

**QUALITY ASSURANCE/QUALITY CONTROL PLAN FOR THE
ITALIAN EMISSION INVENTORY
YEAR 2021**

Legal Disclaimer

The Institute for Environmental Protection and Research, or person acting on its behalf, are not responsible for the use that may be made of the information contained in this report.

ISPRA – Istituto Superiore per la Protezione e la Ricerca Ambientale
(Institute for Environmental Protection and Research)

Via Vitaliano Brancati, 48 – 00144 Rome

www.isprambiente.gov.it

Extracts from this document may be reproduced on the condition that the source is acknowledged

Text available on ISPRA website at <http://www.sinanet.isprambiente.it/it/sia-ispra/serie-storiche-emissioni>

Contact: Riccardo De Lauretis
telephone +39 0650072543
e-mail riccardo.delawaretis@isprambiente.it

ISPRA- Institute for Environmental Protection and Research
Environment Department
Monitoring and Prevention of Atmospheric Impacts
Air Emission Inventory Unit
Via V. Brancati, 48 00144 Rome ITALY

CONTENTS

QA/QC GENERAL5

QA/QC ENERGY14

QA/QC INDUSTRIAL PROCESSES AND PRODUCT USE.....21

QA/QC AGRICULTURE33

QA/QC LULUCF.....43

QA/QC WASTE.....52

IMPROVEMENT PLAN59

QA/QC GENERAL 2020 ACTIVITIES AND FUTURE IMPROVEMENTS

Prepared by: Daniela Romano, Riccardo De Lauretis

April, 2021

NATIONAL AIR EMISSION INVENTORY: GENERAL OVERVIEW

Objective

This document summarizes the specific Quality Assurance (QA) Quality Control (QC) activities and different verification procedures which are applied thoroughly the current inventory compilation as part of the estimation process.

In addition to a description of the current activities applied and the documentation, archiving and reporting processes, a specific section illustrates the main findings of the latest review process together with the actions undertaken by the inventory team.

Further improvements and planned QA activities identified during the preparation of the National Inventory and National Inventory Report 2021 are also presented.

A summary of previous QA/QC procedures which helped to understand the improvement of the inventory over the years concludes the general part of the report.

Sector specific QA/QC and verification documentation are explained in the relevant chapters.

Review process recommendations

In 2020, the Italian inventory was submitted to a centralised UNFCCC review; also, the European annual review of GHG emission inventories of Member States took place in 2020, under the Effort Sharing Decision. The main critical points raised during the review processes were addressed in the current inventory compilation and different improvements have been carried out.

Specific issues are described in the relevant sectoral chapters and there were no important problems concerning the general and cross cutting activities.

QA/QC activities and verification

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.

Specific QA/QC procedures are described in the manual 'Quality Assurance/Quality Control Plan for the Italian Inventory'¹. Verification activities are also part of the overall QA/QC program. These activities have the ultimate objective of increasing the confidence and reliability of the inventory estimates.

Feedbacks for the Italian inventory derive from communication of data to different institutions and/or at local level. For instance, the communication of the inventory to the European Community result in a pre-check of the GHG values before the submission to the UNFCCC and relevant inconsistencies may be highlighted.

Results and suggestions from expert peer reviews of the national inventory within the UNFCCC process can provide valuable feedback on areas where the inventories can be improved.

In addition to these annual reviews, 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. In the same year, also an in depth UNECE review was undertaken in the context of the CLTRAP convention. In the same context, in 2017, an in depth review was done focusing on the main atmospheric pollutants to verify the compliance with the national emission ceiling directive (NECD).

¹ ISPRA, 2013. *Quality Assurance/Quality Control plan for the Italian Emission Inventor: Procedures Manual*

Also a bilateral independent review between Italy and Spain, with a focus on the revision of the GHG and air pollutant inventories of both the Parties was established in 2012. 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 report². 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), and use of plant specific information.

Moreover feedbacks occur once the inventory, the inventory related publications and the national inventory reports are posted on the website, specifically <http://www.isprambiente.gov.it>. Additional comments derive from the communication of data to different institutions and/or at local level.

The inventory is presented every year 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. Emission figures and results are shared and discussed among experts.

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 Ministers. The report is annexed to the economy and financial document (DEF) to be annually approved by the Government.

Expert peer reviews of the national inventory also occur annually within the UNFCCC process; results and suggestions can provide valuable feedback on areas where the inventory should be improved. Specifically, the last in country review of the Italian GHG inventory by the UNFCCC Secretariat occurred in October 2019. Final results and recommendations of the reviews will be soon be available on the UNFCCC website at <https://unfccc.int/documents/9838#beg>.

Responses and actions to the review processes are described in detail in section IV.

With regard emissions projections and policies and measures, an official review was performed by Ecofys, in 2000, in order to verify of the effectiveness of policies and measures undertaken by Italy to reduce greenhouse gas emissions to the levels established by the Kyoto Protocol. In this framework, an independent review and checks on emission levels were carried out as well as controls on the transparency and consistency of methodological approaches³. In 2008, VITO, Öko-Institut and the Institute for European Environmental Policy, for DG Environment, undertook a review on the methodologies and EU Member States best practices used for GHG projections to identify possible ways to improve GHG projections and ensure consistency across the EU. The results were presented at the Workshop ‘Assessing and improving methodologies for GHG projections’. Further analyses were presented in the Workshop on ‘Quantification of the effects on greenhouse gas emissions of policies and measures’.

The preparation of environmental reports, where data are needed at different aggregation levels or refer to different contexts, such as environmental and economic accountings, is also a verification for emission trends. At national level, for instance, emission time series are reported in the Environmental Data Yearbook published by the Institute⁴. Emission data are also published by the Ministry of Environment in the Reports on the State

² AED, 2013. *Italy-Spain bilateral QA*

³ Ecofys, 2001. *Evaluation of national climate change policies in EU member states. Country report on Italy*

⁴ ISPRA, several years. *Environmental Data Yearbook*. ISPRA. <http://www.isprambiente.gov.it/it/publicazioni/stato-dellambiente>.

of the Environment⁵, the National Communications⁶ as well as in the Demonstrable Progress report⁷. Moreover, figures are communicated to the National Institute of Statistics to be published in the relevant Environmental Statistics Yearbooks⁸ as well as used in the framework of the EUROSTAT NAMEA accounting⁹.

Comparisons between national activity data and data from international databases are usually carried out in order to find out the main differences and an explanation to them¹⁰. Emission intensity indicators among countries (e.g. emissions per capita, industrial emissions per unit of added value, transport emissions per car, emissions from power generation per kWh of electricity produced, emissions from dairy ruminants per tonne of milk produced) can also be useful to provide a preliminary check and verification of the order of magnitude of the emissions. This is carried out at European and international level by considering the annual reports compiled by the EC and the UNFCCC as well as related documentation available from international databases and outcome of relevant workshops.

Additional comparisons between emission estimates from industrial sectors and those published by the industry in the relevant Environmental reports are carried out annually in order to assess the quality and the uncertainty of the estimates.

The quality of the inventory has also improved by the organization and participation in sector specific workshops. Follow-up processes are also set up in the framework of the WGI under the EC Monitoring Mechanism, which address to the improvement of different inventory sectors. In 2008 and in 2014, workshops were held, on the implications of the implementation of the 2006 IPCC Guidelines for national GHG inventories. Other workshops addressed: the use of European emissions trading scheme data in the national greenhouse gas inventories, management of uncertainty in national inventories, methodologies to estimate emissions from the agriculture and LULUCF sectors, involving the Joint Research Centre, from the waste sector, involving the European Topic Center on Resource and Waste Management, as well as from international bunkers, involving the International Energy Agency and EUROCONTROL. Presentations and documentation of the workshops are available at the address: http://air-climate.eionet.europa.eu/meetings/past_html.

A national conference on the Italian emission inventory was organized by APAT in October 2006. Methodologies used to carry out national figures and results of time series from 1990 to 2004 were presented detailing explanations for each sector.

In 2007, in the framework of the National Conference on Climate Change, an event previous to the Conference presented the National GHG emission Inventory and specifically the time series of emission estimates from 1990 to 2005; besides a specific session of the Conference was dedicated to the National and local Inventories focusing on methodological issues and policies and measures to be adopted to reduce GHG emissions. In 2010, the time series 1990-2008 was presented in a specific national Kyoto Protocol event. In 2014, emission time series and figure for the compliance with the Kyoto Protocol were presented to the stakeholders and the press. A specific procedure undertaken for improving the inventory regards the establishment of national expert panels (specifically, in the sectors of road transport, land use change and forestry and energy) 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

⁵ MATT, several years. *RSA-Report on the State of the Environment*. Ministero dell'Ambiente. <http://www.minambiente.it/biblioteca/relazione-sullo-stato-dellambiente-2009-sintesi>

⁶ MATT, several years. *National Communication under the UN Framework Convention on Climate Change*. Ministero dell'Ambiente. http://unfccc.int/files/national_reports/annex_i_natcom

⁷ MATT, 2006. *Italian report on demonstrable progress under article 3.2 of the Kyoto Protocol*. Ministero dell'Ambiente. <http://unfccc.int/resource/docs/dpr/ital.pdf>

⁸ ISTAT, several years. *Annuario Statistico Italiano*. Istituto Nazionale di Statistica, Roma, Italia

⁹ ISTAT, 2006. *La NAMEA: conti economici nazionali integrati con i conti ambientali*. Istituto Nazionale di Statistica. http://www.istat.it/dati/dataset/20060301_00/.

¹⁰ ENEA/MAP/APAT, 2004. *Energy data harmonization for CO₂ emission calculations: the Italian case*. Rome 23/02/04. EUROSTAT file n. 200245501004

under the Kyoto Protocol, a Scientific Committee, 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.

In addition to these expert panels, ISPRA participates in technical working groups within the National Statistical System (Sistan). 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. 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.

The assumptions, which uncertainty estimations are based on, 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 Guidance¹¹ and IPCC Guidelines¹².

Quantitative estimates of the uncertainties for the Italian GHG inventory are calculated using Approach 1 as defined in the IPCC 2006 Guidelines, 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 specific categories of the inventory but the results show that, with the information available at present, applying methods higher than Approach 1 does not make a significant difference in figures. The results of the study, 'Evaluating uncertainty in the Italian GHG inventory', were presented at an EU workshop on Uncertainties in Greenhouse Gas Inventories, held in Finland in September 2005, and they are also available on website at the address:

http://air-climate.eionet.europa.eu/docs/meetings/050905_EU_GHG_Uncert_WS/meeting050905.html.

A further research on uncertainty, specifically on the comparison of different methodologies to evaluate emissions uncertainty, was also carried out¹³.

In the last years, Monte Carlo analysis was applied to some key categories of the Italian inventory and it is planned to extend the study to other inventory categories.

In point of fact, the annual QA/QC plan includes all the improvements planned to the inventory and references to the relevant documentation and information supporting the modifications at sectoral and general level. Changes are based on the observations of the different inventory review stages (internal and external evaluations by third parties involved in inventory issues), the review feedbacks received from the UNFCCC Secretariat on the previous inventory or from the European internal review, and other collected information.

Whenever relevant changes in methodologies and emission estimates for key categories are planned, new methodologies and emission factors are chosen after consultation with the national experts also in the framework of the national sectoral expert panels. Internal reviews are also undertaken, comparing different methodologies, before changes are included in the inventory.

The QA/QC plan is updated every year to re-evaluate the quality objectives of the inventory.

All the material and documents used for the inventory preparation are stored at the Institute.

Information relating to the planning, preparation, and management of inventory activities are documented and archived. 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

¹¹ 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

¹² 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

¹³ Romano D., Bernetti A., De Lauretis R., 2004. *Different methodologies to quantify uncertainties of air emissions*. Environment International vol 30 pp 1099-1107

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 electronically available documents and the place where they are stored as well as internal documentation on QA/QC procedures.

Major QA/QC activities over the past years

Energy Balance Verification. A task force made up of energy and inventory experts (Ministry of Production Activities, ENEA and APAT) established to examine differences in basic data between the CRF and the joint EUROSTAT/IEA/UNECE questionnaire submissions and to improve the details of the National Energy Balance finalised its study and reported the results in the document “Energy data harmonization for CO₂ emission calculations: the Italian case”¹⁴.

Carbon Emission Factors Review. A sampling and measurement campaign was carried out jointly with the Stazione Sperimentale Combustibili in order to check the CO₂ emission factors used for emission estimation in the energy sector, specifically the road transport and residential and commercial sector. Representative samples of Italian fuels, specifically gasoline, diesel oil and LPG, were collected and analysed from September 2000 - August 2001. Measurements were compared with default CO₂ emission factors proposed by the IPCC in the 1996 Revised Guidelines and those proposed by the EEA and used in COPERT III methodology. Values of national emission factors resulted higher than the default ones for gasoline and LPG, while those of diesel were lower. Emission factors have been substituted for the years 2000 onwards. The study and the results are described in detail in the APAT report¹⁵. The analysis was repeated in 2013 with the same methodology by Innovhub (former Stazione Sperimentale Combustibili) and carbon content and main characteristic of coal and natural gas have been added. The methodology, data sources and main results are reported in a final technical paper¹⁶.

Road Transport Emissions Review. The Italian Expert Panel on Transport, which comprises experts from Research Institutes, Universities, Industrial Associations, Local Authorities, Ministries and Public Authorities, continues its work on the improvement and assessment of emission estimations from road transport. There has been a considerable improvement on the details of basic data to be used within the COPERT model, both in terms of availability and timeliness. Studies of the expert panel group as well as presentations held in different meetings can be found on the website http://groupware.sinanet.isprambiente.it/expert_panel.

¹⁴ ENEA/MAP/APAT, 2004. *Energy data harmonization for CO₂ emission calculations: the Italian case*. Rome 23/02/04. EUROSTAT file n°200245501004

¹⁵ APAT 2003. *Analisi dei fattori di emissione di CO₂ dal settore dei trasporti*. Ilacqua M., Contaldi M., Rapporti n°28/2003

¹⁶ Innovhub, 2013. *Caratterizzazione chimico-fisica dei combustibili utilizzati in Italia*. Rapporto finale dicembre 2013. Innovhub-Stazione Sperimentale per i combustibili.

Other Off-road Emissions Review. The whole time series of aviation emissions was recalculated as a consequence of a specific sectoral study which considered most recent trends in civil aviation both in terms of modelling between domestic and international flights and technological progress of the fleet. The methodology was applied at national and airport level and the results shared with national experts in the framework of an ad hoc working group instituted by the National Aviation Authority (ENAC). There was also a revision of the methodology to estimate emissions from the maritime sector from 2004, on account of a national study which considered most recent trends in terms of modelling between domestic and international consumptions and improvements in operational activities in harbour. Also in this case, results were presented to a working group on local air emission inventories, formed by local authorities, sectoral experts, the Ministry of Environment, Land and Sea, and air quality model experts. In 2014 submission, a verification of activity data from different sources was undertaken. For aviation EUROCONTROL data, methodology and results for Italy have been included in the inventory from 2016 submission.

Energy – Industrial processes Review. A specific activity relating to improvements of the inventory and QA/QC practices in the last year regarded the progress on the building of a database where information collected in the framework of different European legislation, Large Combustion Plant, INES/PRTR and Emissions Trading, are gathered together thus highlighting the main discrepancies in information and detecting potential errors. The actual figures are considered in an overall approach and used in the compilation of the inventory and resulted in verification and updated of the emission factors for many categories and gases.

F-gases Review. A review with industrial associations and the electrical company ENEL was undertaken in order to improve the quality of estimates by implementing the use of the Tier2 methodology. SF₆ estimates improved with the cooperation of the national electrical company ENEL and the main electrical associations. Specifically, for PFC emissions from aluminium production, the estimates were carried out jointly with the only national producer. A revision has also concerned HFC emissions on account of major information on the leakages made available by the European Association of Responsible Use of HFCs in Fire Fighting. In 2013, in response to the UNFCCC review process, the industrial associations have been contacted to verify f-gases emission factors from refrigeration and air conditioning in the different phases of the process from the production to the end of life of gases and appliances. A detailed analysis at sectoral level was carried out in 2017 and 2018 contacting the relevant operators to study the effect on the market of the implementation of the EU F-gases regulation and in this context additional technical information including past and new emission factors has been collected.

