LIFE CLIM'FOOT
DELIVERABLE A2.2: METHODOLOGY FOR CONSTITUTING THE NATIONAL DATABASE, ITALY

Italian National Agency for New Technologies, Energy and Sustainable Economic Development

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Contents

Introduction

This document describes the methodology applied to develop the Italian National database of emission factors, to be used for the calculation of the Organization Carbon Footprint.
The aim of the document is threefold: i) to share the data sources used, so as to favour the replicability of the calculation in other sectors and contexts; ii) to present a set of EFs as best practice within theClim'Foot project; iii) to present the data elaborated to external users such as regulators, the general public or specific stakeholder groups, in order to promote the replicability of the database in other countries. In addition, the document serves also the purpose of ensuring consistency among the Clim'Foot National EFs databases in terms of completeness of data description, appropriateness of calculation and coherence of data quality assessment and profile.

A brief description of the general methodology used for developing the Italian national database is provided in Chapter 1, wile in Chapter 2 the analysis of the Italian emission factors is provided, with a break-down per sector, in terms of: technical description of the processes considered in each sector; methodological issues encountered in the calculation of emission factors; the data sources and the analysis of the data quality and uncertainty. Moreover the data documentation of each Italian dataset is reported in the annexes 1-7 for each sector. Finally, in Chapter 3 conclusions and the way forward are reported.

1 Methodology

The Italian emission factors (eFs) were developed according to the methodology described in the Deliverable "A2.2 Methodology for constituting national databases" (1). Data have been collected from several sources and have been calculated in accordance with the proposed methodology.

The following main sources have been used for developing the EFs:

- the Italian National Inventory Report 2017 (NIR, 2016), for fuel, waste, direct emission from agriculture, product and process;
- National database on transport, elaborated by ISPRA (2016);
- Leap Database (FAO, 2015) and theGlobal Database of GHG emissions related to feed crops (FAO) for the agricultural product, developed by FAO (FAO, 2015).

The Italian national database includes 180 country-specific emission factors. The number of the emission factors per category is shown in the table below.

Category	Number of EFs
Fossil fuels consumption	43
Electricity consumption	2
Freight transport	16
Passenger transport	57
Chemicals	9
Waste	10
Agriculture	14
Fugitive emission from agriculture	29
TOTAL	**180**

In addition, the Italian national database includes also 120 European emission factors developed by Italian, Greek, Hungarian and Croatian partners, 19 out of 120 have been prepared by the Italian partners. As far as the EU EFs collected by the Italian partners is concerned, the data source was the ELCD - European Life Cycle Database (JRC – EU), in accordance with the recommendation of the Deliverable "A2.2 Methodology for constituting national databases".

The number of the European emission factors per category is shown in the table below.

Category	Number of EFs

Transport	8
Chemicals	3
Construction	7
Water, treatment and distribution	1
TOTAL	**19**

The Italian national database has been developed in excel, and it is structured in 6 sheets, which report the following data and information:

1. Category: it includes the categories for each languages;
2. National DB: it includes the description of the metadata (according to the structure defined in the deliverable A2.2), the CF emission factors in CO2eq (European and Country specific), the characterized CF emission factors, the Emission factors and their unit;
3. Clim'Foot DB: this is linked with the National database (selected metadata published on-line), and includes all the National Databases developed in the project, including both country-specific and EU EFs databases;
4. CHF: it reports the Characterization Factors of CHF
5. PCF: it reports the Characterization Factors of PFC
6. GHG: it reports the Characterization Factors of CO2, CH4f, CH4b, N2O, SF6

Each data record included in the CF DB reports:

- metadata: they provide a description of the data and areaimed to guaranty comprehensive information to support the end user in choosing the right data for the Carbon Footprint calculation;
- elementary flows: they comprise all greenhouse gases (GHG) emitted in the environment by the human activities and are described in the data record with the related quantity of activities considered;
- characterized GHG in CO2eq: emitted GHGs are multiplied by their characterization factor to express different emissions caused by human activities, and are reported as equivalent CO2 emission (CO2eq).

The specific calculations and the assumptions made during the constitution of the Italian national emission factors are presented analytically for each data record in this document.

2 Database analysis

2.1 Waste

2.1.1 Technical description

The waste emission factors have been calculated from the National Inventory Report (NIR) 2016 - Italian Greenhouse Gas Inventory 1990-2014, published by Institute for Environmental Protection and Research (ISPRA) in 2016. The NIR is representative of the Italian energy system. The waste categories covered by Italian NIR and included in Clim'Foot database are the following:

- Organic
- Household
- Industrial waste
- Dangerous waste
- Waste water treatment

The waste sector comprises four treatment categories, each of which contains some different specific treatment processes:

solid waste disposal:
- solid household waste to landfill;
- biological treatment of solid waste:
- composting process;
- anaerobic digestion process.

incineration and open burning of waste:
- incineration of MSW without energy recovery;
- incineration of industrial waste without energy recovery;
- incineration of hospital waste without energy recovery;
- incineration of sewage sludge without energy recovery;
- incineration of waste oils without energy recovery.
- wastewater treatment:
- domestic wastewater;
- industrial wastewater.

All these treatment categories are described below.

The waste sector share of GHG emissions in the national greenhouse gas total is presently 4.35% (and was 4.46% in the base year 1990). Methane emissions from solid waste disposal sites (landfills) are by far the largest source category within this sector.

