e. for solvents, the amount of solvent use is provided by environmental publications of sector industries and specific associations as well as international statistics.

For agriculture, annual production data and number of animals are provided by the National Institute of Statistics and other sectoral associations.

For land use, land use change and forestry, land use classification has been carried out based on IUTI (National inventory of land use), National Forest Inventories (NFIs) and data provided by the National Institute of Statistics; detailed information on fire occurrences are supplied by the Carabinieri Force (the Armed Forces and Police Authority where the State Forestry Service is embedded, following the legislative decree 19/08/2016, n. 177). Activity data used in the estimation process of emissions and removals related to cropland and grazing land management data are based on data collected by ISMEA in the framework of different EU Regulations (see Annex 1.e, Cropland and grazing land management).

For waste, the main activity data are provided by the Institute for Environmental Protection and research and the Waste Observatory.

In Table 1 a summary of the activity data and sources used in the inventory compilation is reported. In case basic data are not available, proxy variables are considered; unpublished data are used only if supported by personal communication and confidentiality of data is respected.

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

Table 1. Main activity data and sources for the Italian Emission Inventory

In Table 2 a summary of the methods and emission factors used in the compilation of the Italian inventory is reported. A more detailed table describing methods and emission factors for the key categories of the national inventory for the year 2016 is reported in the National Inventory Report as an annex (ISPRA, 2018).

SUMMARY 3 SUMMARY REPORT FOR METHODS AND EMISSION FACTORS USED																
GREENHOUSE GAS SOURCE AND CATEGORIES	CO ₂		CH ₄		N ₂ O		HFCs		PFCs		SF ₆		Unspecified mix of		NF ₃	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
1. Energy	T1,T2,T3	CS,D	T1,T2,T3	CR,CS,D,M	T1,T2,T3	CR,D,M										
A. Fuel combustion	T1,T2,T3	CS,D	T1,T2,T3	CR,D,M	T1,T2,T3	CR,D,M										
1. Energy industries	T3	CS	T3	CR,D	T3	CR,D										
2. Manufacturing industries	T2	CS	T2	CR,D	T2	CR,D										
3. Transport	T1,T2,T3	CS,D	T1,T2,T3	CR,M	T1,T2,T3	CR,M										
4. Other sectors	T2	CS	T2	CR	T2	CR										
5. Other	T2	CS	T2	CR	T2	CR										
B. Fugitive emissions from fuels	T1,T2	CS,D	T1,T2	CR,CS,D	T1	D										
1. Solid fuels			T1,T2	CR,D												
2. Oil and natural gas	T1,T2	CS,D	T1,T2	CR,CS,D	T1	D										
C. CO ₂ transport and storage																
2. Industrial processes	CR,CS,T1,T2	CR,CS,D,M,PS	D,T1	CR,CS,D	CS,T2	CS,D,PS	CS,T2	CS,D,PS	CS,T2	CS,PS	CS,T2	CS,PS			T2	CS
A. Mineral industry	T2	CS,PS														
B. Chemical industry	T2	CR,PS	D,T1	CR,CS,D	T2	D,PS	CS	PS	CS	PS						
C. Metal industry	T2	CR,CS,PS	D	CS,D			T2	PS								
D. Non-energy products from fuels and solvent use	CR,CS,T1,T2	CR,CS,D,M,PS														
E. Electronic industry							T2	CS	T2	CS	T2	CS			T2	CS
F. Product uses as ODS substitutes							T2	CS,D								
G. Other product manufacture and use					CS	CS					CS,T2	CS,PS				
H. Other																
3. Agriculture	T1	D	T1,T2	CS,D	CS,T1,T2	CS,D										
A. Enteric fermentation			T1,T2	CS,D												
B. Manure management			T1,T2	CS,D	T2	CS,D										
C. Rice cultivation			T2	CS												
D. Agricultural soils ⁽³⁾					CS,T1	CS,D										
E. Prescribed burning of savannas																
F. Field burning of agricultural residues			T1	CS,D	T1	CS,D										
G. Liming	T1	D														
H. Urea application	T1	D														
I. Other carbon-containing fertilizers																
J. Other																
4. Land use, land-use change and forestry	T1,T2,T3	CS,D	T1,T2	CS,D	T1,T2	CS,D										
A. Forest land	T1,T2,T3	CS,D	T2	CS,D	T2	CS,D										
B. Cropland	T1,T2	CS,D	T1	D	T1	D										
C. Grassland	T1,T2,T3	CS,D	T1	CS	T1	CS										
D. Wetlands																
E. Settlements	T1	D			T1	D										
F. Other land																
G. Harvested wood products	T2	CS														
H. Other																
5. Waste	D	CS	D,T1,T2	CR,CS,D	D,T1	CR,CS,D										
A. Solid waste disposal			T2	CS												
B. Biological treatment of solid waste			D	CS,D	D	D										
C. Incineration and open burning of waste	D	CS	D,T1	CR,CS,D	D,T1	CR,CS,D										
D. Waste water treatment and discharge			T1	D	T1	CR,D										
E. Other																
6. Other (as specified in summary 1A)																

Use the following notation keys to specify the method applied:

D (IPCC default) **T1a, T1b, T1c** (IPCC Tier 1a, Tier 1b and Tier 1c, respectively) **CR** (CORINAIR) **M** (model)
RA (Reference Approach) **T2** (IPCC Tier 2) **CS** (Country Specific)
T1 (IPCC Tier 1) **T3** (IPCC Tier 3) **OTH** (Other)

If using more than one method within one source category, list all the relevant methods. Explanations regarding country-specific methods, other methods or any modifications to the default IPCC methods, as well as

Use the following notation keys to specify the emission factor used:

D (IPCC default) **CS** (Country Specific) **OTH** (Other)
CR (CORINAIR) **PS** (Plant Specific) **M** (model)

Table 2. Methods and emission factors used in the inventory preparation

According to the IPCC Good Practice Guidance and Guidelines, an uncertainty assessment is carried out on the Italian greenhouse gas inventory to establish the uncertainties related to different emission sources and the uncertainty of total emissions for the base year 1990 and the latest inventory year and the so-called trend uncertainty. The uncertainty assessment helps to identify the key categories whose effect on the total uncertainty of the inventory is highest; furthermore, by means of such assessment the improvement measures can be directed so that the total uncertainty of the inventory can be lowered as effectively as possible with the available resources. Uncertainty assessments have been calculated on the Italian greenhouse gas inventory from the inventory of 2001 onwards, recalculations only apply to the base year.

Quantitative estimates of uncertainty for the Italian GHG inventory are calculated using Approach 1 as defined in the IPCC Guidelines (IPCC, 2006), which provides a calculation based on the error propagation equations. In addition, Approach 2, corresponding to the application of Monte Carlo analysis, has been applied to some of the key categories of the inventory in different sectors but the results show that, with the information available at present, applying higher method produces comparable results.

The assumptions on which uncertainty estimations are based are documented for each category. Figures to draw up uncertainty analysis are checked with the relevant analyst experts and literature references and they are consistent with the IPCC Good Practice Guidance and Guidelines (IPCC, 2000; IPCC, 2006).

The IPCC Good Practice Guidance and Guidelines recommends as good practice the identification of *key categories* in national GHG inventories (IPCC, 2000; IPCC, 2006). A *key category* is defined as an emission source or removal that has a significant influence on a country's GHG inventory in terms either of the absolute relative level of emissions or the trend in emissions, or both. Key categories therefore are those found in the accumulative 95% of the total annual emissions in the last reported year or belonging to the total trend, when ranked in descending order of magnitude.

The assessment of national key categories is important because key categories should receive special consideration in terms of methodological aspects and quality assurance and quality control verification.

Two different approaches are reported in the IPCC 2006 guidelines according to whether or not a country has performed an uncertainty analysis of the inventory: Approach 1 and Approach 2. When using Approach 1, key categories are identified by means of a pre-determined cumulative emissions threshold, usually fixed at 95% of the total. If an uncertainty analysis is carried out at category level for the inventory, Approach 2 can be used to identify key categories. Approach 2 is a more detailed analysis that builds on Approach 1; in this case, the results of Approach 1 are multiplied by the relative uncertainty of each source/sink category. Key categories are those that represent 90% of the uncertainty contribution. So the factors which make a source or a sink a key category are a high contribution to the total, a high contribution to the trend and a high uncertainty.

For the Italian inventory, a key category analysis is carried out according to both Approach 1 and Approach 2. National emissions are disaggregated, as far as possible, into the categories proposed in the IPCC guidelines; other categories are added to reflect specific national circumstances. Both level and trend analysis are applied. It should be noted that higher tiers are mostly used for calculating emissions from the key categories as requested by the IPCC guidelines (IPCC, 2006).

Tier 2 QC procedures for key categories, as reported in the QA/QC manual procedures (ISPRA, 2013), are applied. QC procedures are also undertaken on the calculations of uncertainties in order to confirm the correctness of the estimates and that there is sufficient documentation to duplicate the analysis.

The process of the inventory preparation takes over annually. To meet the requirements of transparency, consistency, comparability, completeness and accuracy of the inventory, the entire time series from 1990 onwards is checked and revised every year during the annual compilation of the inventory. Measures to guarantee and improve these qualifications are undertaken and recalculations should be considered as a contribution to the overall improvement of the inventory. In addition to a new year, the inventory is updated annually by a revision of the existing activity data and emission factors in order to include new information available.