Agriculture Review. Since 2006 submission, the main improvements regard the results from the MeditAIRaneo project which have been included in the preparation of the Agriculture emission inventory (GHG/CLRTAP) with effect especially on CH₄, N₂O and NH₃ emissions. Besides, studies on NH₃ and PM₁₀ emissions from swine and poultry within the convention signed between APAT and the Ministry for the Environment, Land and Sea, were carried out by CRPA¹⁷ and University of Milan¹⁸. At the end of 2009 another research study related to land spreading estimations and scenario was completed¹⁹.

LULUCF Review. The ongoing work of the established expert group and the analysis of data from the new

¹⁷ CRPA, 2006[b]. *Predisposizione di scenari di emissione finalizzati alla progettazione di interventi per la riduzione delle emissioni nazionali di ammoniaca ed alla valutazione di misure e di progetti per la tutela della qualità dell'aria a livello regionale*. Final report. Reggio Emilia - Italy

¹⁸ University of Milan, 2008. *Valutazione dei fattori di emissione di particolato e dei gas serra (protossido d'azoto, anidride carbonica, metano) ed ammoniaca, in relazione alle tecniche di abbattimento di inquinanti atmosferici*. Rapporto finale gennaio 2008. L'Università degli Studi di Milano - Dipartimento di Scienze e tecnologie Veterinarie per la Sicurezza Alimentare di Milano

¹⁹ CRPA. 2009. *Valutazione dell'entità delle emissioni ammoniacali derivanti dall'applicazione al suolo dei fertilizzanti, delle loro possibilità di riduzione e individuazione degli elementi per un monitoraggio statistico delle tecniche di applicazione utilizzate*. Rapporto finale. Reggio Emilia – Italia.

national inventory forest allowed continuous improvements of LULUCF emission and removal estimates. In particular the land use assessment has been carried out on the basis of new set of data (i.e. outcomes of Inventory of Land Use (IUTI) and areas assessment resulting from the ongoing National Forest Inventory (NFI). The coefficients used in the estimation process for the litter pool in the relevant categories were updated following the inclusion of latest NFI's outcomes. Activity data related to organic soils, in cropland category, has been updated and plantations have been excluded from cropland and have been allocated in forest land category. Recalculations also occurred in fires estimates, due to the implementation of the new methodology and to the use of updated activity data.

Waste Review. In 2013 a database of incinerators has been built with data collected from different sources resulting in update of previous sectoral estimates. The analysis regarding incineration plants has been conducted through verifications and comparisons with data reported in E-PRTR registry, Emissions Trading Scheme and data collected directly from the operators updating data of waste amount and pollutants emissions at plant level. On the basis of the recent ESD reviews some insights have been made on country specific conditions regarding solid waste disposal, composting and anaerobic digestion sites.

MeditAIRaneo Project. A three years project involving the Inventory Reference Centres of the European Mediterranean Countries (Italy, Spain, France, Greece, Portugal) started at the end of the year 2000. The aim was to examine in details emissions that are specific and/or typical of the Mediterranean Countries. Four different studies on air emissions from vegetation, agriculture, solvent use and urban road transport in Mediterranean areas were funded by APAT. Common objectives are analysis of methodologies and emission factors used by Mediterranean countries for estimating emissions, individuation of Mediterranean peculiarities, in comparison with other European countries, such as climate, technologies, industrial management, identification of methodological points which need in-depth examination and uncertainty assessment. An Italian case study has been developed for each of the four projects. In 2006, all the projects concluded and the results have been used in the national inventory to improve country-specific emission factors.

Emissions Trading Scheme. Analyses of sectoral industrial data from the Italian Emission Trading Scheme database are used to develop country-specific emission factors and check activity data levels. ETS data have been used together with additional information collected by the industrial association to assess CO₂ emissions abatement resulting from the implementation of the II phase EU ETS in Italy as well as for the definition of the benchmark in the III phase of EU ETS and the final communication to the EU for benchmark and carbon leakage for the years 2009 and 2013. In this context, additional information has been elaborated data provided by the industry to assess the sectors subjected to potential carbon leakage and relevant benchmarks.

European Pollutant Release and Transfer Register (E-PRTR). Data from the Italian Pollutant Emission Register from some industrial sectors are used in the inventory compilation or as a check with the estimates carried out at national level. In particular, this regards the production of non-ferrous metals, chemical productions, cement and lime productions and the production of iron and steel.

Local inventories. A study on the top-down approach to the preparation of local inventories was conducted and Italian emissions for different local areas were derived. In 2013, ISPRA finalised the provincial inventory at local scale for the years 1990, 1995, 2000, 2005, 2010²⁰. The results were checked out by regional and local environmental agencies and authorities in order to find out the main weak points and contribute with information available to characterise the local environment, this contributing as well as a feedback to the

²⁰ ISPRA, 2013. *Database della disaggregazione a livello provinciale dell'Inventario nazionale delle emissioni: 1990-1995-2000-2005-2010*. Istituto Superiore per la Protezione e la Ricerca Ambientale, ISPRA

improvement of the national inventory. Final estimates and the detailed methodologies followed for each SNAP sector to carry out emission figures are published in technical reports²¹. In 2017, the provincial inventory at local scale for the years 1990, 1995, 2000, 2005, 2010 and 2015 was finalised²².

Planned improvements

Specific improvements are identified in the relevant chapters and specified in the 2020 QA/QC plan; they can be summarized in the following.

For the energy and industrial sectors, the database where information collected in the framework of different EU legislation, Large Combustion Plant, E-PRTR and Emissions Trading, is annually updated and improved. The database has helped highlighting the main discrepancies in information and detecting potential errors leading to a better use of these data in the national inventory. Energy data submitted to the international organizations in the framework of the Joint Questionnaire OECD/IEA/EUROSTAT will be compared with the national energy statistics with the aim to reduce the differences with the international statistics.

Improvements for road transport sector will be connected to the availability of information regarding activity data, calculation factors and parameters, development of the methodology and update of the software. In particular, an improvement is planned regarding a general review of mileages and speed values with reference to a better distribution between the vehicles categories and driving conditions, subject to the total fuel balance between the sales of national fuels and the estimated total consumption.

For the agriculture and waste sectors, improvements will be related to the availability of new information on emission factors, activity data as well as parameters necessary to carry out the estimates; specifically, for agriculture, further improvements are expected for the grazing, housing, storage systems and land spreading information collected by 2016 Agricultural Survey, while for waste sector the availability of additional information on waste composition. Information collected by 2016 Agriculture survey has been now released by the National Institute of Statistics and it is under elaboration for its use in the 2020 submission.

The improvement of the waste production and management database, handled by another unit of ISPRA, is ongoing, facilitating the extrapolation and elaboration of the huge amount of information contained in the database. Analysis and elaboration e.g. on waste composition will be easier and will allow improvements in the emission estimates in the 2020 submission.

For the LULUCF, final results of the third NFI will allow using of IPCC carbon stock change method to estimate emissions and removals for forest land remaining forest land category.

Additional studies will regard the comparison between local inventories and national inventory and exchange of information with the 'local inventories' national expert group.

Further analyses will concern the collection of statistical data and information to estimate uncertainty in specific sectors by implementing Approach 2 of the IPCC guidelines. In this regards we plan to reassess the uncertainty for the same categories reported in the annex of the NIR because these are the main categories for which the analysis makes sense in consideration of the information available on parameters and underlying distributions. We will try to extend the analysis to some other key categories in the IPPU sector (chemical and mineral).

²¹ Liburdi R., De Lauretis R., Corrado C., Di Cristofaro E., Gonella B., Romano D., Napolitani G., Fossati G., Angelino E., Peroni E., 2004. *La disaggregazione a livello provinciale dell'inventario nazionale delle emissioni*. Rapporto APAT CTN-ACE 2004 APAT/ARPA, 2006. *Confronto tra l'Inventario Nazionale e gli Inventari Locali*. Realizzato nell'ambito del tavolo interagenziale "Inventari delle emissioni e piani di risanamento della qualità dell'aria"

ISPRA, 2009. *La disaggregazione a livello provinciale dell'inventario nazionale delle emissioni*. Anni 1990-1995-2000-2005. ISPRA, 92/2009

²² <http://www.sinanet.isprambiente.it/it/sia-ispra/inventaria/disaggregazione-dellinventario-nazionale-2015/view>

QA/QC ENERGY 2020 ACTIVITIES AND FUTURE IMPROVEMENTS

Prepared by: Antonella Bernetti, Riccardo De Lauretis

April, 2021

NATIONAL AIR EMISSION INVENTORY: ENERGY

Objective

The improvements carried out during the preparation of the 2021 national inventory submission for the energy sector and those expected for the next future are summarised in the following.

Review process recommendations

In the following table, the issue raised and responses provided to the recommendations, for the Energy sector, during the last UNFCCC review process (as described in the report of the individual review of the annual submission of Italy submitted in 2019), then implemented, are reported.

Table 1. *Issue raised for the Energy sector during the UNFCCC review in 2019*

CRF category / issue	Review recommendation	Review report / paragraph	MS response / status of implementation	Chapter/section in the NIR
ENERGY 1.A.2.d Pulp, paper and print – Biomass CO ₂ (E.2, 2018) (E.3, 2016) (E.3, 2015) Accuracy	Further analyses of the EU ETS data for the time series available, taking into consideration biomass fuel mix in the relevant year, and document the relevant information in the NIR	E.4	The relevant information has been provided in the NIR	Chapter 3 paragraph 4
ENERGY 1.B.2 Oil, natural gas and other emissions from energy production – liquid and gaseous fuels CH ₄ Transparency	The ERT recommends that the Party include in the NIR more specific information on why the use of the IPCC good practice guidance better reflects national circumstances than the use of the more recent guidelines in its next annual submission.	E.10	The relevant information has been provided in the NIR	Chapter 3 paragraph 9
ENERGY 1.B.2.b Natural gas – gaseous fuels CH ₄ Transparency	The quantity of natural gas being distributed is less than 50 per cent of the natural gas transmitted in the whole time series, and the CH ₄ IEF of gas distribution in 2017 (4,151.76 kg/Mm ³) is almost four times the default EF provided in the 2006 IPCC Guidelines (0.0011 Gg/Mm ³) (see table 4.2.4, vol. 2). During the review week, the Party clarified that a significant proportion of natural gas does not go through the distribution network but is instead directly transported to industries, including the energy industry. The Party also clarified that the EFs are generated by combining measured data obtained directly from the main gas operators with calibrated estimates from smaller operators. The ERT recommends that the Party include an explanation of the AD gap between gas transmission and distribution and highlight the difference between the CH ₄ IEF for natural gas distribution and the default EF in the 2006 IPCC Guidelines in its next annual submission.	E.11	The relevant information has been provided in the NIR	Chapter 3 paragraph 9

During the EEA greenhouse gases review related to the 2019 submission of Italy other transparency issues, mainly related to the explanation of the trend or implied emission factors, have been raised and solved before the official submission.

During the EEA greenhouse gases review related to the 2020 submission of Italy, no issues were raised in the review report and no revised estimates or technical corrections were deemed necessary, issues identified during the review have been nevertheless taken into account as much as possible to improve 2021 submission.

Under the European National Emission Ceiling Directive (NECD), an in-depth review has been conducted in 2017, 2018, 2019 and in 2020, the main resulting findings and how the recommendations were addressed are reported in Table 2.

Table 2. *Response to the NECD review process recommendations*

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	Implementation
IT-1A1-2019-0001	Yes	1A1 Energy Production, BaP, PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F, 1990 - 2017	For category 1A1 Energy Production that there is a lack of transparency regarding the basis of emission factors used for heavy metals and POPs. Some issues are resolved by commentary provided in the 2020 IIR to cover heavy metals and POPs. This does not relate to an over- or under-estimate of emissions. In response to questions raised during the review, Italy explained that emission factors for heavy metals for 1A1a are country-specific factors and all are derived from a national study from 2001. PCB emission factors are from the 2019 EMEP/EEA Guidebook. PAH, PCDD/F and HCB emission factors are drawn from a TNO study from 1997. The TERT notes Italy's comment that the EMEP/EEA Guidebook emission factors often reference US sources and facilities for POPs and heavy metals, but the EMEP/EEA Guidebook factors are generally applicable. The TERT recommends that Italy improve the information provided in the IIR and, to review current emission factors and emission data against PRTR (where available) and against the EMEP/EEA Guidebook factors and other industry resources.	No	Not yet implemented. Additional information has been included in the IIR. A preliminary analysis of data availability for the time series and comparison with the actual EFs has been done.
IT-1A1c-2019-0001	No	1A1c Manufacture of Solid Fuels and Other Energy Industries, PAHs, 2005	For categories 1A1c Manufacture of Solid Fuels and Other Energy Industries and 1B1b Fugitive Emission from Solid Fuels: Solid Fuel Transformation and pollutant PAH, the TERT noted an over-estimate above the threshold of significance. In the 2019 review, Italy accepted a Potential Technical correction as a Revised Estimate. In the 2020 submission, Italy's IIR indicates that revised estimates have been incorporated into the 2020 submission for 1A1c and that the 1A1b Petroleum refining revised estimate has been incorporated into category 2C Metal production but this emission will be allocated to 1B1b in the next submission (IIR page 30). This was raised during the 2018 and 2019 NECD review. The 2020 review noted that the IIR states that the outstanding issue has been included in the list of improvements and that the recommendation will be addressed in the 2021 submission. The TERT reiterates the recommendation that PAH emissions are correctly allocated to category 1B1b.	TC 2019	Implemented
IT-1A2-2019-0001	Yes	1A2 Stationary Combustion in Manufacturing Industries and Construction, BaP,	For category 1A2 Stationary Combustion in Manufacturing Industries and Construction there is a lack of transparency regarding the	No	Not fully implemented. Additional

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	Implementation
		PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F, 1990-2018	basis of emission factors used for heavy metals and POPs. . In response to questions raised during the review, Italy explained that emission factors are a mix of country-specific and default factors from various versions of the EMEP/EEA Guidebook. The TERT notes Italy's commentary on PRTR data and an intent to update default emission factors for key categories to those from the 2019 EMEP/EEA Guidebook. The TERT recommends that Italy improve the information provided in the IIR to reference the emission factors used and, to update emission factors from older versions of the EMEP/EEA Guidebook with current emission factors in time for the 2021 submission.		information has been included in the IIR.
IT-1A2a-2019-0001	Yes	1A2a Stationary Combustion in Manufacturing Industries and Construction: Iron and Steel, PCBs, Cd, HCB, 1990-2018	For category 1A2a Stationary Combustion in Manufacturing Industries and Construction: Iron and Steel and pollutants Cd and HCB the TERT noted that the IEF ratios are outliers when compared to other Member States. Italy provided a revised estimate for years 2003-2018 for Cd and stated that it will be included in the next submission. The TERT agreed with the revised estimate provided by Italy for Cd and agreed no change for HCB. The TERT recommends that Italy include the revised estimate in its 2021 NFR and IIR submission and reviews the methodology for HCB emission estimates.	RE	Implemented for cadmium emissions
IT-1A2b-2019-0001	No	1A2b Stationary Combustion in Manufacturing Industries and Construction: Non-Ferrous Metals, HCB, 1990-2018	For category 1A2b Stationary Combustion in Manufacturing Industries and Construction: Non-Ferrous Metals and pollutant HCB, the TERT noted the use of notation key 'NA' in activity 1A2b which is not appropriate as solid fuel use is reported in the activity in several years and there is a Tier 1 emission factor in the 2016 EMEP/EEA Guidebook that can be applied. In response to a question raised during the review, Italy commented that a national study on dioxin emissions may also have data for HCB that could be applied. The TERT noted that the issue is below the threshold of significance for a technical correction. The TERT recommends that Italy reviews national data and the EMEP/EEA Guidebook for suitable emission factors and includes an estimate of HCB emissions for relevant years in the 2021 submission. However, Italy should also review reporting of emissions for metals activities, in particular use of notation keys and ensure allocation of emissions with the primary NFR activity in the 2021 submission	No	Not implemented
IT-1A2b-2019-0002	Yes	1A2b Stationary Combustion in Manufacturing Industries and Construction: Non-Ferrous Metals, PCDD/F, 1990-2018	The TERT recommends that Italy review reporting of emissions for metals activities, in particular use of notation keys and ensure allocation of emissions with the primary NFR activity (2C3) in the 2021 submission.	No	Implemented. Notation key IE has been reported in 2C3..
IT-1A4ai-2017-0002	Yes	1A4ai Commercial/Institutional: Stationary, NMVOC, 2000-2015	For category 1A4ai Commercial/Institutional: Stationary the TERT noted that there is a lack of transparency regarding the emission factor references although some information has been added to the IIR. This does not relate to an over- or under-estimate of emissions. This was raised during the 2017, 2018 and 2019 NECD review. In response to a question raised during the review, Italy provided a summary of emission factors and	No	Implemented

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	Implementation
			references and explained that the few emission factors from older versions of the EMEP/EEA Guidebook were used in activities which were minor sources. Clearly for some years use of emission factors from older versions of the EMEP/EEA Guidebook will be appropriate however, the TERT recommends that Italy updates emission factors from older versions of the EMEP/EEA Guidebook in its inventory for current and recent years for the 2021 submission.		
IT-1A4bi-2017-0001	Yes	1A4bi Residential: Stationary, NOX, NMVOC, PM2.5, 2000-2015	For category 1A4bi Residential: Stationary the TERT noted that there is a lack of transparency regarding the emission factor references although some information has been added to the IIR. In response to a question raised during the review, Italy provided a summary of emission factors and references and explained that the few emission factors from older versions of the EMEP/EEA Guidebook were used in activities which were minor sources. Clearly for some years use of emission factors from older versions of the EMEP/EEA Guidebook will be appropriate however, the TERT recommends that Italy updates emission factors from older versions of the EMEP/EEA Guidebook in its inventory for current and recent years for the 2021 submission.	No	Implemented

NIR and IIR report additional information about the last review processes (e.g UNFCCC²³ and UNECE ²⁴), addressing the recommendations of the review teams.