Solid waste disposal on land

The process includes: municipal solid waste (MSW), industrial waste assimilated to municipal waste (AMSW) and sludge from urban wastewater treatment plants.
The main parameters that influence the estimation of emissions from landfills are, apart from the amount of waste disposed into managed landfills, the waste composition, the fraction of methane in the landfill gas and the amount of landfill gas collected and treated. These parameters are strictly dependent on the waste management policies throughout the waste streams which start from waste generation, flow through collection and transportation, separation for resource recovery, treatment for volume reduction, stabilization, recycling and energy recovery and terminate at landfill sites.
Basic data on waste production and landfills system are those provided by the national waste cadastre. It is formed by a national branch, hosted by ISPRA, and by regional and provincial branches. The basic information for the cadastre is mainly represented by the data reported through the Uniform Statement Format (MUD), complemented by information provided by regional permits, provincial communications and by registrations in the national register of companies involved in waste management activities.
Industrial waste assimilated to municipal solid waste (AMSW) could be disposed of in non-hazardous landfills. Composition of AMSW must be comparable to municipal solid waste composition. From 2001, data on industrial waste disposed of in municipal landfills are available from Waste Cadastre.
Sludge from urban wastewater treatment plants has also been considered, because it can be disposed of at the same landfills as municipal solid waste and assimilated, once it meets specific requirements. The total production of sludge from urban wastewater plants is communicated, every three years, by the Ministry for the Environment, Land and Sea from 1995.
The data set reports only the CH_4 emissions.

Biological treatment of solid waste

Biological treatment of solid waste is a key category for N_2O emissions at level and trend assessment but only with the Approach 2 described in the 2006 IPCC Guidelines (IPCC, 2006). Under this source category CH_4 and N_2O emissions from compost production and CH_4 emissions from anaerobic digestion of waste have been reported. It includes:

- <u>composting process</u>: the system boundary is gate to gate. Information on input waste to composting plants is published yearly by ISPRA since 1996. The data set reports only the CH_4 and N_2O emissions;
- <u>anaerobic digestion process</u>: the system boundary is gate to gate. Information on input waste to anaerobic digestion are published yearly by ISPRA since 1996.

Since 2005 data are more accurate. The amount of waste treated in anaerobic digestion has shown a great increase from 1990 to 2014: from 79,440 Mg to 2,280,095 Mg. The data set reports only the CH_4 emissions.

Waste incineration without energy recovery

Waste incineration of MSW without energy recovery

The process includes only municipal solid waste (MSW). Dataset considers only emissions from plants without energy recovery. The data set reports CH_4, CO_2 and N_20 emissions.

Waste incineration of industrial waste without energy recovery

The process includes only industrial waste. The data set reports CH4, CO_2 and N_20 emissions.

Waste incineration of hospital waste without energy recovery

The process includes only hospital waste. The data set reports CH4, CO_2 and N_20 emissions.

Waste incineration of sewage sludge without energy recovery

The process includes only sewage sludge. The data set reports only CH_4 and N_20 emissions, not CO_2.

Waste incineration of waste oils without energy recovery

The process includes only waste oils. The data set reports CH_4, CO_2 and N_20 emissions.

Wastewater treatment

The principal by-product of the anaerobic decomposition of the organic matter in domestic and industrial wastewater treatment plant is methane gas. It is produced from the anaerobic treatment process used to stabilize wastewater sludge.
The plant typology is usually distinguished in 'primary' (only physical-chemical unit operations such as sedimentation), 'secondary' (biological unit process) or 'advanced' treatments, defined as those additional treatments needed to remove suspended and dissolved substances remaining after conventional secondary treatment. In urban areas, wastewater handling is managed mainly using a secondary treatment, with aerobic biological units: a wastewater treatment plant standard design consists of bar racks, grit chamber, primary sedimentation, aeration tanks (with return sludge), settling tank, chlorine contact chamber. The stabilization of sludge occurs in aerobic or anaerobic reactors; where anaerobic digestion is used, the reactors are covered and provided of gas recovery.

Domestic wastewater treatment

The data are expressed in kg/PE (Population equivalent). The data set reports CH_4 and N_20 emissions.

Industrial wastewater treatment

The data set reports CH_4 and N_20 emissions.

2.1.2 Methodological issues

The emission factors for waste treatment were obtained from Italian NIR (ISPRA, 2016) according to the methodology presented in Deliverable A2.2 (Scalbi et al., 2016). For all the processes related to waste treatment, the calculation of the emission factors is an average of the last 5 years data, since 2010 to 2014, last emission reporting year in NIR 2016.

Solid waste disposal on land

Emission (CH_4) estimates from solid waste disposal in landfill have been carried out using the IPCC Tier 2 methodology, through the application of the First Order Decay Model (FOD) (IPPC, 2006 - A). The methane generation rate constant k in the FOD method has different values for rapidly, moderately and slowly biodegradable waste applied to the different parts of the model. The average k is calculated on the basis of the waste composition and assumes different values during different periods: from 1991 to 2005: value is 0.362; from 2006 to 2030 the value is 0.363.

Biological treatment of solid waste

The composting plants are classified in two different kinds: plants that treat a selected waste (food, market, garden waste, sewage sludge and other organic waste, mainly from the agro-food industry) and mechanical biological treatment plants (MBT) where the unselected waste is treated to produce compost, refuse derived fuel (RDF) and a waste with selected characteristics suitable for landfilling or incinerating systems. It is assumed that 100% of the input waste to the composting plants from selected waste is treated as compost, while in mechanical-biological treatment plants 30% of the input waste is treated as compost on the basis of national studies and references (NIR, 2016) (see Fig. 1).

The anaerobic digestion plants are classified in two different kinds: plants that treat a selected waste (agro-industrial waste, sludge and other organic waste) and mechanical biological treatment plants (MBT), where the unselected waste is treated to produce compost, refuse derived fuel (RDF) and a waste with selected characteristics suitable for landfilling or incinerating systems. It is assumed that 100% of the input waste to the anaerobic digestion plants from selected waste is treated as compost, while in mechanical-biological treatment plants 15% of the input waste is considered as anaerobically digested (see Fig. 1) (NIR, 2016).