Recalculations are elaborated on account of changes in the methodologies used to carry out emission estimates, changes due to different allocation of emissions as compared to previous submissions and changes due to error corrections. The inventory may also be expanded by including categories not previously estimated if sufficient information on activity data and suitable emission factors have been identified and collected. Revisions always apply to the entire time series.

Information on the major recalculations is provided every year in the sectoral and general chapters of the national inventory reports; detailed explanations of recalculations are given compiling the relevant CRF tables.

Improvements of the inventory are planned every year considering the outcome of the UNFCCC review process and other reviews, the analysis of key categories in terms of absolute weight and/or combined uncertainty.

The inventory team analyses the results of the review and other outcome from verification processes and decides the list of improvements at general and sectoral level to be implemented in the short or medium term according to the relevance of the modification and the evaluation of the resources needed.

First of all, it is important that emissions of key categories, being the most significant, are estimated with a high level of accuracy. For the Italian inventory, higher tiers are mostly used for calculating emissions from these categories and the use of country specific emission factors is extensive. There are only a few key categories which estimates do not meet these quality objectives, in terms of the methodology and the application of default emission factors or parameters. Among these categories, prioritization is made on account of the actual absolute weight, the expected future relevance, the level of uncertainty and a cost-effectiveness analysis. Therefore improvements have mainly been planned for the LULUCF sector. In addition to this evaluation, also categories estimated with higher tiers but affected by a high level of uncertainty are considered in the prioritization plan. For instance, activities are planned for HFC, PFC substitutes for ODS in order to improve the accuracy of the Italian inventory and reduce the overall uncertainty.

Descriptions and justifications of the current recalculations together with the planned improvements of the inventory are also supplied in the annual QA/QC plan (ISPRA, several years [b]).

A table resuming the main planned improvements to be implemented in the next years is reported in Annex 3 of this report.

With regard to an independent review, as requested by the UNFCCC guidelines, a bilateral independent review between Italy and Spain was carried out, with a focus on the revision of the GHG inventories of both the Parties. Aim of the review was to carry out a general quality assurance analysis of the inventories in terms of the methodologies, the EFs and the references used, as well as analysing critical cross cutting issues such as the details of the national energy balances and comparison with international data (Eurostat and IEA), use of plant specific information. The Italian team revised part of the energy sector of Spain, specifically the categories public power plants, petroleum refining plants, road transport and off-road, whereas the Spanish team revised the Industrial processes and solvent and other product use, and the LULUCF sectors of Italy. Results of these analyses are reported in a technical report.

In addition, an official independent review of the entire Italian greenhouse gas inventory was undertaken by the Aether consultants in 2013. Main findings and recommendations are reported in a final document, and regard mostly the transparency in the NIR, the improvement of QA/QC documentation and some pending issues in the LULUCF sector. These suggestions have been considered to improve the inventory submissions, from 2014 onward.

4.3 Inventory management

As part of its inventory management, each Party included in Annex I shall archive inventory information for each year in accordance with relevant decisions of the COP and/or COP/MOP. This information shall include all disaggregated emission factors, activity data, and documentation about how these factors and data have been generated and aggregated for the preparation of the inventory as well as internal documentation on QA/QC procedures, external and internal reviews, documentation on annual key sources and key source identification and planned inventory improvements (UNFCCC, 2005).

Party shall provide review teams under Article 8 with access to all archived information used by the Party to prepare the inventory, in accordance with relevant decisions of the COP and/or COP/MOP and respond to requests for clarifying inventory information resulting from the different stages of the review process of the

inventory information, and information on the national system, in a timely manner in accordance with Article 8 (UNFCCC, 2005).

As part of its inventory management, each Party included in Annex I should make the archived information accessible by collecting and gathering it at a single location (UNFCCC, 2005).

A proper archiving and reporting of the documentation related to the inventory compilation process is also part of the national QA/QC programme. All information relating to the planning, preparation, and management of inventory activities are documented and archived. The material and documents are stored at the Institute for Environmental Protection and Research and can be consulted whenever needed. All information used for the inventory compilation is traceable back to its source. The inventory is composed by spreadsheets to calculate emission estimates; activity data and emission factors as well as methodologies are referenced to their data sources. Particular attention is paid to the archiving and storing of all inventory data, supporting information, inventory records as well as all the reference documents. The archive is organised so that any skilled analyst could obtain relevant data sources and spreadsheets, reproduce the inventory and review all decisions about assumptions and methodologies undertaken.

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 draft and final inventory report, electronic copies of the draft and final CRF tables;
- 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.

The archive and the 'reference' database are completely accessible to the review team and ISPRA makes this information available, in the framework of the official UNFCCC review process under the Convention and the Kyoto Protocol, to the requests for clarifying inventory information in the different stages of the review, in a timely and complete manner.

REFERENCES AND SOURCES

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

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

EMEP/EEA, 2016. Air Pollutant Emission Inventory Guidebook. EEA. Technical report No 21/2016.

ENEA, several years. Rapporto Energia Ambiente. Ente per le Nuove tecnologie, l'Energia e l'Ambiente, Roma.

EU, 2004, Commission Decision of 29 October 2004 laying down rules implementing Decision 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring community greenhouse gas emissions and for implementing the Kyoto Protocol.

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.

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.

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.

IPCC 2014, 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol, Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds) Published: IPCC, Switzerland.

ISPRA, several years [a]. Rapporto Rifiuti. Istituto Superiore per la Protezione e la Ricerca Ambientale.

ISPRA, several years [b]. Quality Assurance/Quality Control plan for the Italian Emission Inventory. Institute for Environmental Protection and Research.

ISPRA, 2013. Quality Assurance/Quality Control Plan for the Italian Emission Inventory. Procedures Manual. ISPRA, 122/2014.

ISPRA, 2016. Italian Greenhouse Gas Inventory 1990-2014, National Inventory Report 2014.

ISTAT, several years [a]. Annuario Statistico Italiano. Istituto Nazionale di Statistica.

ISTAT, several years [b]. Bollettino mensile di statistica. Istituto Nazionale di Statistica.

MSE, several years [a]. Bilancio Energetico Nazionale (BEN). Ministero dello Sviluppo Economico, Direzione Generale delle Fonti di Energia ed industrie di base. <http://dgerm.sviluppoeconomico.gov.it/dgerm/ben.asp>.

MSE, several years [b]. Bollettino Petrolifero Trimestrale (BPT). Ministero dello Sviluppo Economico. <http://dgerm.sviluppoeconomico.gov.it/dgerm/bollettino.asp>.

MIT, several years. Conto Nazionale delle Infrastrutture e dei Trasporti (CNT). Ministero delle Infrastrutture e dei Trasporti. http://www.mit.gov.it/mit/site.php?o=vc&lm=2&id_cat=148.

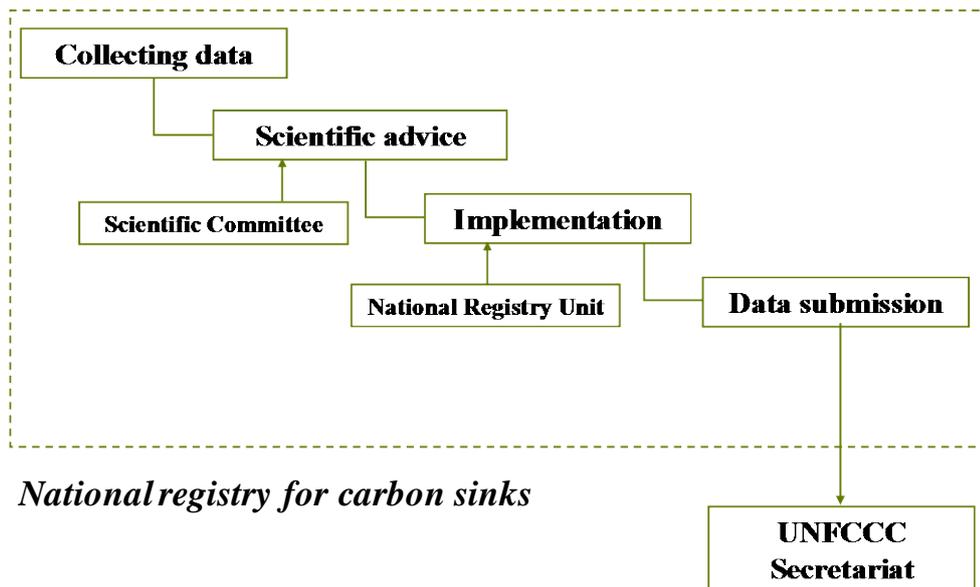
SINAB (National System on Organic Farming), several years. Bio in cifre. <http://www.sinab.it>.

TERNA, several years. Dati statistici sull'energia elettrica in Italia. Gestore Rete Trasmissione Nazionale.

UNFCCC, 2005. Guidelines for national systems under article 5, paragraph 1, of the Kyoto Protocol contained in the document FCCC/KP/CMP/2005/8/Add.3

ANNEX 1: THE NATIONAL REGISTRY FOR CARBON SINKS

The “National Registry for carbon sinks” is part of the Italian National System; it is the instrument to estimate, following the COP/MOP decisions and in accordance with the IPCC guidelines, the greenhouse gases emissions by sources and removals by sinks in the land subject to the art. 3.3 and art. 3.4 activities and to account for the net removals in order to allow the Italian Registry to issue the relevant amount of RMUs.