Inventory improvements and QA activities

Documentation collected in the framework of the different European Directives, and Regulations (E-PRTR, Large Combustion plants and the Emissions Trading scheme) has been completely integrated in a unique informative system, with the aim to verify emissions and activity data reported for the same year under different reporting obligations and identify possible improvements in emission estimations. A further use of this database has regarded the calculation at plant level of emission estimates of other pollutants than greenhouse gases. This activity has been implemented also in view of the submission of national emission figures of other pollutants which have to be communicated in the framework of the EMEP-CLRTAP Convention at 0.1°×0.1° degree scale. Emissions at point source level have been therefore derived for the energy and industrial sectors, refining figures previously attributed at local level by a top-down approach. In the framework of CLRTAP, every five years (four from 2015) emissions are disaggregated at regional and provincial level; for 2019 and previous years data collected from point sources have been analysed and elaborated allowing the distribution of emissions at local level. Results are compared with those obtained by regional bottom up inventories. Emissions disaggregated at local level are also used as input for air quality modelling. Final results are useful to highlight the most critical areas in the Italian Regions.

²³ UNFCCC, 2020. Report on the individual review of the annual submission of Italy submitted in 2019. Note by the expert review team. <https://unfccc.int/documents>

²⁴ UNECE 2020, Final Review Report 2020, Review of National Air Pollutant Emission Inventory Data 2020 under Directive 2016/2284 (National Emission reduction Commitments Directive)

For the stationary combustion in industry and in transformation sector the CO₂ emission factors have been slightly revised from 2005 for different fuels because of the update in atomic weights for the elements involved in the calculation of the carbon content in the natural gas (Hydrogen, Carbon, Oxygen, etc.).

Moreover, the CO₂ emission factor for natural gas has been updated for the whole time series, the update of the average content of CH₄ and CO₂ in the national natural gas mix due to an error has been fixed.

Recalculations also occurred because of the review of carbon balance made with the goal to improve the coherence with international statistics also used as basic data for GHG projections.

Fugitive CH₄ emissions from geothermal extraction have been estimated and included in the inventory.

For 1.A.2.a category, according to the review, Cd emission factors have been updated since 2003 on the basis of plant level emissions data. Simultaneously, NH₃ emission factors from sinter production have been introduced for the whole time series. Further improvement and recalculations have been occurred for glass production because of the use of E-PRTR data for SO_x, NO_x, As, Se and Zn emissions.

For 1.A.1.c category, and in particular for coke production, fugitive PAH emissions, at first estimated under this category, have been allocated in 1B1b.

For 1.A.3.a category, aviation, there has been an update for the entire time series of the engine classification and for consumption data since 2005 according to data provided by EUROCONTROL for Italy. This has resulted in recalculations for NO_x, SO_x, CO since 2000 and PM, COVNM and PAH for the whole time series. Furthermore, as regards aviation, over the years verification and comparison activities covered activity data and emission factors. In particular, number of flights have been compared considering different sources: ENAC, ASSAEROPORTI, ISTAT, EUROCONTROL and verification activities have been performed on the basis of the updated EUROCONTROL data on fuel consumption and emission factors resulting in an update and improving of the national inventory.

For road transport (1.A.3.b), the upgraded version of COPERT 5, v. 5.4.36 has been used including a revision of emission factors especially for the new vehicles and the introduction of new categories of vehicles, and resulted in a revision of emission estimates for the whole time series.

Over the years, an inventory improvement process in the road transport sector was activated as part of the activities of the Transport expert panel, at national and international level, in order to improve the activity data and the accuracy of the emission factors. Besides, over time recalculations of transport time series estimates have been discussed with national experts in the framework of an *ad hoc* working group on air emissions inventories, chaired by ISPRA.

For 1.A.3.d maritime activities, activity data from 2012 for recreational craft has been updated and estimated on the basis of the trend of the distribution of two and four strokes engines and their average gasoline fuel consumption.

As regards navigation, estimates were also discussed over the years with ISTAT experts and there is an ongoing collaboration and data exchange with regional environmental agencies.

Regarding QA/QC activities about pipeline compressors, fuel consumptions reported by the national operators for this activity are compared with the amount of natural gas internal consumption and losses reported in the energy balance as well as with energy consumption data provided by the operators to the emission trading scheme.

For 1.A.4, according to the review process, COVNM EF for 1A4ai and NO_x, COVNM and PM_{2.5} EFs for 1A4bi have been updated on the basis of the 2019 EMEP/EEA Guidebook.

Planned improvements

In this paragraph further improvements identified during the preparation of the National Inventory, National Inventory Report 2021 and of the Informative Inventory Report 2021 are presented.

The database containing information collected in the framework of different EU legislation, Large Combustion Plant, E-PRTR and Emissions Trading, is annually updated and improved. The database has helped highlighting the main discrepancies in information and detecting potential errors leading to a better use of these data in the national inventory.

Energy data submitted to the international organizations in the framework of the Joint Questionnaire OECD/IEA/EUROSTAT will be compared with the national energy statistics with the aim to reduce the differences with the international statistics.

A revision of biomass and waste fuel consumption time series is planned for the next submission on the basis of energy data communicated by the Ministry of Economic Development to the Joint Questionnaire OECD/IEA/EUROSTAT, after a verification and comparison with data up to now used and available in the National Energy Balance reports.

Improvements for road transport sector will be connected to the availability of information regarding activity data, calculation factors and parameters, development of the methodology and update of the software.

For maritime activities further improvements will regard a verification of activity data on ship movements and emission estimates with regional environmental agencies, especially with those more affected by maritime pollution. In particular we plan to build an emission estimation database which calculate every year emissions at harbor level taking in account of the information officially provided by Italy to Eurostat per type of ship, class of tonnage and movement statistics. As regards PM10 and heavy metals emissions from Public Electricity and Heat Production category (1A1a), while PM10 emissions are updated every year on the basis of data submitted by the plants in the framework of the EPRTTR registry, Large Combustion Plants Directive and Environmental Reports, heavy metals emission factors time series have been reconstructed from 1990 to 2001 on the basis of a study conducted by ENEL (major company in Italy) which reports heavy metals emissions measurements by fuel and technology (with or without PM10 abatement technologies) of relevant national plants. From 2001 these emission factors have not been updated. Heavy metals emission data in the EPRTTR registry refer only to few not representative plants and are not sufficient to calculate average emission factors. Further work is planned to update/change emission factors for those pollutants where figures reported in the EPRTTR lead to average values significantly different from those actually used. Moreover a revision of the structure of the energy chapter of the IIR is planned for the next submission introducing specific paragraphs for 1A1 and 1A2 categories.

The previous activities will improve the robustness and accuracy of data reported in the national balance thus of the emission inventory estimates.

Table 2. Planned improvements

Category	Subcategory	Parameter	Gas	Description	Timing
Cross-cutting	Energy balance	AD		A working group of ISPRA and Ministry of Economic Development is investigating about the differences between Eurostat and BEN	2022
1.A.1a	Public electricity and heat production	EFs	HMs	Further work is planned to update/change emission factors for those pollutants, as zinc, where figures reported in the EPRTTR lead to average EFs significantly different from those used.	2022
1.A.3.d	Maritime Navigation	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 this sector. Further improvements will regard a verification of activity data on ship movements and emission estimates jointly with regional environmental agencies, with the aim to build an emission estimation database which calculates every year emissions at harbor level taking into account the information officially provided by Italy to EUROSTAT.	2021 - 2022

QA/QC INDUSTRIAL PROCESSES AND PRODUCT USE 2020 ACTIVITIES AND FUTURE IMPROVEMENTS

Prepared by: Andrea Gagna, Barbara Gonella, Federica Moricci, Ernesto Taurino, Daniela Romano

April, 2021

NATIONAL AIR EMISSION INVENTORY: INDUSTRIAL PROCESSES AND PRODUCT USE

Objective

The improvements carried out during the preparation of the 2021 national inventory submission for the industrial processes sector and those expected for the next future are summarised in the following.

Review process recommendations

In the following tables, issues raised during the last review processes and related to the industrial processes sector are reported; improvements implemented for each subject are also included.

Table 1 describes the responses to the recommendations under the UNFCCC review process.

Table 1. *Response to the UNFCCC review process recommendations*

CRF category / issue	Review recommendation	Review report / paragraph	MS response / status of implementation	Chapter/section in the NIR
IPPU 2. General all gases Convention reporting adherence	The ERT recommends Italy to fix the issues mentioned above including at least: a) Verifying the references as well as the web links to AD and including the right ones or a table with the information; b) Verifying systematically the processing of AD; c) Checking the description of recalculations in the NIR against the CRF tables and ensuring that any recalculations performed are correctly described in the NIR in both the category and the Chapter summarising the recalculations; d) Ensuring the proper use of the notation keys; e) Performing QA of the NIR and the CRF tables and correcting errors annually before the submission;	I.5	The NIR has been updated accordingly and the notation keys have been updated.	Chapter 4
IPPU 2. General – CO ₂ , CH ₄ and N ₂ O Transparency	The NIR provides information for each category under headings such as “source category description”, “methodological issues” and “source-specific QA/QC and verification”. However, methodological and verification issues are mixed together and described under all headings, impeding understanding. In addition, trends in most categories are explained by the use of the data source (e.g. EU ETS, The European Pollutant Release and Transfer Register (E-PRTR), the relevant association) but explanations of the methodologies and assumptions used to elaborate the emission estimates for each subcategory are not sufficiently clear. In addition, the simultaneous use of EU ETS and E-PRTR data is not transparently presented for all the categories likely to cause confusion. During the review Italy showed the methodologies used in each subcategory together with the input AD and its sources. When available, EU ETS verified data is the preferred source if it covers all plants of the subcategory. This source of information is complemented by E-PRTR data when it helps to cover the whole subcategory. Where this is not possible, national data is used and cross-checked using EU ETS and E-PRTR data. Large combustion plant data is used for cross-checking	I.6	The NIR has been updated accordingly as possible. In particular, as regards 2.F.1 category, refrigeration sector is described separately from the stationary air conditioning sector, to better take into account the different method of emissions estimating used but also the different types of data available.	Chapter 4; paragraph 7

CRF category / issue	Review recommendation	Review report / paragraph	MS response / status of implementation	Chapter/section in the NIR
	purposes. Although this is the general approach, the combination and prioritisation of data sources is different depending on the subcategory. The ERT recommends that Italy include more focused information under each heading in the NIR to support understanding and provide more detailed information on the AD selection and the methodologies used to estimate emissions under the “methodological issues” heading in each subcategory of the IPPU sector			
IPPU 2.B Chemical industry – N2O Transparency	In recent years, as EU chemical plants have to report measured emissions under the EU-ETS, Italy has used information on certain measured GHG emissions for N2O emissions from nitric acid production or adipic acid production). However, a tier 2 method is indicated in CRF table summary 3 for the gases in these categories, rather than the tier 3 method based on measurements. During the review Italy explained that a tier 2 method was indicated because the emissions had not been estimated using very detailed information or complex models. The ERT recommends that Italy select a tier methodology according to the 2006 IPCC Guidelines and provide updated information on the tiers used across the time series in the NIR.	I.7	The NIR has been updated accordingly	Chapter 4 paragraph 3
IPPU 2.B.1 Ammonia production CO2 Transparency	The ERT recommends that Italy investigate the reasons for the difference between apparent consumption and the amount of urea used in the inventory and include the results of this investigation in the NIR.	I.8	Italy is carrying out the requested investigations and additional information will be reported in the NIR	Chapter 4 paragraph 3
IPPU 2.F.1 Refrigeration and air conditioning HFCs Transparency	The ERT recommends that the Party describe in the NIR the approach followed and the equations used to calculate the AD and EFs used and the emissions at each stage of the useful life cycle of the equipment (manufacturing, stocks and disposal) for each subcategory in accordance with the information provided in CRF table 2(II)B-Hs2.	I.9	The approach followed and the equations used for calculating the activity data, emission factors used and the emissions of each stage of the useful life cycle of the equipment (manufacturing, stocks and disposal) for each subcategory have been described in detail in the NIR	Chapter 4 paragraph 7
IPPU 2.D.3 Other non-energy products from fuels and solvent use – CO2 Convention reporting adherence	Italy reports indirect CO2 emissions from the atmospheric oxidation of non-methane volatile organic compounds (NMVOCs) in 2.D.3 Non-energy products from fuels and solvent use (p.63 of the NIR and CRF table 2(I)s2). However, in the CRF Summary 1.As3 (IPCC table 7A) and CRF table 6 Italy reports indirect CO2 as NO and in CRF tables 10s1 and 10s2, the Party reports Total CO2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry and Total CO2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry as NA. According to the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO2 the national totals shall be presented with and without indirect CO2.	I.10	We do not agree with this recommendation. In our understanding of the reporting guidelines indirect CO2 emissions from Solvent use shall be included in the National total and reported under 2.D.3 and in particular in CRF table 2(I)s2.	Chapter 4 paragraph 5

CRF category / issue	Review recommendation	Review report / paragraph	MS response / status of implementation	Chapter/section in the NIR
	The ERT recommends that the Party report indirect CO ₂ emissions in CRF Table 6 instead of CRF table 2(I)s2.			

Table 2 reports responses to the recommendations under the review of the European National Emission Ceiling Directive (NECD) conducted in 2020.