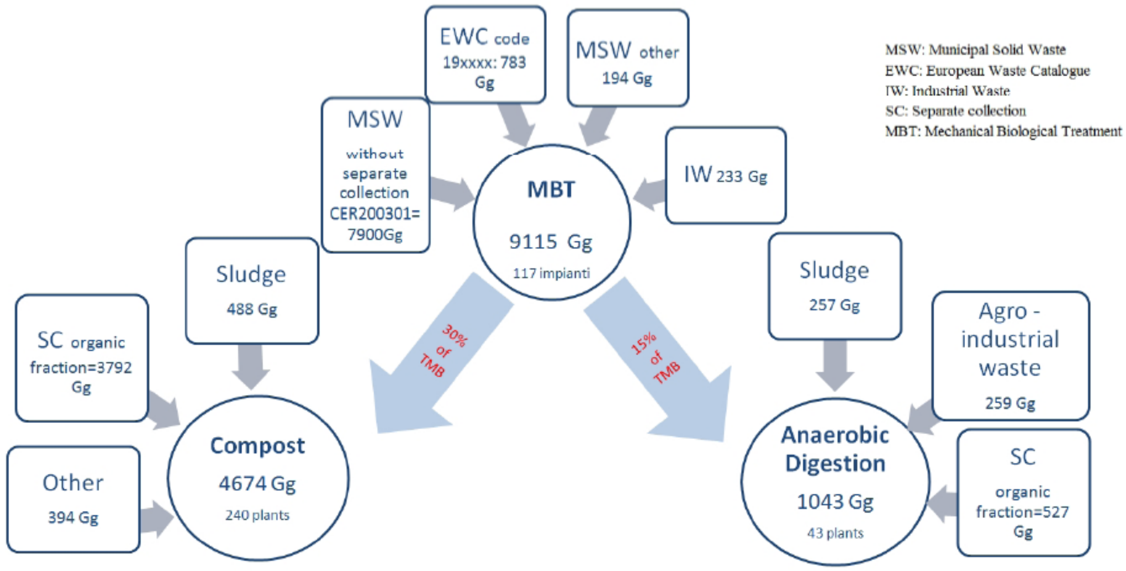

Figure 1 - Waste treated in compost and anaerobic plants in 2013

Waste incineration without energy recovery

Waste incineration of MSW without energy recovery

GHG emissions from incinerators have been calculated applying the methodology reported in IPCC Good Practice Guidance (IPCC, 2000) combined with that reported in the CORINAIR Guidebook (EMEP/CORINAIR, 2007; EMEP/EEA, 2009). A single emission factor for each pollutant has been used combined with plant specific waste activity data. Since 2010, NO_x, SO_2 and CO emission factors for urban waste incinerators have been updated on the basis of data provided by plants.

CO_2 emission factor for municipal waste has been calculated considering a carbon content equal to 23%; a distinction was made between CO_2 from fossil fuels (generally plastics) and CO_2 from renewable organic sources (paper, wood, other organic materials). Only emissions from fossil fuels, which are equivalent to 35% of the total, were included in the inventory. CO_2 emission factor for industrial, oils and hospital waste has been derived as the average of values of investigated industrial plants.

Waste incineration of industrial waste without energy recovery

GHG emissions from incinerators have been calculated applying the methodology reported in IPCC Good Practice Guidance (IPCC, 2000) combined with that reported in the CORINAIR Guidebook (EMEP/CORINAIR, 2007; EMEP/EEA, 2009). A single emission factor for each pollutant has been used combined with plant specific waste activity data.

Since 2010, NO_x, SO_2 and CO emission factors for urban waste incinerators have been updated on the basis of data provided by plants.
All emissions relating to the incineration of industrial waste were considered.
CO_2 emission factor for industrial waste has been derived as the average of values of investigated industrial plants.

Waste incineration of hospital waste without energy recovery
GHG emissions from incinerators have been calculated applying the methodology reported in IPCC Good Practice Guidance (IPCC, 2000) combined with that reported in the CORINAIR Guidebook (EMEP/CORINAIR, 2007; EMEP/EEA, 2009). A single emission factor for each pollutant has been used combined with plant specific waste activity data.
Since 2010, NOx, SO_2 and CO emission factors for urban waste incinerators have been updated on the basis of data provided by plants.
All emissions relating to the incineration of hospital waste were considered.
CO_2 emission factor for hospital waste has been derived as the average of values of investigated industrial plants.

Waste incineration of sewage sludge without energy recovery
GHG emissions from incinerators have been calculated applying the methodology reported in IPCC Good Practice Guidance (IPCC, 2000) combined with that reported in the CORINAIR Guidebook (EMEP/CORINAIR, 2007; EMEP/EEA, 2009). A single emission factor for each pollutant has been used combined with plant specific waste activity data.
Since 2010, NO_x, SO_2 and CO emission factors for urban waste incinerators have been updated on the basis of data provided by plants.
CO_2 emissions from the incineration of sewage sludge were not included at all.

Waste incineration of waste oils without energy recovery
GHG emissions from incinerators have been calculated applying the methodology reported in IPCC Good Practice Guidance (IPCC, 2000) combined with that reported in the CORINAIR Guidebook (EMEP/CORINAIR, 2007; EMEP/EEA, 2009). A single emission factor for each pollutant has been used combined with plant specific waste activity data.
Since 2010, NO_x, SO_2 and CO emission factors for urban waste incinerators have been updated on the basis of data provided by plants.
CO_2 emission factor for oils has been derived as the average of values of investigated industrial plants.

Wastewater treatment

Domestic wastewater treatment
CH_4 emissions from domestic wastewater are estimated using a Tier 2 approach, according to new 2006 IPCC Guidelines (IPCC, 2006).
N_2O emissions from domestic wastewater treatment can occur as direct and indirect emissions. Direct emissions occur from nitrification and denitrification in wastewater

treatment plants, whereas indirect emissions are those from wastewater after disposal of effluent into waterways, lakes or sea. Emissions from advanced centralized wastewater treatment plants are typically much smaller than those from effluent and are estimated using the method reported in Box 6.1 of the Volume 5, Chapter 6 of new 2006 IPCC Guidelines (IPCC, 2006).