Italy has approved the National Plan for greenhouse gases reduction (PNR_{GHG}) with the CIPE (*Interministerial Economic Planning Committee*) decision n. 123, of 19 December 2002. The PNR_{GHG} sets policies and measures to act in order to achieve the national target of the Kyoto Protocol for the first commitment period. A key requirement of CIPE decision (123/2002, article 7.4) was related to the establishment, by the Ministry for the Environment, Land and Sea (MATTEM), in agreement with Ministry of Agriculture, Food and Forest Policies (MIPAAF), of the National Registry for the carbon sinks to account for the net removals, from *afforestation*, *reforestation* and *deforestation* activities (art. 3.3) and from elected activities under article 3.4 of Kyoto Protocol.

The National Registry for Carbon sinks, instituted by a Ministerial Decree on 1st April 2008, is part of National Greenhouse Gas Inventory System in Italy and includes information on lands subject to activities under Article 3.3 and activities under Article 3.4 and related carbon stock changes. The National Registry for Carbon sinks is the instrument to estimate, following the COP/MOP decisions and in accordance with the IPCC guidelines, emissions and removals related to the art. 3.3 and art. 3.4 activities and to account for the net removals in order to allow the Italian Registry to issue the relevant amount of RMUs. In 2009, a technical group, formed by experts from different institutions (ISPRA; Ministry of the Environment, Land and Sea; Ministry of Agriculture, Food and Forest Policies and University of Tuscia), set up the methodological plan of the activities necessary to implement the registry and defined the relative funding. Several activities have been implemented and carried out; in particular IUTI, inventory of land use, has been completed, resulting in land use classification, for all national territory, for the years 1990, 2000 and 2008. For 2012, land use and land use changes data were assessed through the survey, carried out in the framework of the III NFI, on a IUTI's subgrid (i.e. 301,300 points, covering the entire country). Time series related to the areas to be included into the different IPCC categories have been assembled using IUTI data, and the data assessed by the national forest inventories (1985, 2005, 2012). Verification and validation activities have been undertaken and the resulting time series have been discussed with the institutions involved in the data providing (i.e.

National Forest Service, Ministry of Agricultural, Food and Forestry Policies (MIPAAF), Forest Monitoring and Planning Research Unit (CRA-MPF)).

The forest definition to be used in the second commitment period is the same definition adopted for the first commitment period. The forest definition adopted by Italy is in line with the definitions of the Food and Agriculture Organization of the United Nations for its Global Forest Resource assessment (FAO FRA 2000). This definition is consistent with the definition given in Decision 16/CMP.1. Forest is a land with the following threshold values for tree crown cover, land area and tree height:

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

Forest roads, cleared tracts, firebreaks and other open areas within the forest as well as protected forest areas are included in forest.

Italy has elected cropland management (CM) and grazing land management (GM) as additional activities under Article 3.4. Following the Decision 2/CMP.7, the forest management (FM) has to be compulsorily accounted as an activity under Article 3.4.

Italy considers the entire national territory as managed, i.e. subject to human activities, consequently the entire national forest area is subject to human activities that, by-law, are aimed at sustainably manage the forest.

The forest management reference level (FMRL¹) for Italy, inscribed in the appendix to the annex to decision 2/CMP.7, is equal to –21.182 Mt CO₂ eq. per year assuming instantaneous oxidation of HWP, and –22.166 Mt CO₂ eq. applying a first-order decay function for HWP. Italy intends to account for Article 3.3 and 3.4 activities at the end of the commitment period.

The key elements of the accounting system in the National Registry for carbon sinks are:

a. National Land-Use Inventory (IUTI)

aimed at identifying and quantifying:

- lands subject to art. 3.3 and art. 3.4 activities since 31 December 1989;

b. National Inventory of Carbon Stocks (ISCI)

aimed at quantifying:

- carbon stocks and carbon stock changes in any land-use category.

c. National Census of Forest Fires (CIFI)

aimed at identifying and quantifying:

- areas affected by fires.

d. National Inventory of non-CO₂ emissions from forest fires (IEIF)

aimed at quantifying:

- non-CO₂ emissions from areas affected by fires.

e. Cropland and Grazing land Management

¹ Submission of information on forest management reference levels by Italy:

http://unfccc.int/files/meetings/ad_hoc_working_groups/kp/application/pdf/awgkp_italy_2011.pdf

Communication of 11 May 2011 regarding harvested wood products value by Italy:

http://unfccc.int/files/meetings/ad_hoc_working_groups/kp/application/pdf/awgkp_italy_corr.pdf

a. National Land-Use Inventory (IUTI)

The National Land-Use Inventory (IUTI) is aimed at identifying the land uses and land-use changes over the national territory. IUTI supplies data concerning lands subject to art. 3.3 and 3.4 of the Kyoto Protocol. IUTI is based on a survey of sample points throughout Italian national territory considered as a population of points, and on the classification of the land use coupled with the sampling points. By using on-screen interpretation of digital orthophotos, land use is classified with a high degree of accuracy and precision, as required by IPCC standards.

The following set of multi-temporal orthophotos was used as basis of photo-interpretation process:

- 1990, the black and white high resolution full national coverage aerial photography database of TerraItaly² was used to produce orthophotos in scale 1:75.000, spatial resolution of 1 m (the aerial photos, taken on 1988/89, have the same image acquisition standard adopted by USGS-National High Altitude Program at that time: panchromatic film, 400 lines per millimeter);
- 2000, TerraItaly³ 2000 dataset, digital color aerial orthophotos with spatial resolution of 1 m;
- 2008, TerraItaly 2008 dataset, digital color aerial orthophotos with spatial resolution of 0.5 m.
- 2012, AGEA⁴ color and infrared digital orthophoto,s with spatial resolution 0.5 m; years 2010-12.

Furthermore, visual interpretation was supported by ancillary information from available thematic forest and land use maps at regional and sub-regional scales.

a.1 Time:

IUTI adopts statistical sampling procedures to estimate the area covered by IPCC land use categories in Italy at three points in time (1990, 2008 and 2012). The 2012 land use assessment has been carried out in the framework of the III NFI, on a IUTI's subgrid (i.e. 301,300 points, covering the entire country). Time series related to the areas to be included into the different IPCC categories have been assembled using IUTI data, and the data assessed by the national forest inventories (1985, 2005, 2012). Annual estimates of land uses and land use changes are deduced to provide time-series of the areas devoted to any land-use category and any land-use change subcategory to and from any land subject to art. 3.3 and art. 3.4 of the Kyoto Protocol. For the Kyoto Protocol accounting, the time series needed is related to the period 31/12/2012 - 1/1/2021.

a.2 Space:

The sampling grid and the relative sample plots (1,206,000 sampling points) is uniformly distributed throughout the entire Italian national territory, using a non-aligned systematic sampling. The set of sample points was extracted using a 0.5 km square grid, for a total of about 1,206,000 geo-referenced points randomly located in each square cell and fully covering the Italian territory. A subset of the IUTI sample is represented by the 301,300 first phase sample points of the national forest inventory (INFC).

Categories and subcategories:

Land use categories (Table A1.1) are defined according to IPCC requirements:

² http://www.cgrit.it/prodotti/voli_italia.html

³ <http://www.terraitaly.it/>

⁴ <http://www.agea.gov.it/portal/page/portal/AGEAPageGroup/HomeAGEA>

IPCC Category Level I	IUTI Category Level II	IUTI Subcategory Level III	Code
1. Forest land	Woodland		1.1
	Wooded land temporarily unstocked		1.2
	Arable land and other herbaceous cultivations		2.1
2. Cropland	Arboreal cultivations	Fruit orchards and plant nurseries	2.2.1
		Wood product plantations	2.2.2
3. Grassland	Grassland, pastures and uncultivated herbaceous areas		3.1
	Other wooded land		3.2
4. Wetlands	Marshlands and open waters		4
5. Settlements	Urban development		5
6. Other land	Non-productive areas or areas with scarce or absent vegetation		6

Table A1.1. IUTI classification system

Each sample point is photo-interpreted in order to classify the sample into IUTI land use classes at different points in time (1990, 2008) For 2012 the land classification, through the photo-interpretation, has been assessed on a IUTI's subgrid (i.e. 301,300 points, covering the entire country). For sample points where a land use change in the forest category is detected between 1990 and 2008, as a result of afforestation/reforestation/deforestation activities, the land use classification is performed also in an intermediate point in time (2000), in order to estimate by interpolation the annual gain/loss of forest area in different time periods (1990-2000 and 2000-2008)

a.3 Quality assurance/Quality control:

Data supplied by IUTI is collected in the “National Registry for the carbon sinks” of Kyoto Protocol, and fulfill quality needs, outlined in the IPCC guidelines and required by UNFCCC relevant decisions. The photointerpreters have been trained through specific courses, in order to ensure a standard photointerpretation approach. In this phase, a particular attention was paid to the presence and distribution of forest formations. In cases of uncertain land use classification of the sample point, an internal expert panel classified the point.

The procedure of quality control has been carried out by an internal expert panel which led a new photointerpretation on a sub-sample of classified points (5%). The control activities have produced the same classification as carried out by the photointerpreters in more than of 95% of the cases.