Table 2. *Response to the NECD review process recommendations*

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	Implementation
IT-2A1-2019-0001	Yes	2A1 Cement Production, PM _{2.5} , 2000-2018	In the 2019 review, the TERT noted that for 2A1 Cement Production for PM _{2.5} for 1990-2018 the PM _{2.5} estimate was equal to the estimate for PM ₁₀ . For the 2020 submission, this was no longer the case. In response to a question raised during the review about the calculations used, Italy explained that they have applied Tier 1 emission factors for cement production activity (2A1), equal to 234 g/t, 130 g/t and 3% of PM _{2.5} respectively for PM ₁₀ , PM _{2.5} and BC and that they have applied these EFs to cement production. However, these emission factors should be applied to clinker as indicated in the 2016 and 2019 EMEP/EEA Guidebook and therefore emissions are over-estimated. Italy provided revised estimates for years 1990-2018 for PM ₁₀ , PM _{2.5} and BC and stated that these will be included in the next submission. The TERT agreed with the revised estimate provided by Italy. The TERT recommends that Italy include the revised estimate in its 2021 NFR and IIR submission.	RE	Implemented
IT-2C3-2020-0001	No	2C3 Aluminium Production, PM _{2.5} , HCB, PCDD/F, PM ₁₀ , BC, 1990-2018	For 2C3 Aluminium Production for PM _{2.5} , HCB, PCDD/F, PM ₁₀ , BC for 1990-2018 the TERT noted that there is a lack of transparency regarding the allocation of the emissions. Emissions were reported as 'NO' while in the IIR it is mentioned (p. 81-82) that secondary aluminium production takes place. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review,	No	Implemented

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	Implementation
			<p>Italy explained that in general it reports emission from secondary aluminium production in the energy sector (1A2b) and emission from primary aluminium production under 2C3 category. And that primary aluminium production stopped its activity in Italy in 2012 and therefore 'NO' is reported in 2C3. Emission from secondary aluminium, including PM and POPs from the process are reported in the energy sector. And that the emission factor of Dioxin and PAH are country specific while PM₁₀ is from USEPA and the speciation of PM_{2.5} and BC refer to the value reported in the EMEP/EEA Guidebook for secondary aluminium. Italy plans to check the completeness of these EFs, especially of PM₁₀ for its next submission and if it is possible to report separately processes from combustion emissions.</p> <p>The TERT recommends that Italy reports the process emissions from 2C3 in this category in its next submission and clearly describes the method, AD and EF used and on the completeness of the emission factors.</p>		
IT-2D3a-2018-0001	No	2D3a Domestic Solvent Use Including Fungicides, Hg, 1990, 2005, 2016	<p>For 2D3a Domestic Solvent Use Including Fungicides, Hg and all years the TERT noted that the notation key 'NE' is used in the 2020 submission of the NFR tables. The 2018 and 2019 NECD review had flagged that notation key 'NA' was used instead of actual reported emissions. The TERT noted that the issue is below the threshold of significance for a technical correction.</p> <p>The TERT recommends Italy to use the notation key 'NA' instead in its next submission as the 2019 EMEP/EEA Guidebook no longer contain an EF for Hg for 2D3a.</p>	No	Implemented
IT-2G-2018-0002	Yes	2G Other Product Use, Cd, Pb, 1990-2018	<p>For 2G Other Product Use for Cd and Pb for 1990-2018 the TERT noted that there is a lack of transparency regarding the implementation of the revised estimate proposed in 2019. Italy used for the entire period the consumption of 15,000 Mg of explosives in 2004 according to an Italian reference of 2004. However, during last year's review, the TERT</p>	no	Implemented

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	Implementation
			made a calculation based on Eurostat data available for years 2005-2017 on import, export and production of Fireworks. This does not relate to an over- or under-estimate of emissions. This was raised during the 2019 NECD review. In response to a question raised during the review, Italy explained that the amount of 15,000 Mg per year is from a paper (which Italy provided) and refers to the total amount of explosives and not only fireworks. And that this figure has been used to estimate N ₂ O emissions according to the 2006 IPCC Guidelines and no sufficient information is available to reconstruct the whole time series. The same activity data has been used in the CLTRAP submission to estimate atmospheric pollutants. Italy is aware of the Eurostat dataset and it is checking if the Italian reference includes fireworks or not. In any case, in its next submission, Italy plans to estimate separately fireworks and the total explosives. The TERT recommends that Italy carries out these investigations and reports clearly about these in its next IIR and updates the emission estimate if needed.		
IT-2I-2019-0001	No	2I Wood Processing TSP, 1990-2018	For 2I Wood Processing for TSP for 1990-2018 the TERT noted that Italy included estimates in its submission, but this is not mentioned in the IIR methodological chapter. However, it is mentioned in the IIR (page 25) in the table 'Recommendations from TERT, considering revised estimates (RE) and technical corrections (TC)'. This was raised during the 2019 NECD review. The TERT recommends that Italy includes in its next IIR (2021) the method and EF used to estimate these emissions.	No	Method and EF have been included in 2021 IIR (

Inventory improvements and QA activities

Other improvements not identified during the review process have been carried out.

CO₂ emissions have been checked with the relevant industrial associations. Activity data and emissions reported under EU-ETS and EPER/EPRT are compared with the information provided by the industrial associations. In particular, comparisons have been carried out for iron and steel, cement, lime, limestone and dolomite, and glass sectors. The general outcome of this verification step shows consistency among the

information collected under different legislative framework and the information provided by the relevant industrial associations. Additional QA/QC was performed on the inventory of CO₂ emissions from the decarbonation process in the national cement industry: resulting suggestions to focus on raw materials fed to clinker kilns²⁵ were considered and the description of the fluctuation of the CO₂ implied emission factor was already improved in the previous NIR accordingly. Specifically, further investigations about the amount of limestone & dolomite used have led to an update of the activity data and CO₂ estimates along the whole time series.

Further exchange of information with the only facility operating the Titanium dioxide manufacturing process has allowed for avoiding double counting of CO₂ process-related emissions which, in fact, have not been occurring. The whole timeseries was revised accordingly in 2021.

Also, emissions from the metal sector are checked with the relevant process operators. Emissions from magnesium foundries are annually compared with those reported in the national EPER/E-PRTR registry while for the iron and steel sector emissions reported in the national EPER/E-PRTR registry and for the Emissions Trading Scheme are compared and checked. Emissions from primary aluminium production have been also checked with data reported under EU-ETS. Concerning the electric arc furnaces, since 2004, the same estimation scheme as the previous period has been followed but using data becoming from ETS (only process emissions) and related to the amounts of pig iron, metallurgical coke, graphite, anthracite, dolomite, limestone and electrodes. The availability of data for each plant has allowed also the application, for a first attempt, of the Tier 3 methodology (IPCC, 2006) that demonstrated the soundness of estimates.

As the production of primary lead and zinc, in the last year, thanks to the ETS data it has been possible to separate CO₂ emissions in energy and process emissions and Italy is investigating the possibility of extension to other pollutants for the next submissions.

To solve the issue of the allocation of emissions of the integrated Pb and Zn plant (not only about combustion and process but also about the different productions of different metals in the same factory) a depth investigation of the integrated facility has been started on the basis of E-PRTR and IPPC permits. The first result of this investigation has been the update of the emissions since 2014 up to now and the EFs. The analysis of IEAs (Integrated Environmental Authorization) and the comparison with other sources of activity data and emissions and EMEP/EEA Guidebook, has allowed the identification of any inconsistency and the production of estimates.

For that regard the use of solvent categories in the framework of the MeditAIRaneo project, ISPRA commissioned to Techne Consulting S.r.l. a survey to collect national information on emission factors in the solvent sector. The results, published in the report *“Rassegna dei fattori di emissione nazionali ed internazionali relativamente al settore solventi”*²⁶ have been used to verify and validate the emission estimates. ISPRA commissioned to Techne Consulting S.r.l. another survey to compare emission factors with the last update published in the EMEP/EEA guidebook²⁷. The results are reported in *“Fattori di emissione per l'utilizzo di solventi”*²⁸) and have been used to update emission factors for polyurethane and polystyrene foam processing activities.

In addition, for paint application, data communicated from the industries in the framework of the EU Directive 2004/42, implemented by the Italian Legislative Decree 161/2006, on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products have been used as a verification of emission estimates. These data refer to the composition of the total amount of paints and varnishes (water and solvent contents) in different subcategories for interior and

25 Aether Ltd, 2013. *Findings and Recommendations of the Independent Review of the Italian Greenhouse Gas Inventory*

26 TECHNE, 2004. *Progetto MeditAiraneo. Rassegna dei fattori di emissione nazionali ed internazionali relativamente al settore solventi*. Rapporto Finale, novembre 2004

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

28 TECHNE, 2008. *Fattori di emissione per l'utilizzo di solventi*. Rapporto Finale, marzo 2008

exterior use and the total amount of products used for vehicle refinishing and they are available from the year 2007.

Additional verifications of the emissions from the sector occurred in 2013, on account of the bilateral independent review between Italy and Spain and the revision of national estimates and projections, where national emissions from the solvent sector were revised by the Spanish team. The analysis by category has not highlighted the need of major methodological revisions of the sector although some general issues on the appropriateness of the activity data used were highlighted as well as the update for some categories of the emission factors for the last years of the time series on the basis of the recent available scientific documentation.

Hence, a revision involved the chemical products subsector with respect to NMVOC emissions, due to the update of emission factors for polyurethane processing; on the basis of the industrial association communication, the phase out of CFC gases occurred in the second half of nineties and the blowing agent currently used is pentane, which resulted in a strong reduction of emissions. NMVOC emission factors for paint application in construction and building, domestic use, wood and other industrial have been checked and when relevant updated in consideration of the latest available source of information.

In the actual submission, minor recalculations occurred for paint application subcategories mainly due to the update of emission factors in paint application for the manufacture of automobiles and wood and the update of some activity data in 'Other' (fat edible and non edible oil extraction).

Planned improvements

In the following, specific improvements and remarks to be taken into account in the next submission of the national air inventory for IP sector are reported. Planned improvements include also the findings identified in the independent review of the Italian inventory undertaken by Aether in 2013 and those identified in the CLRTAP/UNECE review process.

Periodically, further improvements can result from the analysis of the different databases. The inventory team integrates the documentation collected in the framework of the different pieces of European legislation (EPER-E PRTR, Large Combustion Plants and Emission Trading Scheme) with the aim to verify emissions and activity data reported for the same year under different reporting obligations and to identify possible improvements in emission estimations. In the framework of EU-ETS, CO₂ emissions are checked with the relevant industrial associations at national level.

Both activity data and average emission factors are also compared every year with data reported in the national EPER/E-PRTR registry and in the European emissions trading scheme. Under the EU-ETS, operators are requested to report activity data and CO₂ emissions as information verified and certified by auditors who check for consistency to the reporting criteria.

Every year activity data and emissions reported under EU-ETS and EPER/EPTR are also compared to the information provided by the industrial associations. As previously reported, the general outcome of this verification step shows consistency among the information collected under different sources (pieces of legislations; relevant industrial associations). Further investigations regarding completeness of CO₂ emissions sources from the activities of this sector are planned, as well as additional checks will be carried out on account of information from new entrance installations included in the ETS from 2013.

Concerning the integrated production of Zn and Pb this year the data and information of the IEAs (Integrated Environmental Authorization) have been used. These information will be used, for the next submission, to carry out the right allocation for all pollutants and all categories and to improve the accuracy of the estimates.

In Table 3, the planned improvements are synthesized; for each topic, the reference to the UNFCCC category, which the improvement is focussed, is reported.

Table 3. Planned improvements

Category	Subcategory	Parameter	Gas	Description	Timing
General	-	-	-	Implementation of a quantitative uncertainty analysis for air pollutants	2020-2022
Mineral products	Cement and lime production	Activity data	CO ₂	Further investigations concerning the replacement of natural raw material in clinker manufacture and in lime production are planned.	2020-2022
	Building industry	Emission estimates	PM10	Estimate and report emissions from categories 2A7a, “Quarrying and mining of minerals other than coal” and 2A7b, “Construction and demolition”	2020-2022
Chemical industry	Other chemical industry	Activity data	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 is planned.	2020-2022
Metal production	Lead and zinc production	Allocation	All	Combustion vs process for air pollutants. Possibility to split up between zinc and lead production	2020 - 2022
Consumption of halocarbons and SF ₆	Consumption of halocarbons and SF ₆	Activity data, emissions parameters	F-gases	Investigations are planned in order to gather further data on emissions from the use of heat transfer fluids. For the foam blowing improvements are planned in order to investigate the consumption of other F-gas used and the different contribution of closed cell and open cell foams to the emissions. In the air conditioning and refrigeration sectors improvements are planned to improve the evaluation of disposal and recovered emissions, the topping up and the use of other refrigerants. Other improvements are planned in the Commercial and Professional Refrigeration. Improvements should be obtained by consulting the new National Telematic Registry of fluorinated greenhouse gases and equipment containing fluorinated gases that has been instituted by the DPR 146/2018, entered in force in January 2019.	2020-2022

Mineral products

Further investigations concerning the replacement of natural raw material in clinker manufacture and in lime production are planned to improve the knowledge on the process and the accuracy of the estimations. Further investigations concerning the use of carbonates other than limestone in the source category “other processes uses of carbonates are planned.

Chemical products

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 is planned.

Metal production

CO₂ emissions from lead and zinc production have been subdivided in combustion (reported in 1.A.2) and processes (reported in 2.C.6) on the basis of ETS data. The whole time series has been reconstructed but only for CO₂ emissions, the disaggregation for other gasses is planned. Investigation about the possibility to split up between zinc and lead production for integrated plants.

Consumption of halocarbons and SF₆

Electronics Industry Emissions (2E)

Emissions from the use of heat transfer fluids in the semiconductor industry started to be collected for the year 2017. The national industry is part of the European Semiconductor Industry Association (ESIA) and is involved in the activity of WSC (World Semiconductor Council), including gathered emissions from the use of heat transfer fluids. A further investigation in order to better specify the whole time series is again planned.

Emissions of fluorinated substitutes for ozone depleting substances (2F)

Stationary Air Conditioning. Thanks to a previous collaboration with the Ministry of the Environment, Land and Sea for a survey, at a national level, about HFCs alternative substances with low GWP, natural refrigerants and alternative technologies made in Italy (ISPRA, 2018 [a]) and for the first national census on Italian alternative technologies (ISPRA, 2019), ISPRA is continuously in contact with ASSOCLIMA, the air conditioning national association and with the major experts of the sector. A further investigation in the air conditioning sector is planned to improve the evaluation of emissions from disposal, recovered and containers management, by checking data reported in the National Database and by contacting, as mentioned, the national association and experts. Improvements are also planned regarding the HFCs topping up, the use of R-32 and other significant refrigerants with a lower or null GWP (R-448A, HCs, etc.), in substitution of the traditional R-410A, R-407C and R-134a. A check regarding the trend of the average charges of the equipments over the time series is also expected by considering the effect of the Ecodesign Directive in terms of energy efficiency of machines.

Commercial Refrigeration. Investigations are planned to improve the evaluation of disposal and recovered emissions and of the HFC topping up, by checking data reported in the National Database and by contacting the national associations and experts. New actions are also planned to gather information about the refrigerants market, by evaluating the presence and use of new HFCs with lower GWP (i.e. R-448A) or natural refrigerants. A further fact-finding survey on organized large-scale distribution, and trade retail for the commercial refrigeration subsector is also planned in order to use this information for integrating and/or checking the estimation method used at present.

Professional Refrigeration – dryes and washer -dryers We have started to investigate the dryers and washer-dryers heat pump machines sector. According to Applia Italia, that we contacted, these machines have been starting to use HFC (R-134a, R-450A, R-407C) since recent times and R-290 is indicated as the main alternative to HFC. For all these machines the manufacturing loss rate is estimated less than 1% (Applia Italia, 2019). To date, no further specific data is available to allow an estimate of emissions but we remain in constant contact with the Association, to check the availability of new information over time.

Fire protection systems, Foam blowing, Aerosols. Sectoral experts were contacted in the last years in order to try gathering additional data and information about Foam blowing, Fire extinguishers and Aerosols sub-sectors

but at present no new information is available. For the Foam blowing the investigation focuses on the consumption of other F-gases eventually used in the sectors (i.e. HFC-365mfc and l'HFC-227ea) and on the different contribution of closed cell and open cell foams to the emissions. However, we are in constant contact with these experts to collect any new information that gradually become available.

Other production (2G)

Regarding the other production - (SF₆ Emissions from electrical equipment, SF₆ used in equipment in university and research particle accelerators, N₂O from product uses), the new Presidential Decree, n° 146 of 16 November 2018 adopted due to the enter into force of the F-Gases Regulation n. 517/2014 (EU, 2014), including in its scope also electrical equipments, will improve the control and monitoring system of the appliances. Moreover, improvements in emissions from the use of SF₆ in particle accelerators are expected from new contribution ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development) and companies belonging to national defence.

Categories 2D3a_d_e and 2G

In the following table, the specific planned improvements and remarks to be taken into account in future submissions of the national air inventory for the solvent and other product use sector are reported with the information on the weight of the category on total NMVOC emissions of the sector.

Table 2. *Planned improvements*

Category	Sub-category	NMVOC Emission	Description	Timing
<i>Cross cutting</i>	Paint application for construction and building; Polyester processing; Polyurethane processing	-	Assess the possibility to obtaining information to derive the apparent consumption to be used instead of production data as activity data	2020-2022
<i>Paint application</i>	Other industrial paint application	8%	Assess the possibility to split non industrial application according to the Guidebook EMEP/EEA	2020-2022
<i>Degreasing, dry cleaning and electronics</i>	Metal degreasing	4%	Update information, from the national chemical industrial association (Federchimica), on activity data and emission factor	2020-2022
<i>Chemical products manufacturing and processing</i>	Leather production	5%	Update emission factor for the last years on the basis of the information collected by the industrial association and EPRTTR registry and local emission inventories	2020-2022

Category	Sub-category	NMVOC Emission	Description	Timing
<i>Other use of solvents</i>	Printing industry	4%	Update emission factor for the last years on the basis of the information collected by the industrial association	2020-2022
<i>Other use of solvents</i>	Application of glues and adhesives	5%	Update emission factor for the last years on the basis of the information collected by the industrial association	2020-2022

QA/QC AGRICULTURE 2020 ACTIVITIES AND FUTURE IMPROVEMENTS

Prepared by: Eleonora Di Cristofaro

April, 2021

NATIONAL EMISSION INVENTORY: AGRICULTURE

Objective

This report describes activities and improvements carried out during the preparation of the 2021 national inventory submission for the agriculture sector.