Industrial wastewater treatment

It is assumed that industrial wastewaters are treated 85% aerobically and 15% anaerobically (IRSA-CNR, 1998).

The methane estimation concerning industrial wastewaters makes use of the IPCC method based on wastewater output and the respective degradable organic carbon for each major industrial wastewater source. Default emission factors of methane per Chemical Oxygen Demand (COD) equal to 0.25 kg CH_4 kg-1 COD, suggested in the 2006 IPCC Guidelines (IPCC, 2006), has been used for the whole time series.

N_2O emissions from industrial wastewater have been estimated on the basis of the emission factors equal to 0.25 g N_2O/m^3 of wastewater production (EMEP/CORINAIR, 2007). The wastewater production is resulting from the model for the estimation of methan e emissions from industrial wastewater.

2.1.3 Data quality and uncertainty analysis

Waste treatment emission factors from NIR are representative of the Italian waste treatment system. In particular, the time representativeness (TiR), the technological representativeness (TeR) and the geographical representativeness (GeR) are definable "very good". The TirR, in fact, is not older than 4 years with respect to the reference year of the data source, the technologies used are exactly the same as the technologies covered by the data, referring to TeR, and the process takes place in the same country as the one the data is valid for, referring to GeR. Concerning the uncertainty, NIR doesn't give comprehensive information on the model and the activity data uncertainty. To improve the quality data, the deviation standard of the average of the last 5 years has been calculated for all the waste emission factors included in Clim'Foot database.

Solid waste disposal

The uncertainty in CH_4 emissions from solid waste disposal sites has been estimated both by Approach 1 and Approach 2 of the IPCC guidelines (IPCC, 2006): following Approach 1, the combined uncertainty is estimated to be 22.4% (10% for activity data and 20% for the model, as suggested by the IPCC Guidelines (IPCC, 2006); applying Approach 2 (Montecarlo analysis), the resulting uncertainty is estimated equal to 12.6% in 2009.

Biological treatment of solid waste

The uncertainty in CH_4 emissions from biological treatment (composting and anaerobic processes) of waste is estimated to be about 100% in annual emissions, 20% and 100% concerning activity data and emission factors respectively (IPCC, 2006).

Waste incineration without energy recovery

For all the processes related to waste incineration without energy recovery the combined uncertainty in emissions from waste incineration is estimated to be about 22.4%: 10% for activity data and 20% for the model.

Wastewater treatment

The combined uncertainty in CH_4 and N_2O emissions from wastewater handling is estimated to be about 102% in annual emissions 100% for activity data and 20% for the model, as derived by the IPCC Guidelines (IPCC, 2006).

For further information on waste category, see Annex 1 related to metadata, activity data, emissions and emission factors for the different specific treatment processes.

2.2 Fuels

2.2.1 Technical description

The emission factors for fuel category have been calculated from the National Inventory Report (NIR) 2016 - Italian Greenhouse Gas Inventory 1990-2014 (NIR, 2016), published by ISPRA in 2016. The NIR is representative of the Italian energy system.
The fuel data set included in Clim'Foot database cover fuel combustion of fossil fuels. It is included data related to stationary fuel combustion of fossil fuels (Scope 1), divided in three categories: solid, liquid and gaseous according to their presentation in NIR. These emission factors only include CO_2 emissions. The boundary system is gate-to-gate.
The fossil fuels processes covered by Italian NIR are the following:

Natural gas, Italian combustion mix

- Petrol
- Gas oil - heating
- LPG
- Fuel oil
- Coal
- Refinery gas
- Coke oven gas
- Heavy residual fuels
- Synthesis gas
- Blast furnace gas

Besides, the emission factors for mobile fuel combustion (Scope 1) have also been calculated, according to their presentation in NIR. These include the following fuel processes:

- Gas oil - engine
- Petrol - engine
- LPG - engine

These emission factors, for all the processes, both stationary and mobile fuel combustion, only include CO_2 emissions. The boundary system is gate-to-gate.

2.2.2 Methodological issues

The emission factors for the combustion of fossil fuels (stationary and mobile) were obtained from Italian NIR according to the methodology presented in Deliverable A2.2 (Scalbi et al., 2016). The calculation of the emission factors is an average of the last 5 years data, since 2010 to 2014, last emission reporting year, except for petrol, LPG and gas oil (both for heating and engines). For these categories, in fact, the experimental averages of the period 2012-2014 have been considered. This assumption is justified by the fact that these values are almost identical to the IPCC 1996 (IPPC, 1996) emission factors for diesel fuels and IPCC-Europe for LPG (less than 1% difference).
The emission factors have been reported into different units, according to the NIR ($kgCO_2/kg$; $kgCO_2/kWh$; $kgCO_2/toe$).
Concerning natural gas, data on final consumption of gas refers to the lower heat value (lhv), equal to 8190 $kcal/m^3$.
Monitoring of the carbon content of the fuels nationally used is an ongoing activity at ISPRA. The principle is to analyze regularly the chemical composition of the used fuel or relevant activity statistics, to estimate the carbon content and the emission factor.
A issue encountered in several cases was the lack of disaggregation of the emission factors by greenhouse gas for the national fossil fuels

2.2.3 Data quality and uncertainty analysis

The main issue relating to the emission factors calculated for stationary fuel combustion is that CH_4 and N_2O emission factors are unavailable due to the fact that they are differentiated by technology and fuel. Therefore, the main focus has been on CO_2 emission factors, which are differentiated only by fuel and make up the largest part of emissions.
Fuel emission factors from NIR are representative of the Italian energy system. In particular he time representativeness (TiR), the technological representativeness (TeR) and the geographical representativeness (GeR) are definable "very good". The TirR, in fact, is not older than 4 years with respect to the reference year of the data source, the technologies used are exactly the same as the technologies covered by the data,

referring to TeR, and the process takes place in the same country as the one the data is valid for, referring to GeR. Concerning the uncertainty, NIR doesn't give comprehensive information on the model and the activity data uncertainty.
To improve the quality data, the deviation standard of the average of the last 5 years has been calculated for all the fuel emission factors included in Clim'Foot database.