Classification methodology

The adopted classification methodology ensures that any unit of land could be classified univocally (exclusion of multiple classification of the same unit of land) under a category (exclusion of the null case), by means of:

- a systematic sampling design to select classification points;
- a list of land-use definitions as reported in the IPCC land-use classification;
- a list of land-use indicators able to indicate the presence of a certain use on the land;
- a classification hierarchy to facilitate land use classification (Table A1.2)

Concerning land use classification, the first step is related to a land classification, following artificial land level; the aim is to discriminate between land areas significantly modified by human activity, with an evolution strongly conditioned by prevalently residential and productive activities, and land areas

characterized by a high degree of naturalness, in which natural evolution, although conditioned by human action, still exercises a predominant effect in the determination of the prevalent characteristics of the land.

Distinctions are therefore made between urbanized and agricultural territories, and natural and semi-natural territories (forest, pre-forest and herbaceous formations, open water, rocky areas).

At the subsequent levels, the classification process follows the prevalent use of land in the category of artificial territories, while the discriminating element for natural and semi-natural territories is essentially given by the vegetative cover degree, considering canopy, shrub and herbaceous cover.

A. LAND WITH ITS ORIGINAL CHARACTERISTICS OF PHYSIOGNOMY AND VEGETATION SIGNIFICANTLY MODIFIED BY HUMAN ACTION, CULTIVATED, CLEARED OR SUBJECT TO URBANIZATION WORK, AND DOMINATED BY ANTHROPIC ARTEFACTS DUE TO RESIDENTIAL, INDUSTRIAL, SOCIO-CULTURAL AND AGRICULTURAL ACTIVITIES.

AI. Land occupied by other agricultural cultivations

AI1. Herbaceous cultivations in open fields, subject to regular rotation, for the production of cereals, pulses, other food products or forage.

ARABLE

AI2. Arboreal cultivations not subject to regular rotation, destined permanently to the production of fruit or wood products.

AI2a. *Arboreal cultivations destined prevalently to the production of fruit for nutritional purposes (apple orchards, vineyards, olive groves, etc) or for the production of arboreal or shrub species for ornamental purposes*

ORCHARDS and NURSERIES

AI2b. *Arboreal cultivations destined prevalently to the production of wood products or of woody biomass for energy generation purposes*

ARBOREAL CULTIVATIONS FOR WOOD PRODUCTS

AII. Areas with residential and industrial buildings and services, transport routes, infrastructures and urban green areas (parks and gardens)

SETTLEMENTS

B. NATURAL OR SEMI-NATURAL LAND NOT SIGNIFICANTLY MODIFIED BY HUMAN ACTION OR IN PHASE OF RENATURALIZATION.

BI. Formations constituted by trees able to reach the height on maturity *in situ* of 5 m, but temporarily lacking in canopy cover following accidental events or anthropic action.

WOODED LAND TEMPORARILY WITHOUT ABOVE-GROUND COVER

BII. Formations constituted by trees able to reach the height on maturity *in situ* of 5 m and procuring a degree of canopy cover on the terrain of $\geq 5\%$.

BII1. Formation with a degree of cover $< 10\%$

OTHER WOODED AREAS

BII2. Formation with a degree of cover $\geq 10\%$

WOODLAND

BIII. Formations never as above

BIII1. Formations constituted by shrubs or trees not able to reach a height on maturity *in situ* of 5 m, and procuring a degree of canopy cover on the terrain of $\geq 10\%$

OTHER WOODED LAND

BIII2. Formations constituted by shrubs or trees not able to reach a height on maturity *in situ* of 5 m and procuring a degree of canopy cover on the terrain of $< 10\%$, and silvi-pastoral formations with canopy cover from trees able to reach a height on maturity *in situ* of 5 m but with cover $< 5\%$

BIII2a. *Natural herbaceous formations of ground species with a degree of herbaceous cover*

of $\geq 40\%$.

PASTURES, MEADOWS and UNCULTIVATED HERBACEOUS AREAS

BIII2b. *Natural herbaceous formations with a degree of herbaceous cover of < 40% or land completely lacking herbaceous cover*

BIII2b1. *Land without vegetation or with sporadic herbaceous vegetation. Rocky outcrops and beaches.*

OTHER LANDS

C. AREAS WITHOUT VEGETATION AND COVERED BY STILL OR FLOWING WATER OR AREAS OCCUPIED BY PARTICULAR ECOSYSTEMS OTHER THAN TERRESTRIAL ECOSYSTEMS (FLOATING VEGETATION, WET VEGETATION, SALTWATER VEGETATION, ETC).

MARSHLANDS AND OPEN WATERS

Table A1.2. Classification hierarchy

To achieve land use classification, a 0.5 ha neighbourhood of the sample plot is investigated. The operative procedure consists in digital orthophotos processing, considering sampling points: for each point identified on the territory by coordinates in a known reference system, the land use category, defined according to the classification system, has to be established.

A grid, composed of 9 squares (3 x 3) of 2500 m² each, for an overall surface area of 22,500 m² is used. This graphic object, at the centre of which the sampling point must be situated, allows to assess whether area intercepted by the sampling point has an extension equal to or greater than the established threshold (equivalent to the surface area of 2 of the 9 cells displayed).

If the surface area value is very close to the threshold and the use of the cells still leaves doubts, a graphic tool for surface area measurement is used for the classification process. The contour of the polygon containing the sampling point is mapped, computing the extent of the area.

In Figures A1.1, A1.2 and A1.3, examples from land use classification system are reported. In particular, in Figure A1.1 the sampling point is classified as 3.1 Grassland, given that trees covering the sampling point have a surface area between 500 and 5000 m². In Figure A1.2, the sampling point is classified as 1.1 Woodland, while in Figure A1.3, the sampling point is classified as 3.1 Grassland.