Review process recommendations

During the last UNFCCC Greenhouse gases review process in 2019 the following issues were raised.

Table 1. *Response to the UNFCCC review process issues*

CRF category / issue	Review recommendation	Review report / paragraph	MS response / status of implementation	Chapter/section in the NIR
AGRICULTURE 3.A.2 Sheep – CH4 Transparency	The ERT recommends that Italy improve the transparency of the information by providing information on the assumptions used to adjust the DE% values for mature ewes and other mature sheep.	A.4	Requested information has been provided in the NIR	Chapter 5 paragraph 5.2.2 and 5.2.6
AGRICULTURE 3.B Manure management CH4 Accuracy	The ERT recommends that Italy justify in the NIR the applicability of the currently used VS content values (developed by the researcher from a Danish university in 1992) to the national circumstances of Italy for the entire reporting period and if not possible, to consider using equation 10.24 of the 2006 IPCC Guidelines (vol. 4, chap. 10) to calculate VS excretion per day on a dry-organic matter basis (in kg VS day ⁻¹). Furthermore, the ERT recommends that Italy correct the values for VS content from the referenced currently used document and apply the whole numbers without rounding fractional parts.	A.5	Requested information has been provided in the NIR	Chapter 5 paragraph 5.3.2 <i>Methane emissions (cattle and buffalo)</i> and 5.3.6
AGRICULTURE 3.B Manure management CH4 Transparency	The ERT recommends that Italy improve the transparency of the information by reporting information on the amount of manure generated by each subcategory of cattle and buffalo (e.g. in kg VSmanure/head/day or in kg manure/head/day) and including information on the quantity of bedding material used in solid manure management systems (e.g. in kg VSbedding/head/day or in kg/head/day). Moreover, the ERT recommends that Italy cross-check the country-specific values of VS for cattle and buffaloes against the values calculated on the basis of gross energy intake for each subcategory of cattle and buffalo (using equation 10.24 of the 2006 IPCC Guidelines, vol. 4, chap. 10) and report the results of the verification in the next NIR.	A.6	Requested information has been reported in the NIR and the required data checks has been carried out	Chapter 5 paragraph 5.3.2 <i>Methane emissions (cattle and buffalo)</i> , 5.3.4 and 5.3.6 and Annex 7 paragraph 7.2
AGRICULTURE 3.B Manure management CH4 Accuracy	The ERT recommends that Italy increase the accuracy of the CH4 emission estimates from cattle and buffalo manure management by using data on the allocation of manure management systems for both climate zones, as reported in CRF table 3.B(a)s2, and applying average monthly temperatures from each year for the calculation of CH4 emissions from manure management across the whole reporting period for both climatic zones. The ERT believes that	A.7	As regards the requested information, these has been reported in the NIR	Chapter 5 paragraph 5.3.2 <i>Methane emissions (cattle and buffalo)</i> , 5.3.6 and Annex 7

CRF category / issue	Review recommendation	Review report / paragraph	MS response / status of implementation	Chapter/section in the NIR
	future ERTs should consider this issue further to ensure that the data on allocation of manure management systems and average monthly temperatures are updated. Moreover, the ERT recommends that Italy improve the transparency of the information by providing information on the average monthly temperatures used in the estimations, the specific CH ₄ emission rate (g CH ₄ /kg VS) calculated by Italy on the basis of the equations reported in the NIR, and the total amount of VS handled in slurry/liquid and solid manure management systems for the entire reporting period (e.g. in an annex table).			paragraph 7.2
AGRICULTURE 3.A.1 Cattle CH ₄ Accuracy	The ERT considers that the estimation of Bo is not in line with the guidance presented in the 2006 IPCC Guidelines (vol. 4, chap. 10, p.10.43), which states that “the preferred method to obtain Bo measurement values is to use data from country-specific published sources, measured with a standardized method. If country-specific Bo measurement values are not available, default values are provided in Tables 10A-4 through 10A-9.” The ERT recommends that Italy use a country-specific Bo value obtained from measurements developed to evaluate Bo for manure produced by dairy cattle or apply the default values provided in table 10A-4 of the 2006 IPCC Guidelines.	A.8	Comments on this recommendation have been included in the NIR. Bo is estimated with Equation 10.23 from IPCC (IPCC, 2006, volume 4, chapter 10) and using country specific EFs and VS by livestock category and the average value of MCF by livestock category, considering this procedure more correct than entering the default data in the CRF.	Chapter 5 paragraph 5.3.2 <i>Methane emissions (cattle and buffalo)</i>
AGRICULTURE 3.B.1 Cattle CH ₄ Accuracy	The ERT recommends that Italy conduct a cross-check of the amounts of bedding material used to estimate CH ₄ emissions from manure management and N ₂ O emissions from animal manure applied to agricultural soils, ensuring that the amounts are consistent between two reporting categories.	A.9	Required data checks has been carried out and the relevant information has been reported in the NIR	Chapter 5 paragraph 5.3.4 and 5.3.6
AGRICULTURE 3.B.1 Cattle CH ₄ Completeness	The ERT recommends that Italy complete the estimates of CH ₄ emissions from pasture, range and paddock manure management of dairy and non-dairy cattle and buffaloes for the entire reporting period and report the emissions or provide in the NIR justifications for exclusion in terms of the likely level of emissions according to paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines in its next submission.	A.10	CH ₄ emissions from rom pasture, paddock and range manure management of dairy and non-dairy cattle, and buffaloes have been estimated for the entire reporting period and the emissions have been reported in the 2020 submission and information of the estimate has been reported in the NIR	Chapter 5 paragraph 5.3.2 <i>Methane emissions (cattle and buffalo)</i>
AGRICULTURE 3.B Other livestock CH ₄ Completeness	The ERT recommends that Italy complete the estimations of CH ₄ emissions from pasture management practices of sheep, goats, horses, mules and asses for the entire reporting period or provide in the NIR justifications for exclusion in terms of the likely level of emissions according to paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines in its next submission.	A.11	Methane estimate from manure management of other livestock categories (i.e., sheep, goats, horses, mules and asses) are calculated using default emission factors, which represent all the manure management systems, including grazing. So the recommendation will not	Chapter 5 paragraph 5.3.2 <i>Other livestock categories</i>

CRF category / issue	Review recommendation	Review report / paragraph	MS response / status of implementation	Chapter/section in the NIR
			be followed. Additional explanation has been included in the NIR	
AGRICULTURE 3.B.4 Other livestock CH4 Completeness	The ERT recommends that Italy provide in its NIR the calculation for CH4 emissions from ostrich manure management as provided to the ERT during the review (i.e. using the AD for 2010, 2013 and 2016 and the default EF from the 2006 IPCC Guidelines, vol. 4, table 10A-9) to justify the exclusion of CH4 emissions from ostrich manure management as an insignificant source in line with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	A.12	CH4 emissions from ostrich manure management have been estimated for the entire reporting period and reported in the 2020 submission and information on the estimates have been reported in the NIR	Chapter 5 paragraph 5.3.2 <i>Other livestock categories</i>
AGRICULTURE 3.B.1 Cattle N2O Accuracy	The ERT recommends that Italy improve the consistency of the data on the performance parameters and the feed rations used to estimate gross energy intake by dairy cattle under the enteric fermentation in dairy cattle and the Nex values for dairy cattle for the entire reporting period. The ERT believes that future ERTs should consider this issue further to ensure that the above-mentioned reporting inconsistency is resolved and there is not an underestimation of direct and indirect N2O emissions manure management of dairy cattle and direct and indirect N2O emissions from agricultural soils.	A.13	Updating of Nex values for dairy cattle based on GEI and performance parameters for the entire reporting period has been done and the updated emissions have been reported in the 2020 submission. Relevant information has been included in the NIR	Chapter 5 paragraph 5.3.2 <i>N2O emissions from manure management</i> and 5.3.6
AGRICULTURE 3.B.1 Cattle N2O Transparency	The ERT recommends that Italy revise the aggregated title reported as the "other dairy cattle" subcategory to "other non-dairy cattle", provide a definition for the subcategory "cows in late career" and justify why milk produced by cows in late career is not used for human consumption in commercial quantities.	A.14	Requested information and the revised title of the 'other non-dairy cattle' has been reported in the NIR	Chapter 5 paragraph 5.3.2 <i>Methane emissions (cattle and buffalo)</i>
AGRICULTURE 3.D.a Direct N2O emissions from managed soils N2O Transparency	The ERT recommends that Italy investigate the driving forces for the significant inter-annual changes in AD on the amount of sewage sludge (between 2000 and 2001) and other organic fertilizers (between 2010 and 2011 and between 2011 and 2012) applied to agricultural soils and report this information in its next submission.	A.15	Italy is collecting additional information to be included in the NIR	Chapter 5 paragraph 5.5.4

CRF category / issue	Review recommendation	Review report / paragraph	MS response / status of implementation	Chapter/section in the NIR
AGRICULTURE 3D. Direct and indirect N ₂ O emissions from agricultural soils - 3.F Field burning of agricultural residues N ₂ O, CH ₄ Transparency	The ERT recommends that Italy enhance the transparency of the information in the NIR by providing information on the total amount of crop residues generated and on the shares of crop residues used for different purposes (e.g. in tabular form or in a flow chart).	A.16	Requested information has been reported in the NIR	Chapter 5 paragraph 5.5.2, 5.6.2 and Annex 7 figure A7.1
AGRICULTURE 3.D. Direct and indirect N ₂ O emissions from agricultural soils N ₂ O Transparency	The ERT recommends that Italy improve the transparency in the NIR by including the information how N content (%) reported in table 5.26 are calculated values in its next submission (e.g. in a footnote to the table).	A.17	Requested information has been reported in the NIR	Chapter 5 paragraph 5.5.2

During the last ESD Greenhouse gases review process in 2020 no issue was raised.

During the last NECD review process²⁹ in 2020 the following issues were raised. The technical review of the National Emissions Ceilings Directive (NECD) inventories assessed the implementation of all recommendations, technical corrections and revised estimates from the NECD review 2019.

Table 2. Recommendations from the TERT of the NECD comprehensive review air pollutant inventories

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE, TC or PTC in 2020	Implementation
IT-3B-2019-0001	Yes	3B Manure Management, NO _x , NH ₃ , 2000-2017	For 3B Manure Management, NH ₃ and NO _x emissions the TERT noted that there is a lack of transparency regarding the amount of different substrates treated in biogas facilities. This does not relate to an over- or under-estimate of emissions. This was raised during the 2019 NECD review. In response to a question raised during the review, Italy clarified that, following the 2019 TERT recommendation, annual quantities of livestock manures and the volatile solid content, expressed as kg/t feed of livestock manures, is provided in pages 166-167 of the IIR 2020. The TERT recommends that Italy also includes the amount of nitrogen treated by biogas facilities.	No	Implemented
IT-3Df-2020-0001	Yes	3Df Use of Pesticides, HCB, 1990, 2005, 2016, 2017	For 3Df Use of pesticides, HCB and years 1990, 2005, 2016, 2017 the TERT noted that significant recalculations have been applied (>10% change) for the key category 3Df for the pollutant(s) HCB and year(s) (1990, 2005, 2016-2017). In response to a question raised during the review Italy provided revised estimates that the TERT disagreed with. The TERT decided to calculate a technical correction for the 1990, 2005, 2016, 2017 which was accepted by Italy. The estimates demonstrate that the issue is above the threshold of significance.	TC	Implemented

²⁹ The review of the air pollution emission data submitted by Member States under the European Union's Directive on the Reduction of National Emissions of Certain Atmospheric Pollutants (Directive (EU) 2016/2284) (NECD) defined in Article 10(3).

			The TERT recommends that Italy include a revised estimate in its next submission.		
--	--	--	---	--	--

Improvements and QA activities

Improvements for the Agriculture sector developed in the last years are described in the following.

General aspects

An internal report of the UNFCCC/UNECE-CLRTAP national emission inventory of the agriculture sector has been updated. This report contains information on the procedures undertaken for preparing the national inventory *2021 submission*³⁰.

National statistics

The Italian National Statistical System (SISTAN) revises every year the National Statistical Plan that covers a three years period. In this framework, the Agriculture, Forestry and Fishing Quality Panel (*Circolo Qualità Agricoltura, Foreste e Pesca*) has been established under the coordination of the Agriculture service of ISTAT. In the last years, through this process different improvements, at activity data level, have been reached. Moreover, ISPRA has established a direct contact with a network of sectoral experts useful for the verification of the time series.

ISPRA together with CRPA participated to the preparation of the instructions for specific queries (grazing, housing, storage and land spreading) of the 2010 Agricultural Census, 2013 and 2016 Farm Structure Survey (FSS), and 2020 Agricultural Census. This exercise will allow obtaining information useful as required by the EC regulation and the improvement of the emission inventory, which will include peculiarities of agricultural production in Italy.

Estimation improvements

In 2010 data collection and verification of emission factors presented in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4 – Agriculture, Forestry and other land uses, *AFOLU*) was implemented. In particular, emission factors related to nitrous oxide emissions from agricultural soils were compared. Different local and European scientific publications were used for this verification. Different research groups that are working on soil emission measurements were contacted (University of Naples, University of Turin, University of Udine). In 2015, emission estimates have been updated on the basis of the 2006 IPCC Guidelines.

N excretion in Italy has been evaluated through a N balance inter-regional project “Nitrogen balance in animal farms”, funded by the Regional Governments of the most livestock-intensive Italian Regions. The N-balance methodology has been applied in real case farms, monitoring their normal feeding practice, without specific diet adaptation. In the project the most relevant dairy cattle production systems in Italy has been considered. In contrast with what normally found in European milk production systems, poor correlation between the N excretion and milk production has been found. Probably there are two reasons for explaining the non correlation: a) extreme heterogeneity in the protein content of the forage and in the use of the feed; b) the non optimisation of the protein diet of less productive cattle^{31,32}.

³⁰ Di Cristofaro E., several years. *Procedura per la preparazione, caricamento e reporting dell'inventario nazionale delle emissioni 1990-2019, del settore Agricoltura. Rapporto interno VAL-ATM/ISPRA*. Roma – Italia.

³¹ De Roest and Speroni, 2005. *Il bilancio dell'azoto negli allevamenti di latte. Agricoltura*. Marzo 2005. pag 112-114

³² CRPA, 2010. *Personal communication - experts Laura Valli and Maria Teresa Pacchioli from Centro Ricerche Produzioni Animali (expert consultation on N excretion and natinal production systems)*. Reggio Emilia, Italy.

Regarding uncertainty analysis applied to GHG estimates, Monte Carlo analysis has been extended to other key categories of the sector, the estimation of uncertainties are shown in the *NIR submission 2014*.

In November 2014 submission, revised CH₄ and N₂O emission estimates from manure management have been calculated using a country-specific methodology and MCF, that separate the manure used in anaerobic digesters from the manure treated as slurry/solid.

In 2014, as regards CH₄ emissions from rice cultivation, the cultivation period (days) for some rice varieties have been updated. Despite the upload of the vegetation period of some varieties, the estimate of the average value for water regime does not change the previous values.

In November 2014, the CH₄ emission factors used for the rice cultivation category in the Italian emissions inventory were presented at the 9th Expert Meeting on Data for the IPCC Emission Factor Database (EFDB) and the values were entered into the database. On the basis of the feedback received during the meeting, the daily emission factor for continuously flooded fields without organic amendments for multiple aeration regime have been updated.

As regards N₂O emissions from agriculture soils, in 2015, data on crop residues and, in particular, on the relationship between crop residues and product were compared with studies and research provided by the Agricultural Research Council (CRA). However, these studies were conducted in different countries from Italy, so despite the differences, the values used in the inventory, based on national studies, have not been changed. Following the suggestion of the CRA experts, in the estimation of N₂O emissions from crop residues, the total amount of residues has been considered, without deducting the fraction removed for purposes such as feed, bedding and construction. Therefore, the data were corrected using the fixed residues/removable residues ratio for each crop considered, which is the same information used to estimate the emissions from category emission 3F.

A detailed checklist of procedures for compiling the agriculture sector that is used as part of the QC system was included in the QA/QC Manual. A data flow chart for the agriculture sector was compiled and included in the file that already describe the inventory compilation procedures for the agriculture sector and archived in the reference database. The data flow chart describes the link to the working files used for the estimates.