For further information on fuel category, see Annex 2 related to metadata, activity data, emissions and emission factors for the different processes.

2.3 Electricity

2.3.1 Technical description

In the case of electricity, the emission factors have been calculated including the emission factors for:

- Italian electricity mix, at net of production and losses;
- Italian electricity losses on the grid.

The mix of electricity production for the reference year 2013 is composed of 19% Hydroelectric, 67% Electricity from fossil fuels, 2% Geothermic and 5% Electricity from wind and 7% photovoltaic. In the estimation of technology mix for electricity production all plants existing in Italy was considered in term of technology and type of fuel used. The electricity production does not account for the grid losses, that are 6.7%. The boundary is gate-to-gate.

2.3.2 Methodological issues

The emission factors have been calculated collecting data from NIR developed by ISPRA The report is "Fattori di emissione atmosferica di CO2 e sviluppo delle fonti rinnovabili nel settore elettrico" (in Englis, "CO2 Emission and development of renewable source in electric sector") (2015b). This report is an example of data source referred to National Sectorial experts. The report includes information on the Italian electricity production for the years from 1990 until 2013. For the National database the Italian electricity mix at production is reported only for 2013, the latest mix production available for Italy.

2.3.3 Data quality and uncertainty analysis

Electricity from ISPRA, (2015b) are representative of the Italian energy system. In particular he time representativeness (TiR), the technological representativeness (TeR) and the geographical representativeness (GeR) are definable "very good". The TirR, in fact, is not older than 4 years with respect to the reference year of the data source, the technologies used are exactly the same as the technologies covered by the data, referring to TeR, and the process takes place in the same country as the one the data is valid for, referring to GeR. Concerning the uncertainty, from ISPRA, (2015b) doesn't give comprehensive information on the model and the activity data uncertainty.
To improve the quality data, the deviation standard of the average of the last 5 years has been calculated for all the fuel emission factors included in Clim'Foot database.

For further information on electricity category, see Annex 3 related to metadata, activity data, emissions and emission factors.

2.4 Products and processes, chemicals

2.4.1 Technical description

The emission factors for chemical products and processes production have been calculated from the National Inventory Report (NIR) 2016 - Italian Greenhouse Gas Inventory 1990-2014 (NIR, 2016), published by ISPRA in 2016. the calculated emission factors are related to the following processes:

- Ammonia
- Nitric acid
- Adipic acid
- Calcium carbide
- Titanium dioxide
- Soda ash production and use
- Ethylene
- Carbon black
- Propylene

The system boundary is gate to gate.

Ammonia

Since 2002 national production of ammonia in Italy has been collected at facility level. Since 2009 only one facility (Enichem Agricoltura) has been producing ammonia in Italy and reporting data to the national Pollutant Release and Transfer Register (PRTR) (EEA, 2016). Ammonia is obtained after processing in ammonia converters a "synthesis gas" which contains hydrogen and nitrogen. CO_2 is also contained in the synthesis gas, but it is removed in the decarbonising step within the ammonia production process. Part of CO_2 is recovered as a by-product and part is released to atmosphere.
The data set reports only the CO_2 emissions.

Nitric acid

Since 2009 nitric acid production has been carried out in only two plants at national level. Nitric acid is produced from ammonia by catalytic oxidation (with air) of NH_3 to NO_2 and subsequent reaction with water. Currently the reactions involved take place in low and medium pressure processes. Activity data have been collected at plant level for the whole time series.
The data set reports only the N_2O emissions.

Adipic acid

Adipic acid production is a multistep process which starts with the oxidation of cyclohexanol using nitric acid and Cu catalysts. Adipic acid is then used to produce nylon or is fed to other production processes. Emissions data from adipic acid production are provided and referenced by one plant, which is the only producer in Italy (Radici Chimica, several years).

The data set reports CO_2 and N_2O emissions.

Calcium carbide

Calcium carbide production process takes place in electric furnaces. CARBITALIA S.p.A. is the only facility which can operate calcium carbide production in Italy. Since the previous submission CO_2 emissions from calcium carbide production process and use have been estimated on the basis of the activity data provided by the sole Italian producer/retailer. Activity data relating to the manufacture of calcium carbide are referred to the years from 1990 to 1995 when the production stopped; activity data concerning the use of calcium carbide have been provided for the whole timeseries too. The data set reports only CO_2 emissions.

Titanium dioxide

CO_2 emissions from dioxide titanium production have been estimated on the basis of information supplied directly by the Italian maker. In Italy there is only one facility where this production occurs and titanium dioxide is produced through the "sulphate process" that involves the use of sulphuric acid to concentrate the input raw mineral in terms of titanium dioxide content, then selective precipitation and calcination allow getting the final product. TiO_2 is the most used white pigment especially for paint and plastic industries.

The data set reports only CO_2 emissions.

Soda ash production and use

CO_2 emissions from soda ash production have been estimated on account of information available about the Solvay process, the only one facility that operates soda ash production. The CO_2 emission factor for those years is based on the estimation process of the GHG emissions inventory of Spain and on the information that Solvay has made available to the Spanish inventory team for a plant with the same technology as the Italian one. Solvay process allows producing soda ash through the conversion of sodium chloride into sodium carbonate using calcium carbonate and ammonia. CO_2 is released and calcium chloride is the waste. Up to the second half of year 2000 in the unit for the production of peroxidates there was one sodium carbonate line and a sodium perborate line which was then converted to sodium carbonate production. Soda ash is also used in glass production processes.

The data set reports only CO_2 emissions.