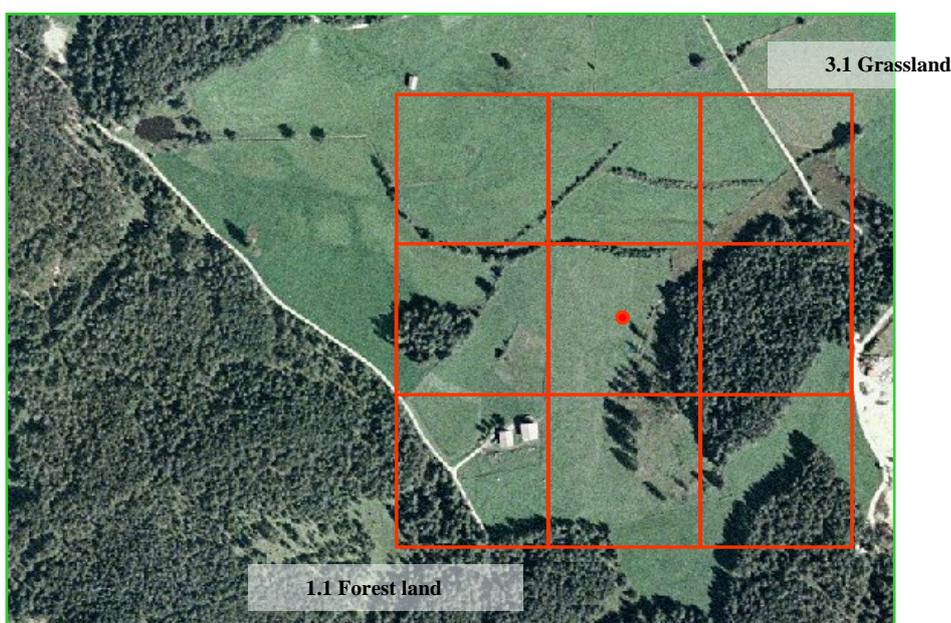


Figure A1.1 Land use classification system - grassland

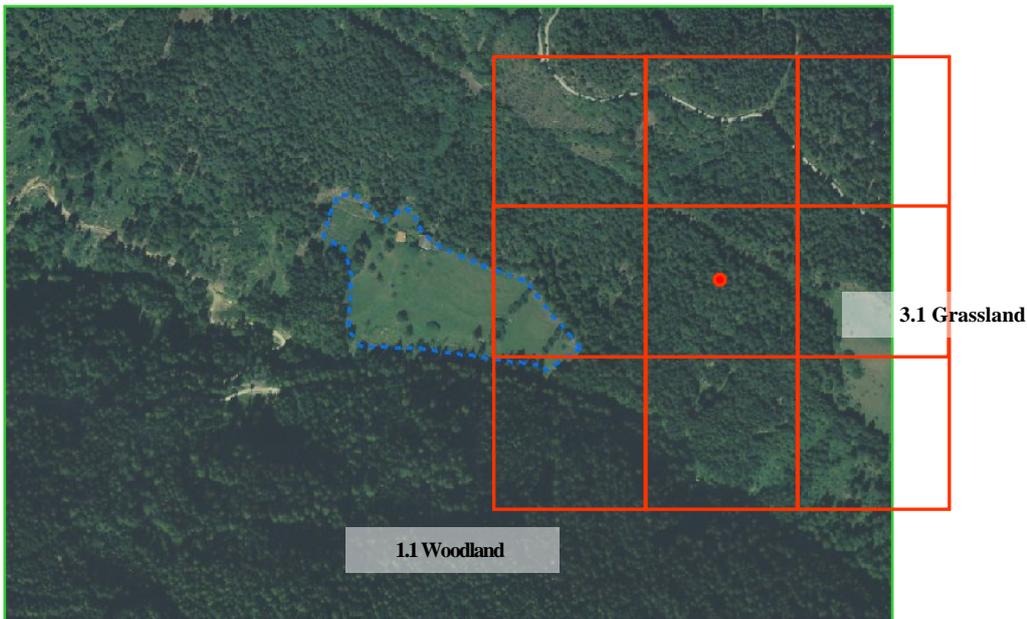


Figure A1.2 Land use classification system - Woodland

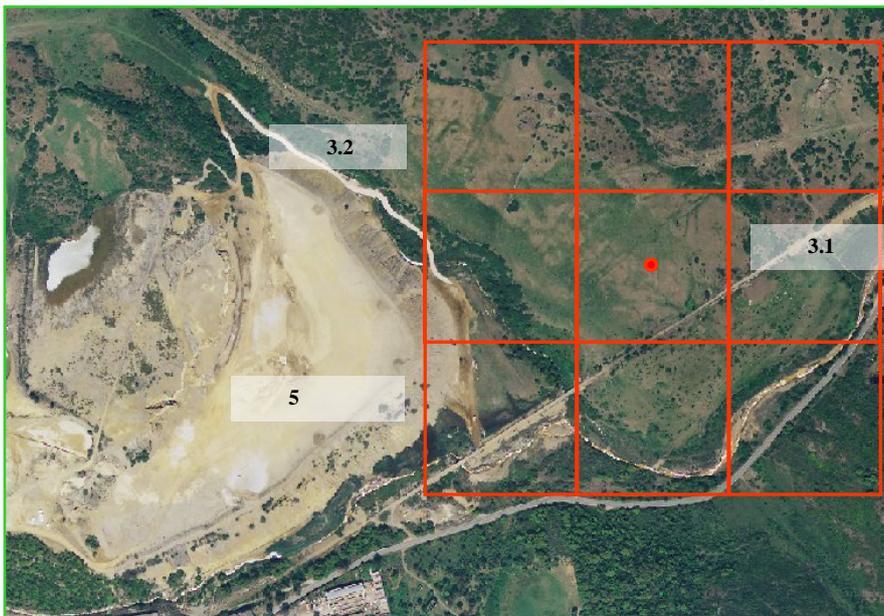


Figure A1.3 Land use classification system – grassland

b. National Inventory of Carbon Stocks (ISCI)

The National Inventory of the Carbon Stocks is a sampling of carbon stocks related to the different land-use categories.

The National Inventory of the Carbon Stocks includes:

- carbon stock changes in the land-use category forest land, the dataset is derived by the NFIs⁵ data;
- carbon stock changes in the subcategories of the conversion to or from forest land to other predominant uses, the land in conversion to and from *forest land* to other uses require data integration with studies and additional surveys in order to estimate, at regional level, the C stock levels related to non-forest land uses(i.e. *settlements, cropland, grassland, wetlands*).

⁵ Italian National Forest Inventories: http://www.sian.it/inventarioforestale/jsp/home_en.jsp

b.1 Time:

ISCI annually provides time series of carbon stock levels and carbon stock changes for the category *forest land* and for the sub-categories land in conversion to and from *forest land* to other uses. For the Kyoto Protocol accounting, the time series needed is related to the period 31/12/2012 - 1/1/2021.

b.2 Space:

Concerning the category *forest land* and any other category in conversion to and from *forest land*, the NFIs assure the spatial coverage, providing carbon stocks data, at NUT2 level.

b.3 Quality assurance:

Data supplied by ISCI is collected in the “*National Registry for the carbon sinks*” of Kyoto Protocol, and fulfill quality needs, outlined in the IPCC guidelines and required by UNFCCC relevant decisions.

c. National Census of Fires (CIFI)

The National Census of Fires is a system aimed to detect, locate and classify areas affected by fires; it provides data on burned forest land area and fires occurring in other land use categories.

The core of CIFI is the detailed database, provided by the Italian National Forest Service (CFS - Ministry of Agriculture, Food and Forest Policies), collecting data related to any fire event occurred in 15 administrative Italian regions⁶ (the 5 autonomous regions are not included), and reporting, for each fire event, the following information:

- *burned area [ha]*
- *forest typology (27 classes in line with the NFI nomenclature)*
- *scorch height [m]*
- *fire's type (crown, surface or ground fire)*

Data and information related to fire occurrences in the 5 remaining autonomous regions are collected at regional level, with different level of disaggregation and details (for example, in Sardinia region, the amount of biomass burned is reported instead of the scorch height).

Therefore the data used in the estimation process may be subdivided into the following groups with similar characteristics:

- a. time series from 2008 on for the 15 Regions: data related to burned area, divided into different forest types, scorch height and fire's type;
- b. time series from 2008 on for the 5 autonomous regions/provinces: data related to burned area;
- c. time series from 1990 to 2007 for the 20 Italian regions: data related to burned area.

Statistics related to fires occurring in other land use categories (i.e. cropland, grassland and settlements) have been collected in the framework of *ad hoc* expert panel on fires has been set up, formed by experts from different institutions from ISPRA and Italian National Forest Service (Ministry of Agriculture, Food and Forest Policies), currently in charge for the official publication related to burned area (<http://www3.corpoforestale.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/6358>).

c.1 Time:

CIFI annually provides, from 01/01/2008, time series of forest areas affected by fires. For the Kyoto Protocol accounting, the time series needed is related to the period 31/12/2012 - 1/1/2021.

⁶ The Italian territory is subdivided in 20 administrative regions, 5 of which are autonomous: Valle d'Aosta, Friuli Venezia Giulia, Sardegna, Sicilia and Trentino Alto Adige, the latest subdivided in two autonomous provinces (Trento and Bolzano).

c.2 Space:

CIFI covers all the national territory and will provide geographically referenced data on burned *forest land remaining forest land* areas (art. 3.4) and on *land converted to forest land* burned areas (art. 3.3).

Fires occurring in other land use categories (i.e. cropland, grassland and settlements) have been collected at NUTS2 level.

Key elements:

The key elements are:

- ground surveys that have to detect fires and record boundaries of burned areas. Additional data will concern collection of attributes as damage evaluation (percentage of oxidised biomass), forest typology (following NFI classification);
- remote sensed data will integrate data from ground surveys, in order to cross-check detected burned areas, at 0.5 ha spatial definition;

c.3 Quality assurance:

Data supplied by CIFI is collected in the “*National Registry for the carbon sinks*” of Kyoto Protocol, and fulfill quality needs, outlined in the IPCC guidelines and required by UNFCCC relevant decisions.

d. National Inventory of non-CO₂ emissions from fires (IEIF)

The fires GHG emissions National Inventory is aimed to estimate non-CO₂ emissions from forest fires (CO₂ emissions are not taken into account, being already computed by National Inventory Carbon Stocks as decreases in carbon stocks) and GHG emissions from fires affecting land subject to Cropland Management and Grazing land Management activities.

It provides:

- emission estimates related to fires on the land-use category *forest land*;
- emission estimates related to fires on the land-use categories in conversion to or from *forest land* to other predominant uses.
- Emission estimates related to fires on land-use categories *cropland* and *grassland*

d.1 Time:

The fires GHG emissions National Inventory annually provides time series of GHG emissions from fires. For the Kyoto Protocol accounting, the time series needed is related to the period 31/12/2012 - 1/1/2021.

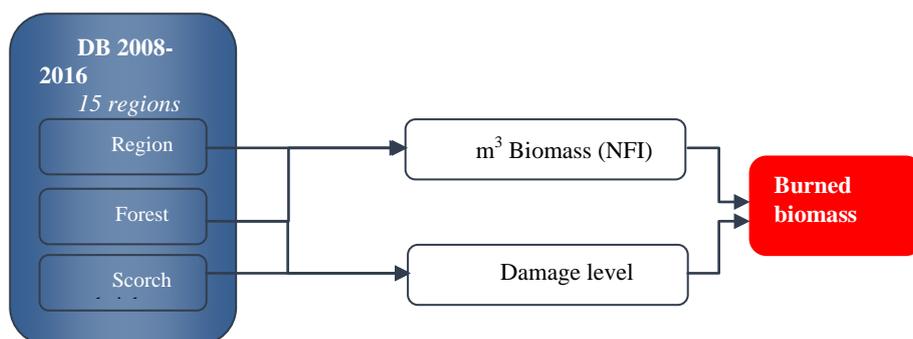
d.2 Space:

IEIF supplies estimates of emissions released by fires detected by National Census of Fires.

Key elements:

On the basis of the different datasets available, in each year and group of regions, different approaches and assumptions have been followed to estimate non CO₂ emissions from forest fires.

- a. The estimation of non CO₂ emissions from fires in the 15 regions has been carried out on the basis of the following approach aimed to assess forest fire damage and related biomass losses in Italy, taking into account two main elements: the fire intensity (assessed through the scorch height) and the forest typologies affected by fire. These two elements allow an assessment of the fraction of biomass burnt in a fire event. The estimation process has been carried out using the database containing around 32,700 records, related to any fire event fires on forest and other wooded land for the period 2008-2016, including information as the scorch height and the area per forest type.