As a part of QC activities and data verifications, the verification of statistics was carried out: the livestock number was compared between conjunctural (short-term) statistics used in the estimates and Agricultural census for the year 2010. Moreover, an assessment of the methane conversion factors (MCF) has been carried out on the basis of the data coming from the Farm Structure Survey 2007 (carried out by ISTAT) and the 2010 Agriculture Census (ISTAT), resulting in very slight differences comparing to the used average methane conversion factors. The percentage of animals in temperate zone based on data from the 2010 Agriculture Census and the average temperature at provincial level are shown in the NIR. This information has been included to support the details on the estimation of the methane emission factors from manure management.

Data on cow's milk collection from farms for dairy industry provided by the AGEA³³ were compared to official statistics provided by ISTAT, for the years 2004-2015. Data from AGEA are on average higher by 6% in the years 2004-2007 and 3% in the years 2011-2013. In other years, the differences are negligible, in particular for the years 2014 and 2015.

Differences on sheep's milk collection data are found between FAOSTAT and national statistics. FAO data is 30% and 40% higher on average than ISTAT official statistics, for the period 1990-1994 and 1998-2003 respectively. In the following years, the data are practically the same and from 2009 the FAO data are equal to the quantity of milk collected at the farms, provided by ISTAT. The milk directly suckled by lambs is not considered. Further investigation will be carried out.

³³ AGEA is the Agency for Agricultural Payments. The Agency has the task of performing the functions of coordination, monitoring and disbursement of European funds for agriculture - <http://www.agea.gov.it/portal/page/portal/AGEAPageGroup/HomeAGEA/home>. Data are available online at the link <http://www.sian.it/downloadpub/jsp/zfadlx001.jsp> (the filename is *Riepilogo per regione di produzione delle consegne mensili non rettifiche registrate*).

Data on national sales of synthetic nitrogen fertilizers (by type of fertilizers) as provided by *Assofertilizzanti – Federchimica* (personal communication) for the period 2012-2016 have been compared to official statistics provided by ISTAT and used to estimate the FSN amount. Differences were mainly found for the amount of simple mineral nitrogen fertilizers, where data from *Assofertilizzanti* are higher by 20%, on average, for the years 2013-2016. This could be due to a possible double counting of some product which could be considered as a single product and as a compound with other fertilizers. Further investigations will be conducted.

Concerning compost data, from waste sector only data on compost production are available. Official statistics provided by ISTAT on compost used in agriculture sector (that is the green and mixed amendments) are compared to data on compost from waste sector. For the year 2015, the amount of compost used is 58.1% of the compost production only from plants that treat a selected waste.

In 2016, some updates have been done: as regards CH₄ emissions from enteric fermentation, Tier 2 methodology has been applied for sheep category; data on biogas from digesters used for energy production provided by TERNA have been updated and biogas flared has been estimated in response to the 2016 UNFCCC review process; N₂O emissions from nitrogen leaching and run-off during manure management activities have been estimated; for liming category, additional information has been collected from the industry on the amount of dolomite and limestone applied and the weighted average emission factor has been used to estimate CO₂ emissions.

In 2017 submission, in response to the UNFCCC review process, the cross check of crop residues with the calculations of the amount of organic bedding materials added to animal manure available for application to soils has been done. The estimated amount of nitrogen in bedding materials is equal to 66% of the nitrogen contained in straw removed from wheat and barley crops, for the year 2015.

In 2018 submission, some updates have been done: on the basis of the 2010 General Agricultural Census data on housing distribution for dairy cattle category, the production of manure both liquid/slurry and solid has been updated, involving a change in the methane emission factors. Based on the 2010 General Agricultural Census and the 2013 Farm Structure Survey data on manure management systems, NH₃ emission factors for cattle, buffalo, swine and poultry categories and CH₄ emission factors on manure storage for swine category have been updated. NO_x emissions from storage have been updated according to the Tier2 methodology reported in the last version of the EMEP/EEA Guidebook (EMEP/EEA, 2016). NH₃ emissions from digesters biogas facilities have been estimated and subtracted from manure management category (cattle and swine) and allocated in the anaerobic digestion at biogas facilities (5B2 of the waste sector in the NFR classification under UNECE/LRTAP Convention). N₂O emissions have been recalculated according to the update of the average value of Frac_{LEACH-(H)} for the entire national territory based on a country specific methodology.

In 2019 submission, some updates have been done: CH₄ emissions have been recalculated because of the update of the values of some parameters for estimating the manure sent to the digesters³⁴ (such as data related to the percentages of the different substrates that feed the anaerobic digesters and data relative to the average content of volatile solids by type of substrates). As a result of these changes, the amount of manure sent to the digesters decreases considerably and CH₄ losses of the biogas recovery plants become greater than the methane emissions avoided due to the storage of manure in the digesters. Compared to the previous submission, CH₄ emissions from manure management for cattle and swine are increased throughout the time series. Based on the update of parameters for estimating the manure sent to the digesters described above, also the amount of nitrogen contained in the manure has been updated and has remarkably decreased, leading to an increase in total N₂O direct emissions from manure management. N₂O emissions have been recalculated according to the update of Frac_{LOSSMS} that now includes the losses of N₂, consequently the amount of managed manure nitrogen available for application to managed soils has decreased.

³⁴ On the basis of the recent study for the evaluation of the effects on emissions of livestock management practices carried out by CRPA - CRPA, 2018. *Studio per la valutazione degli effetti sulle emissioni delle trasformazioni in corso nel settore degli allevamenti*

In 2020 submission, some updates have been done. CH₄ emissions have been recalculated because of the data updating on manure production for cattle and buffalo from the year 2016 based on Ministerial decree of 25 February 2016 on criteria, and general technical standards, for the regional regulation of the agronomic use of farmed effluents and wastewater, as well as for the production and agronomic use of digestate (GU, 2016)³⁵. The number of laying hens and broilers has been updated from the year 2011 based on 2010 Agricultural Census and 2013 Farm Structure Survey. CH₄ emitted during grazing for cattle and buffaloes and CH₄ from manure management for ostriches have been included, as requested during the 2019 UNFCCC review. N₂O emissions have been also recalculated because of the updating of the N excreted for dairy cattle from the year 1990 based on the 2019 UNFCCC review and calculated using equations 31-33 of the 2006 IPCC Guidelines. Besides, the number of laying hens and broilers has been updated from the year 2011 based on 2010 Agricultural Census and 2013 Farm Structure Survey. Moreover, the N excreted for other poultry has been updated from the year 2005 based on ISTAT statistics, such as 2010 Agricultural Census, 2005, 2007 and 2013 Farm Structure Survey. The N excreted for calves, buffalo, turkeys and other poultry has also been updated from the year 2016 based on Ministerial decree of 25 February 2016 on criteria, and general technical standards, for the regional regulation of the agronomic use of farmed effluents and wastewater, as well as for the production and agronomic use of digestate (GU, 2016).

In 2021 submission, some updates have been done. The main changes are described. CH₄ emissions from enteric fermentation have been recalculated because of the data updating from 2004 of DE and Y_m parameters used to estimate CH₄ emissions for dairy cattle category. CH₄ emissions from manure management have been recalculated because of the following data updating: the average monthly temperatures; the coefficients of cattle and buffalo manure production for the years 2007-2015; the weight of the category other poultry (which affects the coefficient of manure produced) for the years 2007-2015; the number of broilers and laying hens in the period 2001-2009 and since 2011. On the basis of updated temperatures, cattle and pig allocation rates in temperate zones and MCF were recalculated. N₂O emissions from manure management and from agricultural soils have been recalculated because of the updating of the N excreted for dairy cattle from the year 2000. Following the update of the gross energy intake (GE), based on the estimation of the parameters digestibility (DE) of diet and methane conversion factor (Y_m), the excreted nitrogen value of dairy cows was updated from the year 2004. Excreted nitrogen is in fact calculated from GE using equations 10.31-10.33 of the 2006 IPCC Guidelines. In addition, the percentage for protein in diet has been updated from the year 2000 respect to the previous submission. This parameter is used with GE in the estimation of excreted nitrogen.

Planned improvements

In the following table, improvements for the Agriculture emission inventory (UNFCCC/UNECE-CLRTAP) are reported.

Table 4. *Planned improvements*

Category	Subcategory	Parameter	Gas	Description	Timing
Enteric fermentation	Non-dairy cattle	Emission factor	CH ₄	On the basis of the information on the standard diets of cattle for fattening, which will be provided by the CRPA, the updating of values relating to dry matter intake currently in use will be evaluated. In addition, the Y _m values will be evaluated on the basis of the information on the diets and the data reported in the 2019 IPCC guidelines.	2021

³⁵ Gazzetta Ufficiale della Repubblica Italiana (G.U.), 2016. Attuazione della legge 3 maggio n. 79 in materia di ratifica ed esecuzione dell'Emendamento di Doha al Protocollo di Kyoto (G.U. n. 298 del 22 dicembre 2016).

Category	Subcategory	Parameter	Gas	Description	Timing
	Sheep	Emission factor	CH ₄	Additional data and information will be collected to improve the estimation of methane emissions from sheep, in particular for the DE parameter for mature ewes and other mature sheep	2021
Manure management	Livestock categories	CH ₄ EFs	CH ₄	On the basis of the updated provincial average temperature data, the emission factors will be updated, calculated as a weighted average of the default emission factors assigned to the provinces according to climate zone	2022
Agricultural soils	Activity data	Urea	NH ₃ /GHG	Further checks will be made between apparent consumption and end uses, based on production data, import, export and final uses.	2022

National statistics

The implementation of an *ad hoc* survey on “Agricultural Production Methods”, namely Farm and structure survey (FSS), regulated by the European Commission (EC), will be crucial for improving the preparation of the national agriculture emission inventory (UNFCCC/UNECE-CLRTAP). This survey was carried out during the 2010 General Agricultural Census in Italy. Detailed data such as animal grazing information, animal housing and storage systems characteristics, and use of manure/slurry for land application information were collected. Data from 2010 Agricultural Census, FSS 2013 and 2016 were analysed and the emission factors of ammonia, the values of nitrogen excreted between liquid and solid manure of some categories of livestock and methane emission factors of dairy cattle and swine categories were updated based on the results of the calculations. A study carried out by the CRPA in 2018 (CRPA, 2018) mentioned before also includes a survey on the digesters and the outcomes of the survey have been used to update the estimates as described in paragraph 5.3.2 of the NIR. During 2020, based on the comparison with Assofertilizzanti and ISTAT experts on the time series of synthetic fertiliser use, the nitrate data in the years 2009-2011 were revised. In addition, nitrate data (quantity and nitrogen content) were recalculated in the years 1990-2000 to include the estimated CAN fertiliser.

Estimation improvements

Information and administrative data related to number of heads, average weight by livestock category, food rations of livestock for cattle and swine, milk production data is collected every year by the Ministry of Economic Development as part of the Decree of Ministry for the Environment, Land and Sea 9 December 2016 *Attuazione della legge 3 maggio n. 79 in materia di ratifica ed esecuzione dell'Emendamento di Doha al Protocollo di Kyoto* (GU, 2016) and comparisons and verifications with the data used to estimate emissions is carried out.

Improvements will be related to the availability of new information, on emission factors, activity data as well as parameters necessary to carry out the estimates.

QA/QC LULUCF
2020 ACTIVITIES AND FUTURE IMPROVEMENTS

Prepared by: Marina Vitullo and Guido Pellis

April, 2021

NATIONAL AIR EMISSION INVENTORY: LULUCF

Objective

The report summarizes the improvements and remarks, which have been identified during the preparation of the 2021 inventory submission for the LULUCF sector.

Review process recommendations

In Table 1, responses to the main questions raised during the last UNFCCC review process, related to the national inventory submitted in 2019, are described.

Table 1. *Response to the UNFCCC review process recommendations*

CRF category / issue	Review recommendation	Review report / par.	MS response / status of implementation	Chapter/section in the NIR
LULUCF 4. General– (L.8, 2018) Transparency	Report more detailed explanatory information and a justification of recalculations in the NIR in line with paragraph 44 of the UNFCCC Annex I inventory reporting guidelines (e.g. providing information on the updated AD and/or on errors corrected in the models used)	L.1	Additional information has been included in the NIR	chapter 6 paragraph 2
LULUCF 4. General (L.8, 2018) Transparency	Ensure that the NIR contains up-to-date and consistent information on recalculations applied in the sector	L.2	Additional information has been included in the NIR	chapter 6 paragraph 2
LULUCF 4.A Forest land – CO ₂ (L.2, 2018) (L.5, 2016) (L.5, 2015) (56, 2014) Transparency	Document the For-est model validations in the NIR	L.3	The validation against the latest NFI data is planned to be used for the 2021 submission, since the NFI will be released by end of October 2010.	chapter 6 paragraph 2
LULUCF 4.A Forest land – CO ₂ (L.5, 2018) (L.7, 2016) (L.7, 2015) (58, 2014) Transparency	Provide definitions and thresholds for carbon pools in a table in the NIR	L.4	Additional information has been included in the NIR	chapter 6 paragraph 2
LULUCF 4.B.1 Cropland remaining cropland – CO ₂ (L.11, 2018) Transparency	Provide information on the smoothing process applied for the estimates and provide a table with the calculations with and without the smoothing in the NIR	L.6	A table reporting land use data with and without the smoothing over a 5 years period has been included in the NIR (submission 2019). An additional clarification related to the granularity of the smoothing process has been added to the NIR	chapter 6 paragraph 1
LULUCF 4.C.1 Grassland remaining grassland – CO ₂ (L.6, 2018) (L.13, 2016) (L.13, 2015) Accuracy	Include the subset of “improved grazing” land in the CRF tables and the NIR under the Convention while the new information is becoming available	L.7	The soil C stock changes for grassland has been estimated and reported based on updated available country specific data; the information on the subset of land included in the category has been detailed in the NIR.	chapter 6 paragraph 4

LULUCF 4(V) Biomass burning (4.E Settlements) – CO ₂ , CH ₄ and N ₂ O (L.12, 2018) Completeness	Revise the use of the notation key from “NO” to “NE” for CO ₂ , CH ₄ and N ₂ O emissions together with the relevant justification for excluding the emissions, in line with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines (regarding biomass burning for settlements)	L.8	Notation keys have been changed and additional information has been included in the NIR	chapter 6 paragraph 6
LULUCF Land representation – Convention reporting adherence	The ERT recommends that Italy correct the error in the reporting of the total national land area in the land transition matrix reported in CRF table 4.1 that is owing to the error made when updating the areas of forest land remaining forest land for 2005, 2006 and 2007.	L.10	The errors have been fixed	chapter 6 paragraph 1
LULUCF 4.A Forest land – CO ₂ Transparency	The ERT recommends that Italy include in Annex 14 of the NIR a summary of the process used to infer the correction factors to consider informal harvest in the estimates of carbon stock changes in forest and include a table or a graph similar to the ones presented to the ERT during the review week showing the correction factors calculated by region.	L.11	Additional information has been included in the NIR	chapter 6 paragraph 2; Annex 14
LULUCF 4.A Forest land – CO ₂ Transparency	The ERT recommends that Italy correct the threshold values for below-ground biomass and for all other non-living biomass in litter contained in the table and encourages the Party to add the appropriate table number to the table on carbon pools in NIR section 6.2.4.	L.12	The errors have been fixed	Chapter 6 paragraph 2
LULUCF 4.B.1 Cropland remaining cropland – CO ₂ Completeness	In response to questions from the ERT and in the presentations from the Party during the review week, Italy presented the main outcomes of an ad-hoc project carried out in the last 2 years aimed to build a country specific estimation methodology, able to take into account the detailed information on implemented management practices in the estimation process of carbon stock changes related to the soils pool; preliminary estimates for CM, including soils pool, were presented and are planned to be reported in the next annual submission. The ERT commends Italy for these efforts to improve the inventory, The ERT recommends to report these new estimations of CSC in mineral soils in Cropland remaining Cropland and in CM under KP-LULUCF, as applicable, in the next submission.	L.13	Soil organic matter (SOM) of Cropland mineral soils has been estimated and reported	chapter 6 paragraph 3
LULUCF 4.C.1 Grassland remaining grassland – CO ₂ Completeness	Italy explains in the NIR (page 254) that SOM of Grassland mineral soils is not estimated and reported as "NE" because "no data are currently available on management practices in specific units of land". However, values of CSC in this C pool are actually reported in GM under KP (category B.3), and in CRF table 4.C under grassland remaining grassland the notation key "NO" has been used for mineral soils in grazing land and "NA" for mineral soils in other wooded lands, using the Tier 1 assumption that this C pool is not a net source which is not fully adequate as a justification for not reporting a C pool under the Convention. In response to questions from the ERT and in the presentations from the Party during the review week, Italy presented the main outcomes of an ad-hoc project (see ID# L.13) and preliminary estimates for GM including soils pool were presented and are planned to be reported in	L.14	Soil organic matter (SOM) of grassland mineral soils has been estimated and reported	chapter 6 paragraph 4