Ethylene

Ethylene belongs to the organic chemical processes. It is produced in petrochemical industry by steam cracking to manufacture ethylene oxide, styrene monomer and polyethylenes. Syndial Spa (ex Enichem) and Polimeri Europa (Syndial, several years; Polimeri Europa, several years) were the main producers in Italy up to 2006. Since 2007 Polimeri Europa has become the main producer for those products, while it has been the main producer of styrene since 2002. Data have been provided by the Italian producers.

The data set reports only CH_4 emissions.

Carbon black
CO_2 and CH_4 emissions from carbon black production process have been estimated on the basis of information supplied by the Italian production plants in the framework of the national EPER/E-PRTR registry and the EU emissions trading scheme.
The data set reports CH_4 and CO_2 emissions.

Propylene
Propylene belongs to the organic chemical processes. It is obtained by cracking of oil and is used to manufacture polypropylene, acetone and phenol.
Syndial Spa (ex Enichem) and Polimeri Europa (Syndial, several years; Polimeri Europa, several years) were the main producers in Italy up to 2006. Since 2007 Polimeri Europa has become the main producer for those products, while it has been the main producer of styrene since 2002. Since 1995 data have been provided by the manufacturing companies.
The data set reports only CH_4 emissions.

2.4.2 Methodological issues

The emission factors for chemicals were obtained from Italian NIR (NIR, 2016) according to the methodology presented in Deliverable A2.2 (Scalbi et al., 2016). The calculation of the emission factors is an average of the last 5 years data, since 2010 to 2014, last emission reporting year in NIR 2016.

Nitric acid
The N_2O average emission factors are calculated from 1990 on the basis of the emission factors provided by the existing production plants in the national EPER/E-PRTR registry.
N_2O emissions from adipic acid production are based on the IPCC default EF.

Calcium carbide
The default IPCC CO_2 emission factors (IPCC, 2006) have been used to estimate the emissions from manufacture and use along the whole time series.

2.4.3 Data quality and uncertainty analysis

These chemical emission factors from NIR are representative of the Italian system. In particular, the time representativeness (TiR), the technological representativeness (TeR) and the geographical representativeness (GeR) are "very good". The TirR, in fact, is not older than 4 years with respect to the reference year of the data source, the technologies used are exactly the same as the technologies covered by the data, referring to TeR, and the process takes place in the same country as the one the data is valid for, referring to GeR. Concerning the uncertainty, NIR doesn't give comprehensive information on the model and the activity data uncertainty.

To improve the data quality, the standard deviation of the average of the last 5 years has been calculated for all the chemical emission factors included in Clim'Foot database.

Ammonia, calcium carbide, titanum dioxide, soda ash production and use
The uncertainty of CO_2 emissions is estimated equal to 10.4%, as combination of uncertainties related to activity data (3%) and for the model/emission factors (10%).

Nitric acid
The uncertainty in N_2O emissions is estimated by 10.4%, as combination of uncertainties related to activity data (3%) and for the model/emission factors (10%).

Adipic acid
The uncertainty in N_2O and CO_2 emissions is estimated by 10.4%, as combination of uncertainties related to activity data (3%) and for the model/emission factors (10%).

For further information on chemical products and processes production category, see Annex 4 related to metadata, activity data, emissions and emission factors for the different processes.

2.5 Products and process, agriculture

The data are referred to vegetables.

2.5.1 Technical description

The data used to build vegetables emission factors are collected from the Leap Database made from the FAO associations (FAO, 2015). The study, is an attempt to provide a global life cycle inventory dataset that can be used to assess feed supply chain. The free online database was consulted to gather information for different kind of crops.
The data extrapolated from the database takes into account the emissions from Crop Nutrition, Plant protection, Weed management, Irrigation and Harvesting. Moreover, regional characterization factors are implemented.
Maize, Barley and Wheat have been considered for Clim'Foot database varying the production system (Irrigated or Rainfed) and the production practice (No tillage, minimal tillage or conventional).
The results obtained in the dataset takes into account the emissions from CO2, N2O and CH4.
The system boundaries of the system extend from the extraction of raw materials, to the harvest of 1kg of DM (dry matter) production (FAO, 2015).

2.5.2 Methodological issues

The data obtained from the database are given in an aggregated form, presenting only the CO2-eq emissions, without the breakdown into each greenhouse gas (FAO, 2015).

2.5.3 Data quality and uncertainty analysis

In order to estimate the emissions from crops cultivation situated in different geographical contests, national characterization factors have been implanted. However, for some of the input data, as the utilization of fertilizers, only one fertilization rate was used at a national level, although fertilizer application should vary by crop as well (FAO, 2015).

For further information on agriculture process, see Annex 5 related to metadata, activity data, emissions and emission factors.

2.6 Process and fugitive, animals

2.6.1 Technical description

The emission factors for agriculture have been calculated from the National Inventory Report (NIR) 2016 - Italian Greenhouse Gas Inventory 1990-2014, published by Institute for Environmental Protection and Research (ISPRA) in 2016 (ISPRA, 2016). Among the categories covered by the NIR report, Manure Management and Enteric Fermentation have been chosen for this database.

Enteric Fermentation

Methane is produced as a by-product from enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category.
In 2014, the CH4 emissions related to Enteric Fermentation were the 74.6% of the total CH4 emissions of the Italian agricultural sector. Many different livestock categories are committed to these emissions; however, the main contributors are dairy and non-dairy cattle, which represent more than 70% of the total emissions from Enteric Fermentation.
In order to build a representative database, 10 livestock categories have been investigated; for each of them, 2 EFs have been composed. The first provides the emissions caused by 1kg of livestock, while the latter is referred to one animal.
Here, the list of the considered categories is provided:

- Dairy Cattle
- Non-Dairy Cattle
- Buffalo
- Sheep
- Goats
- Horses
- Mules and Asses
- Sows
- Other Swine
- Rabbits

The dataset reports only the CH4 emissions (ISPRA, 2016).