In case of missing data, record by record, a gap filling procedure has been adopted, using the following assumptions/data:

1. Scorch height data missing: the average damage level for the forest type/type of fire/region calculated over the 2008-2016 period has been attributed to the record.
2. No volume is associated with the record – this is due to the probable misclassification of the forest type by the surveyors, which have attributed a forest type that is not present in the region, thus no data from NFI can be attributed. In this case the average burned volume per region and fire’s type has been attributed to the record. In case of no specific indication on fire’s type, then the average of the most severe fire’s type, by region, calculated over the complete dataset (2008-2016) has been used (i.e. highest average among averages calculated per fire’s type in the region)
3. Scorch height and volume missing: In case information on both issues is missing the highest average burned biomass calculated per fire’s type in each region has been attributed to the record.

b. The emissions from fires for the 5 autonomous regions/provinces has been estimated on the basis of the average values assessed for the 15 regions from 2008 on, using the following procedure:

1. for each of the 15 regions (group a), the highest value of C released among the averages, calculated for the years from 2008 on, has been selected, per fire’s type;
2. the 15 regions have been clustered into three group with similar climatic conditions and forest types (Northern, Center and Southern Italy);
3. the average values of carbon released for fire’s type have been calculated for the three abovementioned clusters;
4. the 5 autonomous regions have been classified according the 3 cluster identified at step 2;
5. an average value of carbon released, computed at step 3, is associated to the 5 autonomous regions, according the belonging cluster;
6. the emissions from fires are estimated by multiplying average value of carbon released per the burned area of each autonomous region.

d.3 Quality assurance:

Data supplied by IEIF is collected in the “*National Registry for the carbon sinks*” of Kyoto Protocol, and fulfill quality needs, outlined in the IPCC guidelines and required by UNFCCC relevant decisions.

e. Cropland and grazing land management

These sections of the *national registry for carbon sinks* have been added following the decision by Italy to elect cropland management (CM) and grazing land management (GM) as additional activities under Article 3.4 of the Kyoto Protocol for the second commitment period (2013-2020). The Ministry for the Environment, Land and Sea (MATTEM) jointly with the Ministry of Agriculture, Food and Forest Policies (MIPAAF) has established a Committee of National experts at institutional and scientific level, aimed to deal with all issues related to reporting and coordination of activities related to LULUCF reporting, included also

the needs set out by the Kyoto Protocol; a focus will be applied to verification activities carried out in the framework of the implementation of EU Decision n. 529/2013⁷.

e.1 Cropland management

This section of the *national registry for carbon sinks* is aimed to the data collection and to estimate emissions and removals related to the cropland management activity under art. 3.4 of the Kyoto Protocol.

Land subject to cropland management have been assessed on the basis of the following subcategories:

1. land covered by arable crops and woody crops subject to inspections and certifications, in accordance with the EU Regulations on **organic production**⁸;
2. land covered by arable crops grown using “**conservative practices**”, including management practices aimed to preserve the soil⁹ (e.g.: tillage practices to prevent/reduce soil erosion; cover crop; minimum tillage, zero tillage or sod seeding, mulching);
3. land covered by arable crops and woody crops grown using “**sustainable management systems**¹⁰”, including tillage and soil management practices usually provided for within the integrated production. These practices are intended to improve the crops adaptation for maximize the production results; foster pest control; improve the efficiency of nutrients by reducing the losses due to leaching, runoff and evaporation; maintain the soil in good structural conditions; prevent erosion and landslides, preserve the soil organic matter and facilitate soil drainage.
4. land set aside¹¹ requiring cover crops, spontaneous or sown, all the year long and agronomic practices consisting of mowing or another equivalent operations in order to preserve the normal soil fertility, protect wild fauna, prevent a potential inoculum of burnings, especially during drought conditions, and avoid the pests spread.
5. land covered by arable crops and woody crops grown using “**ordinary agriculture**” is the land which doesn’t fall within one of the above kinds of management.
6. land subject to **greening practices**, in accordance with the EU Regulation 1307/2013.

With regard to data sources:

- a. Data of cropland managed with **organic practices** has been derived from the National System on Organic Farming (SINAB, <http://www.sinab.it/>) of the Ministry of Agriculture, Food and Forest Policies (MIPAAF). Data from SINAB are collected at national level for the total organic area starting form 1990.

⁷ Decision n. 529/2013/EU of the European Parliament and of the Council of 21 May 2013 on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32013D0529>.

⁸ Council Regulation (EEC) No 2092/91: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31991R2092:EN:HTML>, Commission Regulation (EC) n. 889/2008: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R0889&from=EN>; Council Regulation (EC) n. 834/2007: <http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=URISERV:f86000&from=IT>; Council Regulation (EEC) n. 2092/91: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31991R2092:EN:HTML>; Rural Development Regulations – organic farming measure (Regulations (ex) 2078/1992, (ex) 1257/1999, (ex) 1698/2005 and 1305/2013)

⁹ in accordance with the Regulation (EEC) n. 2078/92: http://ec.europa.eu/agriculture/envir/programs/evalrep/text_en.pdf, (ex) 1257/1999, Council Regulation (EC) n. 1698/2005: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32005R1698&from=en>, and Regulation (EU) n. 1305/2013: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0487:0548:EN:PDF>

¹⁰ in accordance with the national guidelines on integrated production and with the EU Regulations on the Rural Development (Regulations (ex) 2078/1992, (ex) 1257/1999, (ex) 1698/2005 and 1305/2013)

¹¹ EU Regulations ((ex) 1094/88; (ex) 1765/92 e 1251/99; (ex) 1782/03 and 1307/2013) and National decree on cross compliance implementation (ex) DM 22.12.2009 and DM 23.1.2015

- b. Data of cropland managed with “**conservative practices**” are derived from the Implementation Report Tables¹² (AIRs) of the regional Rural Development Programmes (RDPs). Data have been collected at regional level (NUTS2), from 2008, and have been homogenized taken into account the different definitions adopted for these practices at NUTS level.
- c. Data of cropland areas managed with “sustainable management systems” are derived from the AIRs of the regional RDPs¹³ and the Annual Report of the Operative Programmes of the fruit and vegetables in the framework of CMO¹⁴, being the integrated production funded under these two schemes. Data have been collected at regional level (NUTS2), from 2000. The AIRs provide data referred to total cropland areas. The data were broken down by arable crops and woodycrops by applying the indicators contained in the national database¹⁵. Verification activities have been carried out through direct information acquired by the Regions with largest share of areas under these management systems.
- d. Data of land set aside are derived from Eurostat¹⁶ and are available for 1990, 1993, 1995, 1997, 2000, 2003, 2005 and 2007. Data for the missing years have been estimated by interpolation.
- e. Data of land using “ordinary agriculture” is obtained by difference between the total area detected by national statistics (ISTAT) and the data related to the abovementioned subcategories.

e.1.1 Time

Annual data of land subject to cropland management and related estimates of emissions and removals are provided. For the Kyoto Protocol accounting, the time series needed is related to the period 31/12/2012 - 1/1/2021; data on 1990 is needed to implement the net-net accounting.

e.1.2 Space

The reporting area boundaries for cropland management have been identified with the administrative boundaries of Italy (NUTS1) and administrative regions (NUTS2). The spatial assessment for cropland management refers to the cadastral unit or to a part of it, where the cropland management is carried out.

e.2 Grazing land management

The aim of this section of the *national registry for carbon sinks* is the data collection and the estimates of emissions and removals related to the grazing land management activity under art. 3.4 of the Kyoto Protocol. Land subject to *grazing land management* have been assessed on the basis of the definition included in the Annex to the decision 16/CMP.1¹⁷. Lands under GM in Italy are those predominantly covered by herbaceous vegetation (introduced or indigenous) for a period longer than five years, used for grazing or fodder harvesting and /or under practices to control the amount and type of vegetation. As preliminary step, only the area related to the ‘improved grazing land’ have been reported; this area corresponds to lands subject to inspections and certifications procedures, in accordance with the EU Regulations¹⁸ on organic production, as well as by the Rural Development Regulations¹⁹ related to the organic farming measure. Data of grazing

¹² http://ec.europa.eu/agriculture/cap-indicators/output/working-document-rd-monitoring-implementation-report-tables_en.pdf in the framework of the EU’s rural development policy: http://ec.europa.eu/agriculture/rural-development-2014-2020/index_en.htm; for 2007-2014 referred to action 214.6)

¹³ for 2007-2014 referred to action 214.1 – tables O.214(1) and O.AGRI.ENV

¹⁴ Common Organisation of the Markets (CMO) in agricultural products
http://www.europarl.europa.eu/atyourservice/en/displayFtu.html?ftuId=FTU_5.2.4.html

¹⁵ Indicatori Agricoli Territoriali”, National Rural Network: <http://indiciterritorialiagricoli.ismea.it>

¹⁶ Fallow land and set-aside land: <https://open-data.europa.eu/it/data/dataset/aLDul3sogcS8Hur7m4HWg>

¹⁷ *Grazing land management* is the system of practices on land used for livestock production aimed at manipulating the amount and type of vegetation and livestock produced.

¹⁸ Commission Regulation (EC) n. 889/2008: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R0889&from=EN>; Council Regulation (EC) n. 834/2007: <http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=URISERV:f86000&from=IT>; Council Regulation (EEC) n. 2092/91: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31991R2092:EN:HTML>

¹⁹ Regulation (EEC) n. 2078/92: http://ec.europa.eu/agriculture/envir/programs/evalrep/text_en.pdf;

lands managed with organic practices has been derived from the National System on Organic Farming (SINAB, <http://www.sinab.it/>) of the Ministry of Agriculture, Food and Forest Policies (MIPAAF).