	the next annual submission. The ERT commends Italy for these efforts to improve the inventory. The ERT recommends the Party to report these new estimations of CSC in mineral soils in Grassland and GM, as applicable, in the next submission or recommends/encourages to report this carbon pool as “NA” using the assumption of steady state for the carbon stock provided by the Tier-1 method in section 6.2.3.1 of Vol. 4, Chapter 6 of the 2006 IPCC Guidelines			
LULUCF 4(V) Biomass burning – CO ₂ , CH ₄ , N ₂ O Accuracy	The ERT recommends that Italy revise the methodology used to estimate emissions from biomass burning by using the mean instead of maximum of average values estimated for the years 2008-2016 for estimating emissions for the years 1990-2007.	L.15	The recommendation has been addressed, changing the estimation methodology	chapter 6 paragraph 2, 3, 4 and 12
LULUCF 4.G HWP – CO ₂ Transparency	The ERT recommends that Italy document in the NIR the methodology used to estimate CO ₂ emissions from SWDSs reported in CRF table 4.Gs1 and the rationale for the reported half-life value of 3.89 years. The ERT further encourages the Party to report carbon input to SWDSs or report it as “IE”, noting that these values have already been considered in the estimation of carbon losses	L.16	Additional information has been included in the NIR	chapter 6 paragraph 13
KP-LULUCF Article 3.4 activities – CO ₂ (KL.1, 2018) (KL.2, 2016) (KL.2, 2015) Accuracy	Include transparent and verifiable information that demonstrates that the litter pool and deadwood pool for CM and above-ground biomass, below-ground biomass, litter, deadwood pools for grassland management are not net sources, as stated in the annex to decision 2/CMP.7, and change the notation key from “NO” to “NE”.	KL.1	Additional information has been included in the NIR	chapter 9 paragraph 3
KP-LULUCF FM – CO ₂ (KL.6, 2018) Yes. Accuracy	Correct the reporting of the FM cap in the CRF accounting table	KL.3	The correct FMcap has been included in the CRF	
KP-LULUCF CM – CO ₂ (KL.7, 2018) Yes. Transparency	Provide detailed information in the NIR on how the IUTI is updated and how it impacts the further refinement of AD classes in woody crops and non-woody crops, together with detailed information on the typologies of perennial woody crops and biomass estimates that are affected by the IUTI updates, which may affect the IEF changes	KL.4	Additional information has been included in the NIR	Annex 10
KP-LULUCF General – CO ₂ , CH ₄ , N ₂ O Transparency	Italy reported recalculations in CM of -191.57 kt CO ₂ eq (29.2%) in 2016 which might be related to the recalculations applied to CL under the Convention for the same year and further recalculations in GM for the years 2013-2016, ranging from +507.64 kt CO ₂ eq (-79.1%) in 2013 to +672.23 kt CO ₂ eq (-95.2%) in 2015. A small recalculation was also applied to FM in 2016. No specific information on these recalculations was found in Chapters 8 and 9. In response to questions from the ERT, Italy noted that the drivers for CM recalculation are basically the same described in the Cropland category under the Convention, since the activity data and estimation process adopted under CM are the same. Given the differences in temporal frameworks between Convention categories and KP activities and the rules applied by the Party for the areas subject to KP-LULUCF activities as documented in Section 9.5.3, the ERT considers that these recalculations need to be documented in the NIR,	KL.5	Additional information has been included in the NIR	chapter 9 paragraph 3

	therefore recommends that Italy clearly describe in the NIR the drivers of recalculations applied to KP-LULUCF activities			
KP-LULUCF CM – CO ₂ , CH ₄ , N ₂ O Transparency	<p>The inter-annual change in the Carbon Stock Change of perennial woody crops between 2015 (1,234.36 ktCO₂) and 2016 (32.36 ktCO₂) which represents a 97.4% decrease and is considered significant. During the review, Italy noted that the inter-annual change in the Carbon Stock Change of perennial woody crops is due to the small inter-annual variation of the perennial woody crops in the same period (2403.8 kha in 2015 vs 2402.9 kha in 2016): the small change in area is the driver for the assessment of C losses (associated to cropland area where perennial crops have been removed): in 2015, 34kha have been estimated while only 1kha has been estimated in 2016, and referred to Table 6.12 of the NIR where the time-series of areas with C losses are reported. The ERT also noticed a sudden drop of -1,051.53 kt CO₂ eq. (-49%) in Cropland emissions between 2015 and 2016, which is not clearly explained in the NIR. In response to questions from the ERT, Italy noted that the change between 2015 and 2016, in 2019 submission compared to 2018 submission, was triggered by an update of 2015 area of annual crops (6,415.95 kha in 2019 submission vs 6,419.19 kha in 2018 submission) and an update of 2016 area of woody crops (2,403.87 kha in 2019 submission vs 2,377.56 kha in 2018 submission) made by the ISTAT.</p> <p>The ERT considers that important changes in trend of emissions/removals like this significant drop in Cropland estimates between 2015 and 2016, which impacted the CM estimates under KP-LULUCF, need to be better explained in the NIR and recommends that the Party clearly document in the NIR the drivers of significant changes in trend of emissions/removals in Cropland and CM.</p>	KL.6	Interannual changes in the time series if any has been documented in the relevant paragraph of the NIR	chapter 6 and chapter 9
KP-LULUCF Biomass burning – CO ₂ , CH ₄ , N ₂ O KP reporting adherence	<p>The ERT recommends that Italy revise the methodology used to estimate emissions from biomass burning by using the mean instead of the maximum average values calculated for 2008–2016 to estimate emissions for 1990–2007. The ERT further recommends that Italy report in the NIR revised information on the calculation of the background level and the margin, including any recalculation made to them to maintain methodological consistency with the reported emissions and the forest management reference level and revise accordingly the values reported in tables 4(KP-I)A.1.1 and 4(KP-I)B.1.3, where applicable.</p>	KL.7	The estimation methodology has been revised based on updated available country specific data; the description of the process and consequent recalculations have been detailed in the NIR.	chapter 9 paragraph 3

Inventory improvements and QA activities

Forest land (4A)

Several activities have been implemented and carried out; 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 (MATTE) 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. In addition, a specific Decree³⁶ was adopted by Ministry for the Environment, Land and Sea to fulfil the requirements outcoming from the ratification of the Doha amendment to the Kyoto Protocol establishing the second commitment period. The technical annex to the abovementioned Decree includes detailed list, for each reporting sector, of the needed data and timeframes; the relevant data providers have been identified and included in the same Decree. The entry into force of the Decree facilitates the data collection as well as is aimed to increase the quality and timeliness of the gathered data. A specific Annex is included to the NIR to provide detailed information on *For-est* model.

Cropland (4B)

In the framework of the abovementioned Decree related to the Doha amendment to the Kyoto Protocol, a technical working group, headed by ISPRA, has revised data and methods to estimate C stock changes for living biomass pool, for perennial crops under cropland remaining cropland, and for soil pool. For living biomass, total woody crops area has been broken down into age groups, taking into account three main woody crops categories (i.e. olives, vineyards and other fruit). The estimation process has been carried out at NUTS2 (regional) level based on the available data from national statistics (ISTAT) related to the different woody crops species³⁷, harvest/maturity cycles. The values of aboveground and belowground biomass carbon stock at harvest for the different crops used to estimate the living biomass C stock changes have been assessed on the basis of the database collected in the framework of the LIFE project MEDINET³⁸.

For mineral soils, the change in mineral soil C stocks is the result of a change in management practices in a unit of land across time; the detailed list of cropland management practices, for annual and perennial crops, as well as the relevant data sources used for each of the abovementioned management practice, are reported in the NIR (tables 6.15, 6.16). In addition, the SOC_s, per region and per management practices, for annual and woody crops, have been updated, as shown in the NIR (table 6.18).

Grassland (4C)

In the framework of the abovementioned Decree related to the Doha amendment to the Kyoto Protocol, a technical working group, headed by ISPRA, has revised data and methods to estimate soil C stock changes. For mineral soils, the change in mineral soil C stocks is the result of a change in management practices in a unit of land across time; the list of grazing land subcategories, including the relevant data sources used, are reported in the NIR (table 6.21). In addition, the SOC_s, per region and per management practices, have been updated, as shown in the NIR (table 6.23).

Supplementary information required under Article 7.1 of the KP - art. 3.3

(Afforestation/Reforestation/Deforestation) and art. 3.4 (Forest Management, Cropland Management, Grazing land management)

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 (MATTE) 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.

³⁶ Decree of Ministry for the Environment, Land and Sea 9 december 2016 Attuazione della legge 3 maggio n. 79 in materia di ratifica ed esecuzione dell'Emendamento di Doha al Protocollo di Kyoto (GU, 2016).

³⁷ Olive, vineyard (for wine grapes and other), orchards (orange, mandarine, clementine, lemon, grapefruit, bergamot, cedar, chinotto), apple, peach, pear, apricot, cherry, kiwifruit, other fruits (carob, fig, plum, hazelnut, almond, raspberry)

³⁸ MEDINET (Mediterranean Network for Reporting Emissions and Removals in Cropland and Grassland): <https://www.lifemedinet.com/>

Relevant updates occurred in Cropland Management (CM) and Grazing land Management (GM). Living biomass pool has been estimated, for woody crops under CM, considering different woody crops species, broken down into age groups, harvest/maturity cycles. Soil carbon stock changes, under CM and GM, have been estimated based on the change of management practices in a unit of land across time, as reported in the NIR (tables 9.1). In addition, the SOC_s, per region and per management practices, have been updated, as shown in the NIR (table 9.2, 9.3).

Planned improvements

In the following, specific improvements and remarks to be considered in the next submission of the national GHG inventory for LULUCF sector are reported.

In Table 2, the planned improvements are synthesized; for each topic, the reference to the UNFCCC category or KP activity, which the improvement is focussed, is reported.

Table 2. *Planned improvements*

Category	Sub category	Parameter	Gas	Description	Timing
Forest land	FL-FL; L-FL	-	GHG	<ul style="list-style-type: none"> – Implementation of the III NFI's outcomes; the final outcomes, related to the field surveys, are expected to be available in 2022. – Update of the model could be planned to allow for disaggregated estimates of C stock changes in land converted to forest land, since the current version of forest model do not discriminate among forest remaining forest and land converted to forest. – A confusion matrix, between forest typologies of the NFI2005 and those of the first forest inventory classification systems will be carried out. 	2023
				<ul style="list-style-type: none"> - the for-est model currently do not remove year by year the impact of deforestation from the calculation of the forest biomass density and consequently from the calculation of the annual increment. - the for-est model currently do not calculate annual biomass increment in the areas converted to forest in the year. The inclusion of such areas is considered necessary to address the identified underestimations of the biomass C stock. 	
Cropland	CL	Activity data	GHG	Verification activities, data collection	2022
Grassland	GL	Activity data	GHG	Verification activities, data collection	2022
HWP	HWP	emission factors	CO ₂	Analysis on the end-use, the discard rates of HWP, as well as the final market use of wood in Italy. The main outcome of this investigation could be the set-up of country specific emission factors to be used in the estimation process	2023

KP LULUCF	art. 3.3; art. 3.4	Activity data	CO ₂	Implementation of the III NFI's outcomes; the final outcomes, related to the field surveys, are expected to be available in 2021	2023
	CM	Activity data; emissions/re movals	CO ₂	Data collection and verification activities	2022
	GM	Activity data; emissions/re movals	CO ₂	Data collection and verification activities	2022

In the following, details related to the specific improvements are provided category by category.

Forest land (4A)

In the next annual submission, no improvements are planned, due to the delay in provision of the third NFI data, now rescheduled for 2022.

The third NFI data will allow the calibration of the increment curve and verification of the *for-est* estimates through a comparison with estimates prepared with the stock-difference method; in addition an update of the model could be planned to allow for disaggregated estimates of C stock changes in land converted to forest land, since the current version of *for-est* model do not discriminate among forest remaining forest and land converted to forest.

A confusion matrix, between forest typologies of the NFI2005 and those of the first forest inventory classification systems is under finalization and will be implemented.

The following improvements will be implemented in the *for-est* model, once the III NFI data will be available:

- the *for-est* model currently do not remove year by year the impact of deforestation from the calculation of the forest biomass density and consequently from the calculation of the annual increment.
- the *for-est* model currently do not calculate annual biomass increment in the areas converted to forest in the year. The inclusion of such areas is seen needed to address the identified underestimate of the biomass C stock (see Annex 14 on the *for-est* model).

Cropland (4B) - Grassland (4C) - Wetlands (4D) - Settlements (4E)

No improvements are planned for the next submission.

Harvested wood products (HWP) (4G)

Planned improvements are related to the investigation on the end-use, the discard rates of HWP, as well as the final market use of wood in Italy. The main outcome of this investigation could be the set-up of country specific emission factors to be used in the estimation process. A review will also be undertaken aiming to better understand the interactions among the different sectors to which the HWP pool is related (i.e. LULUCF/forest land, the Energy sector and the Waste sector).

Biomass Burning (4V)

No improvements are planned for the next submission.

Supplementary information required under Article 7.1 of the KP - art. 3.3

(Afforestation/Reforestation/Deforestation) and art. 3.4 (Forest Management)

The full implementation of the III NFI's outcomes, which are expected to be available in 2022, is foreseen for the 2023 submissions; in particular, also for the KP activities, these data will allow a comparison between the

two IPCC methods (carbon stock change versus gains-losses) could be undertaken; the comparison is a valuable verification exercise and is able to highlight any potential outlier which detaches the two estimates.

Supplementary information required under Article 7.1 of the KP - art. 3.4 (Cropland Management - Grazing land Management)

No improvements are planned for the next submission.

QA/QC WASTE
2020 ACTIVITIES AND FUTURE IMPROVEMENTS

Prepared by: Barbara Gonella, Ernesto Taurino

April, 2021

NATIONAL AIR EMISSION INVENTORY: WASTE

Objective

This report summarises the improvements, which have been identified during the preparation of the 2021 inventory submission for the waste sector.

Review process recommendations

In the following table, issues raised during the review process and related to the waste sector are reported; responses to each subject are also included.

Table 1. *Response to the UNFCCC review process recommendations*

CRF category / issue	Review recommendation	Review report / paragraph	MS response / status of implementation	Chapter/section in the NIR
WASTE 5.A Solid waste disposal on land – CH4 (W.7, 2018) Transparency	Provide in the NIR further explanation on how time-series consistency and completeness is ensured (This could be done by including a description on how the historical and more recent waste categorizations are combined (e.g. textiles, leather and wood in historical data are included in other waste type)	W.2	The NIR has been updated accordingly	chapter 7 paragraph 2
WASTE 5.A Solid waste disposal on land – CH4 (W.7, 2018) Transparency	Provide in the NIR a reason for applying the current waste composition in the calculation for the weighted average k values for the entire time series (for slowly degraded waste (paper/nappies/textiles/leather/wood), which has variations of composition and inconsistent categorization throughout the time series, see W.1 above).	W.3	The NIR has been updated accordingly	chapter 7 paragraph 2
WASTE 5.A Solid waste disposal on land – CH4 (W.8, 2018) Transparency	Provide in the NIR summary information on waste disposal amounts for each climate zone	W.4	The NIR has been updated accordingly	chapter 7 paragraph 2
WASTE 5.A.2 Unmanaged waste disposal sites – CH4 (W.10, 2018) Transparency	Include in the NIR information to justify why disposal amounts from unmanaged disposal sites related to the Naples waste management issue are not included in the inventory estimates.	W.6	The NIR has been updated accordingly	chapter 7 paragraph 2

WASTE 5.B Biological treatment of solid waste – CH ₄ and N ₂ O (W.11, 2018) Transparency	The ERT recommends the Party include the information of dry basis AD and the assumption of moisture content in the NIR.	W.7	The NIR has been updated accordingly	chapter 7 paragraph 3
5.D.2 Industrial wastewater – N ₂ O Transparency	Improve the transparency of the NIR and of CRF table 5.D by using the appropriate AD in the CRF table or by including an explanation that the AD reported in CRF table 5.D are in fact the N-N ₂ O in the effluent.	W.9	The NIR has been updated accordingly	chapter 7 paragraph 5
WASTE 5.A Solid waste disposal on land – CH ₄ (W.7, 2018) Transparency	Italy reported the annual change in total long-term carbon storage in HWP waste as “NO” under the memo items in CRF table 5, however, in CRF table 4.Gs1, it reported net CO ₂ emissions from HWP in SWDSs in 2017 as 2,681.15 kt CO ₂ . The ERT noted that this is not consistent. During the review Italy explained that the same database was used for HWP for both the waste and LULUCF sectors (see issue ID# L.16 above). The ERT recommends that Italy ensure that the information on the annual change in total long-term carbon storage in HWP waste presented in CRF table 5 is consistent with the information reported in LULUCF in CRF table 4.Gs1.	W.11	CRF tables have been updated accordingly	
WASTE 5.C.1 Waste incineration – CO ₂ Transparency	The ERT recommends that the Party improve transparency by including the values of carbon content for the whole time-series and the reason for these changes on carbon contents, fossil carbon fraction and oxidation factors, in order to facilitate the replication of the estimation. The ERT believes that future ERTs should consider this issue further to ensure that there is not an underestimation of CO ₂ emissions from these categories.	W.12	The NIR has been updated accordingly	chapter 7 paragraph 4

Issues raised during the 2020 ESD Greenhouse gases review process.