Manure Management

In 2014, the CH_4 emissions from Manure Management were the 16.6% of the total Italian agriculture emissions. The main livestock categories contributors are swine and cattle, which combined represent more than 80% of the total Manure Management emissions.

As for the Enteric Fermentation, 5 livestock categories were analysed, and for each of them 2 Emission Factors have been calculated. The categories considered are the following:

- Dairy Cattle
- Non-dairy Cattle
- Buffalo
- Sows
- Other Swine

The EFs are composed from methane and nitrous oxide (direct and indirect) emissions. N2O direct and indirect emissions are produced during the storage and treatment of manure before it is applied to land (ISPRA, 2016).

2.6.2 Methodological issues

The emission factors for agriculture are obtained from Italian NIR (ISPRA, 2016) according to the methodology presented in Deliverable A2.2 (Scalbi at al., 2016). For all the processes, the calculation of the emission factors is an average of the last 5 years data, since 2010 to 2014, last emission reporting year in NIR 2016.

Enteric Fermentation

Methane emissions from Enteric Fermentation are estimated by defining an emission factor for each livestock category, which is then multiplied by the population. Population data were collected from ISTAT (ISTAT, 1991; 2007[a], [b]). Livestock categories provided by ISTAT are classified according to the type of production, slaughter or breeding, and the age of animals. Moreover, in order to build a time consistent series of data, the number of animals for some of the categories have been tracked using information available from FAO and UNAITALIA (FAO, several years; UNAITALIA, several years).

Manure Management

The IPCC Tier 2 approach is used to estimate methane EFs for manure management of cattle, buffalo and swine. Two approaches are available to estimate EFs from Manure Management: method 1 is applied at a regional basis and it is therefore site specific and more complex. On the other hand, method 2, utilized a national simplified approach for the calculation. For estimating slurry, solid manure EFs and a specific conversion factor for cattle and buffalo, method 1 was used. Method 2 was instead applied for the other categories. Livestock population activity data is collected from ISTAT (ISTAT, 1991; 2007[a], [b]).

2.6.3 Data quality and uncertainty analysis

Enteric Fermentation

The NIR reported the uncertainty related to the CH_4 emissions from enteric fermentation as 20.2%, resulted from the combination of 3% uncertainty for activity data and 20% from the emission factor.
In 2014, emissions from enteric fermentation were 12.6% lower than in 1990. The reason for these phenomena was mainly due to the reduction in the number of cattle (25.7% from 1990 to 2014). Dairy cattle and non-dairy cattle have decreased by 30.7% and 23.2%, respectively in that timeframe. As mention in the technical description, cattle and non-cattle are the main contributors to the Enteric Fermentation CH_4 emissions. Therefore, a reduction in their number leaded to a strong decreased in the overall contributions.

Manure Management

Uncertainty related to CH_4 and N_2O direct emissions are estimated to be equal to 20.6%, as a combination of 5% and 20% for activity data and emission factors. On the other hand, indirect N_2O emissions has been estimated as 50.2%, 5% for activity data and 50% for the emission factors.
Moreover, the emissions from manure management decreased by 21.9% from 1990 to 2014. This reduction has been caused by the falling in the number of dairy and non-dairy cattle (30.7% and 23.2% respectively) and the number of swine (3.2%), which are the livestock categories that contributes most in the total manure management emissions (ISPRA, 2016).

For further information on process and fugitive related to animals, see Annex 6 related to metadata, activity data, emissions and emission factors.

2.7 Road transport (people and freight)

2.7.1 Technical description

The emission factors for road transport category included in Clim'Foot database have been calculated from a specific national database published by ISPRA in 2016 (ISPRA, 2016 [B]) **http://www.sinanet.isprambiente.it/it/sia-ispra/fetransp/**
The database is based on the estimates made for the national inventory of air emissions, annually elaborated by ISPRA as verification tool of the commitments made at international level on air protection such as the Geneva Convention on Long-range Transboundary Air Pollution of the United Nations Economic Commission for Europe (UNECE - CLRTAP), the European Directives on the limitation of emissions.
The data included in Clim'Foot database are related only to road transport, at national level. The data are referred to 2014.
The emission factors are related both to people and freight transport, for different vehicles:

- people transport: passenger cars; buses; mopeds; motorcycles;
- freight transport: light duty vehicles; heavy duty trucks.

The emission factors have been calculated for some different kind of fuel and route:

- mix fuel on: mix route / urban route / rural route / highway route;
- specific fuel on: mix route / urban route / rural route / highway route.

In particular, the emission factors have been calculated for the following processes:

- Passengers car, mix fuel on: mix route / urban route / rural route / highway route;
- Buses mix fuel on: mix route / urban route / rural route / highway route;
- Light duty vehicles fueled by gasoline, diesel on: mix route / urban route / rural route / highway route;
- Heavy duty trucks gasoline, diesel on: mix route / urban route / rural route / highway route.
- Passengers car fueled by: gasoline; diesel; LPG; E85[1]; natural gas; hybrid gasoline on: mix route / urban route / rural route / highway route;
- Mopeds fueled by gasoline on: mix route / urban route / rural route;
- Motorcycles fueled by gasoline on: mix route / urban route / rural route / highway route;
- Buses fueled by diesel, natural gas on: mix route / urban route / rural route / highway route;

[1] 85% ethanol + 15% gasoline

- Light duty vehicles fueled by gasoline, diesel on: mix route / urban route / rural route / highway route;
- Heavy duty trucks gasoline, diesel on: mix route / urban route / rural route / highway route.

All the possible combinations have been calculated. The emission factors include CO_2, CH_4 and N_20 emissions for all the processes. Gas emissions are expressed in kg/km driven. Data related on vehicles and fuel productions are not included.