Total organic area is reported in the SINAB at national level since 1990. Quantitative information on the different subcategories, including organic grazing land, is available from the year 1999. The data related to the land subject to the organic grazing land from 1990 to 1998 has been deduced applying the average proportion of organic grazing land to the total organic area (22.6%) in the period 2000-2012.

Carbon stock changes related to land subject to *grazing land management* have been estimated on the basis of the guidance of 2013 KP Supplement (IPCC, 2014). In particular no change in carbon stocks in the living biomass pool has been assumed; Tier 1 method has been followed for dead wood and litter, assuming that the abovementioned pools are at equilibrium, and no carbon stock changes are occurring. Changes in carbon stocks in mineral soils have been estimated following the 2006 IPCC Guidelines on the basis of country specific SOC_{ref} deduced by the default reference soil organic carbon stocks for mineral soils (table 2.3, vol.4, chapter 2, IPCC, 2006). The assessment of the country specific SOC_{ref} has been carried out using the following layers: Climatic Zone layer²⁰, Corine Land Cover 2006²¹ (classes codes: 2.3, 3.2), Italian soil map (Costantini et al., 2013). The country specific SOC_{ref} have been stratified into three macroareas in Italy (north, center and south).

e.2.1 Time

Annual data of land subject to grazing land management and related estimates of emissions and removals are provided. For the Kyoto Protocol accounting, the time series needed is related to the period 31/12/2012 - 1/1/2021; data on 1990 is needed to implement the net-net accounting.

e.2.2 Space

The reporting area boundaries for grazing land management have been identified with the administrative boundaries of Italy (NUTS1) and administrative regions (NUTS2). The spatial assessment for grazing land management refers to the cadastral unit or to a part of it, where the grazing land management is carried out.

e.3 Quality assurance

Data will be annually collected in the section related to cropland and grazing land management and have to fulfill quality requirements as stated by the IPCC and UNFCCC guidelines.

Council Regulation (EC): n. 1257/1999 <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31999R1257&from=en>; Council Regulation (EC) n. 1698/2005: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32005R1698&from=en>; Regulation (EU) n. 1305/2013: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0487:0548:EN:PDF>

²⁰ European Commission's Joint Research Centre (JRC): Climatic Zones <http://esdac.jrc.ec.europa.eu/projects/renewable-energy-directive>

²¹ Corine Land Cover 2006: <http://sia.eionet.europa.eu/CLC2006>

ANNEX 2: THE NATIONAL REGISTRY

According to Article 7 of the Kyoto Protocol each Party included in Annex I shall incorporate in its annual greenhouse gas inventory the necessary supplementary information for the purposes of ensuring compliance with Article 3 of the Kyoto Protocol.

Supplementary information under article 7, paragraph 1, with regards to units holdings and transactions during the year 2016, is reported in the SEF submission (figures are also included in tables A8.2.2.1 - A8.2.2.5c of this document).

This annex reports supplementary information with regards to the national registry and in accordance with the guidelines set down in Decision 15 CMP.1 (Annex II.E Paragraph 32).

More detailed information can be found in the relevant annexes that have been submitted to UNFCCC along with this document.

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

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

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

No change of name or contact occurred during the reported period.

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

Italy maintains its national registry in a consolidated manner with all the Parties that are also EU Member States and with the European Union, sharing the same platform hosted and facilitated by the European Commission.

No change of cooperation arrangement occurred during the reported period.

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

The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the Data Exchange Standard (DES). All tests were executed successfully and lead to successful certification on 1 June 2012.

The version of the EUCR released after 8.0.7 (the production version at the time of the last submission) introduced minor changes in the structure of the database.

These changes were limited and only affected EU ETS functionality. No change was required to the database and application backup plan or to the disaster recovery plan. The database model is provided in Annex A.

No change to the capacity of the national registry occurred during the reported period.

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

Changes introduced since version 8.0.7 of the national registry (the production version at the time of the last submission) are listed in Annex B.

Each release of the registry is subject to both regression testing and tests related to new functionality. These tests also include thorough testing against the DES and were successfully carried out prior to the relevant major release of the version to Production (see Annex B).

No other change in the registry's conformance to the technical standards occurred during the reported period.

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

The overall change to a Consolidated System of EU Registries also triggered changes to discrepancies procedures, as reflected in the updated *manual intervention document* and the *operational plan*. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries.

No change of discrepancies procedures occurred during the reported period.

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

The overall change to a Consolidated System of EU Registries also triggered changes to security, as reflected in the updated *security plan*. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries.

No change regarding security occurred during the reported period.

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

Publicly available information is provided via the Union registry at the national homepage

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

All non-confidential information required by Decision 13/CMP.1 annex II.E paragraphs 44-48, is publicly accessible with the following exceptions:

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

No change to list of publicly available information occurred during the reported period.

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

The Italian registry can be accessed at the following URL:

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

No change of the registry internet address occurred during the reported period.

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

The overall change to a Consolidated System of EU Registries also triggered changes to data integrity measures, as reflected in the updated *disaster recovery plan*. The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries.

No change of data integrity measures occurred during the reported period.

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

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

On 2 October 2012 a new software release (called V4) including functionalities enabling the auctioning of phase 3 and aviation allowances, a new EU ETS account type (trading account) and a trusted account list went into Production. The trusted account list adds to the set of security measures available in the CSEUR. This measure prevents any transfer from a holding account to an account that is not trusted.

Changes introduced since version 8.0.7 of the national registry (the production version at the time of the last submission) are listed in Annex B. Both regression testing and tests on the new functionality were successfully carried out prior to release of the version to Production. The site acceptance test was carried out by quality assurance consultants on behalf of and assisted by the European Commission.

ANNEX 3: THE NATIONAL SYSTEM FOR POLICIES, MEASURES AND EMISSIONS PROJECTIONS

In 2016, in the context of the Kyoto Protocol commitments and its amendment (*‘Doha amendment’*) for the second Commitment Period (2013-2020), Italy adopted the Law n. 79/2016, “Ratification of the Doha amendment to the Kyoto Protocol” which establishes the *National system for policies, measures and emissions projections*, in line with art. 12 of the EU Monitoring Mechanism Regulation (MMR 525/2013/EU)

ISPRA is responsible of this system and, in cooperation with IMELS, collects all the information and data from the competent Ministries. The list of information and data that the competent ministries have to provide to MATTM and ISPRA are reported in article 1 of the Law, as well as the timing for providing such information.

Figure A3.1 shows the decision making process and data flow related to climate changes policies.

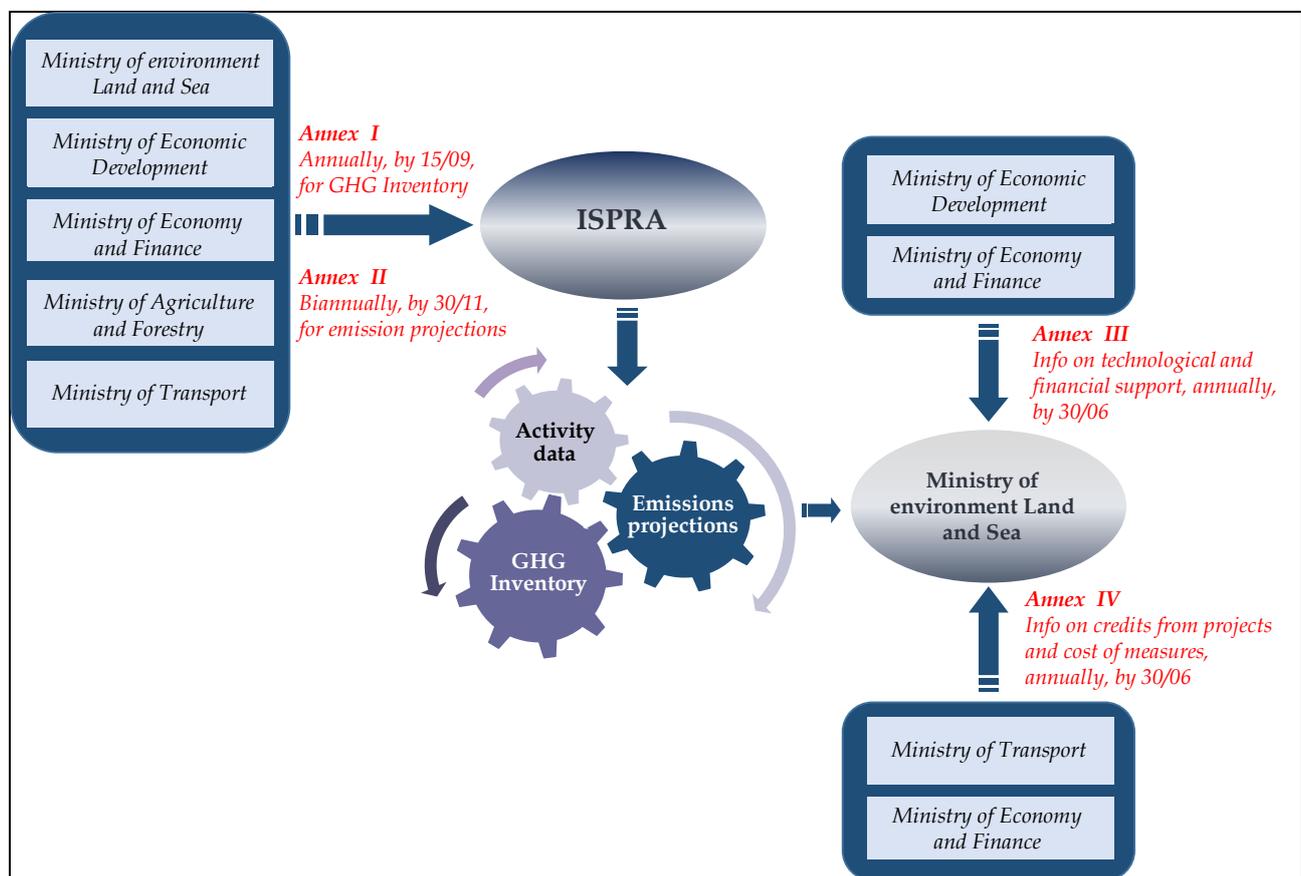


Figure A3.1. National system for policies, measures and emissions projections

Two working groups have been established for national decision-making processes related to climate change policies. The description of these two groups is reported in the following Figures A3.2 and A3.3.