Table 2. *Response to the ESD review process recommendations*

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	Implementation
IT-5A-2020-0004	Yes	5A Solid Waste Disposal, CH ₄ , 1990-2018	For CH ₄ emissions 5A Solid Waste Disposal for all years the TERT noted that Italy is applying a country-specific methodology that has been improved recently. Regarding the previous approach, Italy had demonstrated that was consistent with the 2006 IPCC Guidelines, but since changing its methodology, no QA activities that would ensure that the country-specific method is still consistent with the 2006 IPCC Guidelines have been carried out. The TERT cannot conclude whether this issue may relate to an over- or under-estimate of emissions. In response to a question raised during the review, Italy explained that it will insert the comparison in the QA/QC	No	The comparison between the Italian and the IPCC model has been accomplished and reported in the NIR (chapter 7 paragraph 2)

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	Implementation
			plan and will report in the next submission the results of this comparison using both methodologies. The TERT recommends that Italy include the results of a verification of its country-specific model by comparing its emissions estimates with the IPCC Tier 1 model. For instance, the IPCC model could be set up a first time using IPCC default inputs and a second time, using the Italian model input parameters (as far as possible). The results may therefore be presented as QA activities in the NIR (including a short description of each scenario).		

Table 3. *Response to the NECD review process recommendations*

Observation	Key Category	NFR, Pollutant(s), Year(s)	Recommendation	RE or TC	Implementation
IT-5C-2019-0001	Yes	5C Waste Incineration, PCBs, HCB, 1990-2018	The TERT reiterates the recommendation from the 2019 review to take in account the implementation of abatement technology over the years for those sources where this is not considered yet (for instance 5C1bv). The TERT additionally, recommends Italy to further improve the transparency in the IIR and to use the emission factors from the survey on incineration of sewage sludge in the 2022 submission.	No	
IT-5C1a-2020-0001	No	5C1a Municipal Waste Incineration, SO ₂ , NO _x , NH ₃ , NMVOC, PM _{2.5} , BaP, PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F, PM ₁₀ , CO, BC, 2013-2018	The TERT recommends that Italy continues to use 'NO' as notation key when all incineration is with energy recovery, to report the emissions from this in the energy sector and to correct the data in IIR table 7.5 in the next submission.		Data in the table 7.5 have been corrected
IT-5E-2019-0001	No	5E Other Waste, PCDD/F, 2005, 2016, 2017	The TERT recommends that Italy makes their country specific approach complete by estimating the emissions from burning of household furniture and upholstery in the building fires that are currently missing.		New estimates have been produced

Inventory improvements and QA activities

Other improvements not identified during the review processes have been carried out in the last years.

An in depth analysis of EWC codes of waste disposed of in landfills has been done for the year 2007, thanks to the complete database of Waste Cadastre kindly supplied by ISPRA Waste Office. This accurate analysis has permitted to verify the correctness of waste typology assumptions used for the estimations. Italy has investigated more deeply the country specific conditions and revised the k-values considering the subdivision of the national territory in dry or wet zones on the basis of georeferenced data (30 km grid) consisting of the monthly average climatic summaries (period 1986-2015) of precipitation and evapotranspiration referring to the rainy period (October-December) and to the entire national territory provided by the Research Centre for Agriculture and Environments CREA-AA. Subsequently the ratio between precipitation (MAP = Mean Annual

Precipitation) and evapotranspiration (PET = Potential Evapotranspiration) has been calculated and dry and wet zones distinguished following the 2006 Guidelines.

The LCV used for biogas derives from national experts and it has been verified with energy and quantitative data about biogas production from waste supplied by TERN (National Independent System Operator)³⁹.

Where information is available, wastewater flows and COD concentrations are checked with those reported yearly by the industrial sectoral reports or technical documentation developed in the framework of the Integrated Pollution and Prevention Control (IPPC) Directive of the European Union (<http://eippcb.jrc.es>).

A thesis on GHG emissions from wastewater handling has been carried out at Environmental, Hydraulic, Infrastructures and Surveying Engineering Department (DIIAR) of Politecnico di Milano⁴⁰, where national methodology has been compared with that reported in 2006 IPCC Guidelines and with a methodology developed in the framework of a previous thesis for the estimation of emissions from wastewater treatment plants located in Regione Lombardia.

As planned in the previous submissions a rearrangement of incinerators database has been made. During this process an in depth analysis of all incineration plants has been carried out with the target to eliminate double counting and to add eventual no counted plants. Once the list of plants was updated, a new and unique database has been developed to manage activity data, emissions of greenhouse gases and other pollutants, and spatial disaggregation, supporting QA / QC processes. On the basis of carbon content in different waste fraction and the relevant variation along the time series the CO₂ emission factor for incineration has been updated. In a similar way for air pollutants since 2010, emission factors for urban waste incinerators have been updated on the basis of data provided by plants concerning the annual stack flow, the amount of waste burned and the average concentrations of the pollutants at the stack. As the emission factors are considerably lower than the old ones due to the application of very efficient abatement systems it was necessary to apply a linear smoothing methodology assuming a progressive application of the abatement systems between 2005 and 2010. Emission factors for industrial waste incinerators have been updated from 2010 onwards on the basis of the 2019 EMEP/EEA Guidebook. Similarly to municipal waste smoothing has been applied between 2005 and 2010 supposing a linear application of the abatement systems.

Following the discussion started during the European review a specific survey on methane emission factor from composting and the relationship with technologies and management practices has been conducted (ISPRA, 2017) resulting in a new emission factor equal to 0.65 kg CH₄/Mg waste treated on a wet weight basis.

In the same way, detailed information has been acquired about solid waste disposal sites, in particular about:

- Inventory of methane generation rate (k) values for CH₄ from landfills;
- Assessment of values and background of k values;
- Spatial distribution of dry and wet zones in Italy and location of landfills;
- Formulation of a proposal for emission estimates for CH₄ in future NIRs;
- Verification.

On the basis of this information new estimates have been produced. On the basis of the last European Review (EEA, 2020) A comparison of the IPCC waste model (MS excel) with the model used by Italy for the simulation of biogas production was carried out. To adequately compare the two calculation models, 4 outputs were created corresponding to the categories used in the Italian model:

wet-managed (SWDS in wet zone and well managed), wet unmanaged (SWDS in wet zone and not managed), dry managed (SWDS in dry zone and well managed) and dry unmanaged (SWDS in dry zone and not managed).

³⁹ TERN, several years. *Dati statistici sull'energia elettrica in Italia*. Rete Elettrica Nazionale.

⁴⁰ Solini, 2010. *Emissioni di gas serra dallo scarico e trattamento di acque reflue*. PhD tesi
ISPRA, 2017. Update of CH₄ emission factor from composting. Technical note n.1/2017.

Planned improvements

In the following, specific improvements and remarks to be taken into account in the next submission of the national air inventory for the waste sector are reported.

In Table 4, the planned improvements are synthesized; for each topic, the reference to the UNFCCC category, which the improvement is focussed, is reported.

Table 4. *Planned improvements*

Category	Subcategory	Parameter	Gas	Description	Timing
Biological treatments	Anaerobic digestion			Anaerobic digestion of solid waste is under investigation to collect more information about technologies and emission factors.	2021
Waste incineration	Municipal waste incineration	Combustion technologies	GHG	An assessment of the changes in GHG EFs across the time series with the aim of reflecting efficiency improvements or other changes with time is planned for the future.	Done
Wastewater treatment and discharge	Domestic and commercial	Activity data	CH ₄	The served population equivalent figures supplied by the National Institute of Statistics will be verified with the results of the next national survey, if available.	2021
Wastewater treatment and discharge	Domestic and commercial	Anaerobic digestion technology	CH ₄	Anaerobic digestion of sludge from activated sludge processes is under investigation to collect more information about technologies and possible gas escape.	2021
Wastewater treatment and discharge	Industrial	Activity data and emission factors	CH ₄ , N ₂ O	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories will be applied for industrial wastewaters.	2021
Other waste	-	Activity data and emission factors	AQ pollutants	Acquire more info about data and management system of waste not considered in 5A-5B-5C-5D categories. Focus on accidental episodes.	done

Solid waste disposal on land

An in depth analysis of EWC codes of waste disposed of in landfills will be done for the year 2019, as for 2007, thanks to the complete database of Waste Cadastre kindly supplied by ISPRA Waste Office. This accurate analysis will permit to adequate the waste composition to the current situation.

More recent data on the fraction of CH₄ in landfill gas and on the amount of landfill gas collected and treated are under investigation. Different sustainability report and E-PRTR declaration are and will be analysed to obtain activity data about the collected biogas.

Regarding the energy conversion efficiency of biogas engine, actually assumed equal to 0.3, as the technological evolution is probably leading to increase efficiency to around 40%; further investigations are planned.

Investigation on industrial sludge disposed into landfills is on-going, the information about the amount of sludge disposed in managed landfills has already been collected and must be processed and checked on the basis of data reported in the National Cadastre. The National Waste cadastre is managed by ISPRA and is formed by a national branch hosted by ISPRA and regional and provincial branches hosted respectively by the

Regional Agencies for the Protection of the Environment. So the system requires continuous and systematic knowledge exchange and QA/QC checks in order to ensure homogeneity of information concerning waste production and management throughout the entire Italian territory.

Following another recommendation deriving from the review process, Italy investigated the possibility to estimate the emissions from certain episodes of illegal dumping. There are no quantitative data about this issue but from a qualitative point of view it was known that waste was prevalently industrial waste rich in heavy metals and inorganic chemicals, generally no or slowly biodegradable. Anyhow, the waste has been collected and temporarily stored in “ecoballe”, therefore officially registered and sent to appropriate treatments resulting in the data reported by the National database

Biological treatment of solid waste

Anaerobic digestion of solid waste is under investigation to collect more information about technologies and emission factors.

Waste incineration

As reported for solid waste disposal on land, the waste composition is very important to improve CO₂ emission factor on the basis of carbon content, but in the case of incineration combustion technologies are equally important. In order to update the government’s strategy to achieve Italy’s emissions reduction target under the Kyoto Protocol, the GHG emission projections for 2020, specific to waste management, have been updated with a focus on how this could influence the waste composition. The new information on waste composition has improved also CO₂ waste incineration emission estimates reviewed in the 2019 submission.

The analysis regarding incineration plants has been conducted through verifications and comparisons with data reported in E-PRTR registry, Emissions Trading Scheme and updated data of waste amount and pollutants emissions (ENEA-federAmbiente, 2012). These investigations have led, in the previous submissions, to the allocation of some plants erroneously reported as incinerators whilst boilers and cement kiln facility already considered in the energy sector have been deleted. New updates will come from the new report on energy recovery from waste management published by Utilitalia and ISPRA in 2019 which will be used for next submissions.

Wastewater handling

Possible improvements in future submissions could come from the share of information with the Office of the Ministry of the Environment, Territory and Sea who is responsible for water activities.

Some improvements could also come from the analysis of E-PRTR data and from Environmental Reports of those industries whose produce wastewaters.

The served population equivalent figures supplied by the National Institute of Statistics will be verified with the results of the next national survey, when available. Anaerobic digestion of sludge from activated sludge processes is under investigation to collect more information about technologies and possible gas escape. Finally, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories will be applied for industrial wastewaters.

.

IMPROVEMENT PLAN

Prepared by: Riccardo De Lauretis

April, 2021

NATIONAL AIR EMISSION INVENTORY: IMPROVEMENT PLAN

The quality objectives of the Italian inventory are revised every year and improvements are planned on account of the results of the various review processes, the accuracy of the estimation method, the uncertainty and weight of the category analysed, and a cost effectiveness evaluation.

The following table show a list of priorities identified by the inventory team to be implemented in the next submissions.

Sector	Category	Parameter	Gas	Description	Timing
General	-	-	-	Quantitative uncertainty analysis of emission estimates of other pollutants reported in the UNECE/CLRTAP framework	2020-2022
	-	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	2020-2022
Energy	Public electricity and heat production	EFs	HMs	Update/change emission factors for those pollutants, as zinc, where figures reported in the EPRTR lead to average EFs significantly different from those used	2022
	Transport-maritime	EFs	NOx HC CO PM	Update of average national emission factors for maritime on the basis of the information collected at harbour level by regional environmental protection agencies which should allow the application of more advanced Tiers for this category	2022
	Cement /lime production	AD	CO ₂	Further investigations concerning the replacement of natural raw material in clinker manufacture and in lime production	2022
IPPU	Building industry	AD	PM10	Estimate and report emissions from categories 2A7a, "Quarrying and mining of minerals other than coal" and 2A7b, "Construction and demolition"	2022
	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	2022
	Lead and zinc production	Allocation	All	Allocation of emission between combustion and process sectors	2020-2022

Sector	Category	Parameter	Gas	Description	Timing
	Consumption of halocarbons and SF ₆	AD	F-gases	Investigations are planned in order to gathered further data on emissions from the use of heat transfer fluids. For the foam blowing improvements are planned in order to investigate the consumption of other F-gas used and the different contribution of closed cell and open cell foams. In the air conditioning and refrigeration sectors improvements are planned to improve the evaluation of disposal and recovered emissions, the topping up and the use of other refrigerants.	2020-2021
	Paint application	EFs	HC CO ₂	Assess the possibility to split non industrial application according to the Guidebook EMEP/EEA	2020-2022
Agriculture	Non-dairy cattle	Emission factor	CH ₄	On the basis of the information on the standard diets of cattle for fattening, which will be provided by the CRPA, the updating of values relating to dry matter intake currently in use will be evaluated. In addition, the Ym values will be evaluated on the basis of the information on the diets and the data reported in the 2019 IPCC guidelines	2021
	Sheep	Emission factor	CH ₄	Additional data and information will be collected to improve the estimation of methane emissions from sheep, in particular for the DE parameter for mature ewes and other mature sheep	2021
	Livestock categories	Emission factor	CH ₄	On the basis of the updated provincial average temperature data, the emission factors will be updated, calculated as a weighted average of the default emission factors assigned to the provinces according to climate zone.	2022
	Agriculture soils	Urea activity data	GHG/ NH ₃	Further checks will be made between apparent consumption and end uses, based on production data, import, export and final uses.	2022
	Forest land	-	GHG	Implementation of the III NFI's outcomes; the final outcomes, related to the field surveys, are expected to be available in 2022 and update of the estimation for-est model	2023
LULUCF/ KP-LULUCF	Cropland /Grassland	AD/EFs	GHG	Verification activities, data collection	2022
	HWP	EFs	CO ₂	Analysis on the end-use, the discard rates of HWP, as well as the final market use of wood in Italy. The main outcome of this investigation could be the set-up of country specific emission factors to be used in the estimation process	2023
Waste	Biological treatment	Anaerobic digestion technology	CH ₄	Anaerobic digestion of solid waste is under investigation to collect more information about technologies and emission factors.	2022

Sector	Category	Parameter	Gas	Description	Timing
	Domestic and commercial wastewater	Activity data	CH ₄	The served population equivalent figures supplied by the National Institute of Statistics will be verified with the results of the next national survey, if available.	2021
	Industrial wastewater	Activity data and emission factors	CH ₄ , N ₂ O	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories will be applied for industrial wastewaters	2021