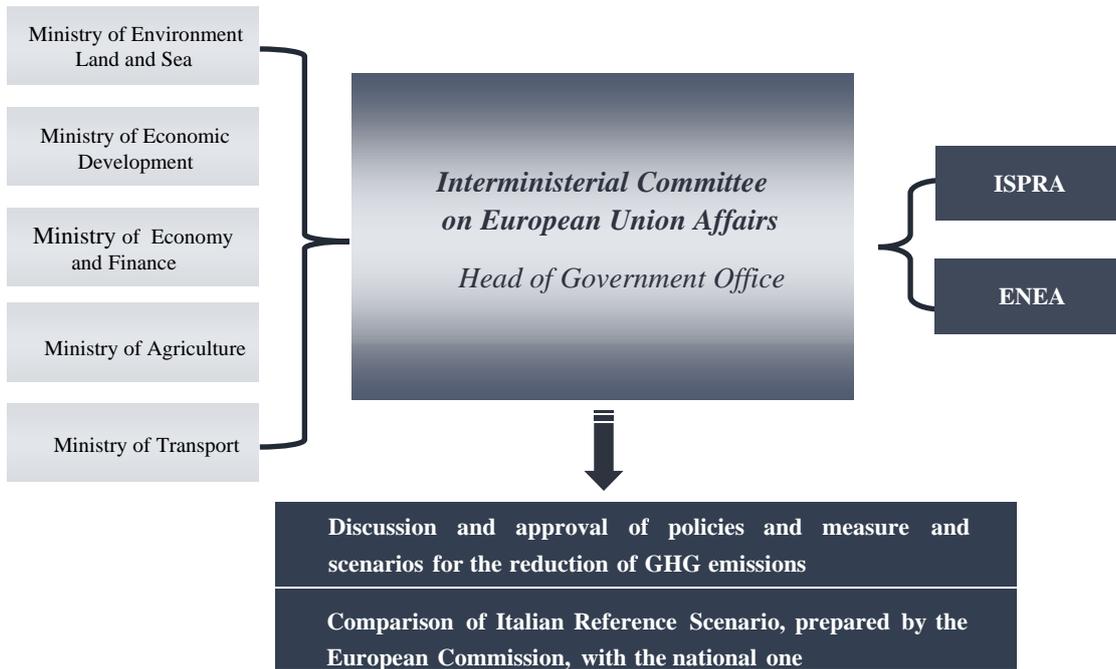


Figure A3.2. Interministerial working group for the definition of national target

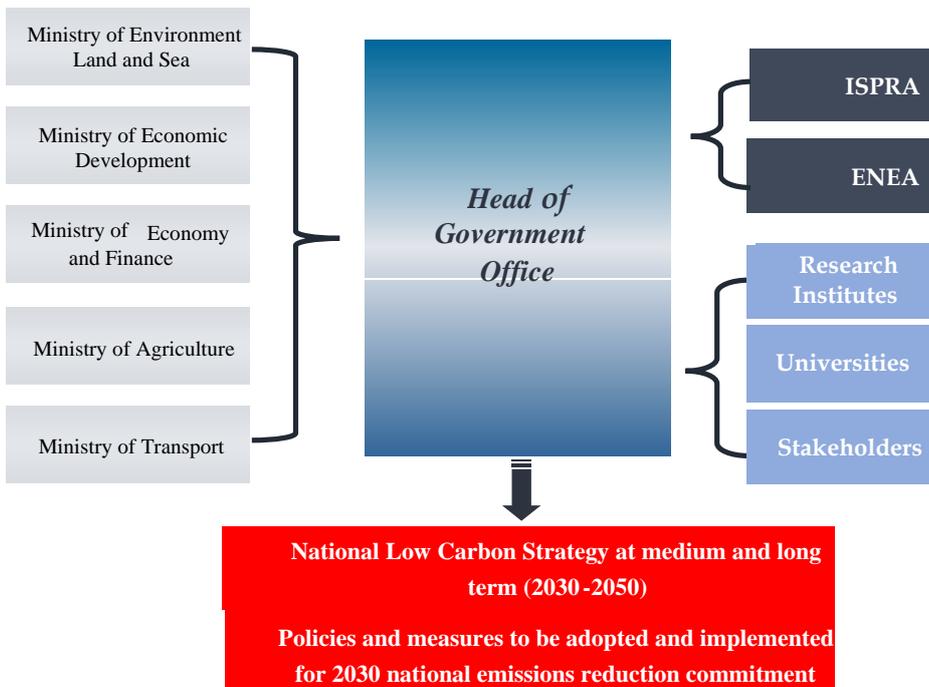


Figure A3.3. Interministerial working group for the National Low Carbon Strategy

ANNEX 4: PLANNED IMPROVEMENTS

In the following table are reported the planned developments of the national emission inventory for the next years and their expected implementation.

Sector	Category	Parameter	Gas	Description	Timing
Cross-cutting	-	-	-	Implementation and verification of EMEP/EEA 2016 Guidebook	2017-2018
	-	-	-	Improve the QA/QC annual plan report with the description of the tier2 QC checks implemented at sectoral level	2017-2019
	-	-	-	Quantitative uncertainty analysis of emission estimates of other pollutants reported in the UNECE/CLRTAP framework	2017-2019
Energy	-	AD	-	A working group of Ispra and Ministry of Economic Development is investigating about the differences between Eurostat and BEN. The analysis of differences includes the comparison of ETS data with figures of energy consumption for electricity production reported by the Italian Independent System Operator (TERNA) to the Ministry of Economic Development Activities for publication in the BEN	2017-2019
	Public electricity and heat production	EFs	HMs	Update/change emission factors for those pollutants, as zinc, where figures reported in the EPRTTR lead to average EFs significantly different from those actually used	2017-2019
	Off-road Industry	EFs	All	Survey on activity data and technological parameters of off-road vehicles	2018-2019
	Transport-maritime	EFs	NOx HC CO PM	Agreements have been established with ISTAT for maritime data provision which should allow a yearly availability of basic data and the application of more advanced Tiers for the estimation of these sectors	2017-2019
IPPU	Cement /lime production	AD	CO ₂	Further investigations concerning the replacement of natural raw material in clinker manufacture and in lime production	2018-2019
	Building industry	AD	PM10	Estimate and report emissions from categories 2A7a, "Quarrying and mining of minerals other than coal" and 2A7b, "Construction and demolition"	2018
	Chemical industry	AD	CO ₂	A detailed balance of the natural gas reported in the Energy Balance, as no energy fuel consumption, and the fuel used for the production processes in the petrochemical sector	2017-2019

	Lead and zinc production	Allocation	All	Allocation of emission between combustion and process sectors	2017-2018
	Consumption of halocarbons and SF ₆	AD	F-gases	Investigations on activity data on the basis of the new national database of F-gases and implementation of top-down approach to cross-check the final emission estimates of stationary refrigeration and air conditioning. Mobile air conditioning will be also investigate with a focus on the quality of the information collected and how import/export is managed, and methodologies used with regard the recharging and end of life	2017-2018
	Paint application	EFs	HC CO ₂	Assess the possibility to split non industrial application according to the Guidebook EMEP/EEA	2018-2019
Agriculture	Livestock /Agriculture soils	EFs	NH ₃ GHG	Analysis of the information collected from the 2016 Farm structure survey with regard to land spreading	2018
	Dairy cattle	N excretion	N ₂ O	Further efforts on theoretical assessment of N excretion data based on N balance methodology	2019
	-	Uncertainty	-	Re-assessment of uncertainty analysis with Montecarlo	2019
LULUCF	Forest land	-	GHG	Implementation of the III NFI's outcomes; the final outcomes, related to the field surveys, are expected to be available in 2019	2019-2020
	Cropland /Grassland	AD/EFs	GHG	Verification activities, data collection and model implementation for soils pool, data collection and reporting at regional level	2018-2019
	Settlement	AD	CO ₂	Improvement of data collection	2019
Waste	Disposal on landfills and incinerators	AD	CO ₂ , CH ₄	Waste composition and Carbon content of waste managed in landfills or incinerated	2015-2018
	Domestic and commercial wastewater	MCF; AD	CH ₄	Methane conversion factor from domestic and commercial wastewater will be investigated in the future. Moreover the served population equivalent figures supplied by the National Institute of Statistics will be verified with the results of the next national survey	2016-2018