2.7.2 Methodological issues

The developed methodology for the estimate of air pollutant emissions is based on EMEP/EEA air pollutant emission inventory guidebook 2013 (EMEP/EEA, 2013) and is consistent with the IPCC 2006 Guidelines related to greenhouse gas emissions. COPERT 4 v. 11.3 software (EEA, 2015) has been used, developed by the EEA, within the activities of the European Topic Centre for Air Pollution and Climate Change Mitigation (ETC/ACM). The estimates were made on the basis of national input data about the vehicle fleet and movements (numbers of vehicles, mileage and average fuel consumption, speed of vehicle category with reference to urban, rural and highway routes, other country-specific parameters).
The emission factors are calculated on the basis of the mileage and fuel consumption, with reference both to the technologies and to the aggregation by sector and by fuel, calculated both on any route and on specific route (urban, rural, highway route).

2.7.3 Data quality and uncertainty analysis

These transport emission factors are representative of the Italian system. In particular, the time representativeness (TiR), the technological representativeness (TeR) and the geographical representativeness (GeR) are "very good". The TirR, in fact, is not older than 4 years with respect to the reference year of the data source (2014), the technologies used are exactly the same as the technologies covered by the data, referring to TeR, and the process takes place in the same country as the one the data is valid for, referring to GeR. Concerning the uncertainty, the source report doesn't give comprehensive information on the model and the activity data uncertainty.

For further details on the national emissions estimates, some documents are available at the following link: http://www.sinanet.isprambiente.it/it/sia-ispra/fetransp

More information on data source are available here:
http://www.sinanet.isprambiente.it/it/sia-ispra/fetransp/note-esplicative/at_download/file

Excel file is available here: http://www.sinanet.isprambiente.it/it/sia-ispra/fetransp/fattori-emissione-trasporto-stradale/at_download/file

For further information on road transport category, see Annex 5 related to metadata, activity data, emissions and emission factors both to people and freight transport, for different vehicles.

3 Conclusions

The definition of a common methodology for constituting the National Databases within the LIFE Clim'Foot project provided solid bases to implement the national databases in term of methodological appropriateness and consistency, reproducibility as well transparency of DB. A common issues for all the calculated EFs is the lack of detailed information about the uncertainty of the data, which in the Clim'Foot database has been reported either as a results of an estimation process or as a standard deviation, calculated considering the average of the data collected in the last five years. In addition, the consistency of the input data used for calculating te EFs represented a major issue. In fact, not all the data sources provided disaggregated greenhouse gas emission data: some are delivered only a sub-set of emissions, reporting them as the most relevant ones, while others reported only the results in terms of CO2 equivalent, thus aggregating already the emission according to the characterization factors. Nevertheless it is also important to summaries the lessons learnt during the national databases development by each country, highlighting the main issues concerning data collection, EFs calculation, and fulfillment of the requirements reported in the deliverable "Methodology for constituting the national database". This report, carried out for each database developed within the project, allows to spread good practices for all stakeholders that will implement a carbon accounting and for the policy makers who will create new National Emission factors Database and become an important part of the implementation of Clim'Foot replication strategy.

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5 Annexes

Annex 1 - Metadata, activity data, emissions and emission factors of waste category

Solid waste disposal on land

General Information	
Information	Description of content
Process name (***)(*)	Solid waste to landfill (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	The process includes: municipal solid waste (MSW), industrial waste assimilated to municipal waste (AMSW) and sludge from urban wastewater treatment plants Emission (CH_4) estimates from solid waste disposal in landfill have been carried out using the IPCC Tier 2 methodology, through the application of the First Order Decay Model (FOD) (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_3_Ch3_SWDS.pdf) The methane generation rate constant *k* in the FOD method has different values for rapidly, moderately and slowly biodegradable waste applied to the different parts of the model. The average k is calculated on the basis of the waste composition and assumes different values during different periods: from 1991 to 2005: value is 0.362; from 2006 to 2030 the value is 0.363. The main parameters that influence the estimation of emissions from landfills are the amount of waste disposed into managed landfills, the waste composition, the fraction of CH_4 in the landfill gas and the amount of landfill gas collected and treated.
Technological representativeness – TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good

Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	The uncertainty in CH_4 emissions from solid waste disposal sites has been estimated both by Approach 1 and Approach 2 of the IPCC guidelines: - following Approach 1, the combined uncertainty is estimated to be 22.4% (10% for activity data and 20% for the model, as suggested by the IPCC Guidelines (IPCC, 2006); - applying Approach 2 (Montecarlo analysis), the resulting uncertainty is estimated equal to 12.6% in 2009.
Data Acquisition	
Source and Reliability	- Data on MSW are provided by the national Waste Cadastre formed by a national branch, hosted by ISPRA, and by regional and provincial branches. The basic information for the Cadastre is mainly represented by the data reported through the Uniform Statement Format (MUD), complemented by information provided by regional permits, provincial communications and by registrations in the national register of companies involved in waste management activities. - Data on AMSW disposed in landfills are available from Waste Cadastre. - Data on total production of sludge from urban wastewater plants is communicated by the Ministry for the Environment, Land and Sea from 1995. The share of CH_4 emissions from landfill is presently 31.5% of the CH_4 national total. The percentage of waste disposed in landfills dropped from 91.1% in 1990 to 41.3% in 2014.
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Activity data and emissions

ACTIVITY DATA	1990	1995	2000	2005	2010	2011	2012	2013	2014
MSW production (Gg)	22,231	25,780	28,959	31,664	32,479	31,386	29,994	29,573	29,655
MSW disposed in landfills for non hazardous waste (Gg)	17,432	22,459	21,917	17,226	15,015	13,206	11,720	10,914	9,332
Assimilated MSW disposed in landfills for non hazardous waste (Gg)	2,828	2,978	2,825	2,914	3,508	2,883	2,292	2,512	2,913
Sludge disposed in managed landfills for non hazardous waste (Gg)	2,454	1,531	1,326	544	301	292	214	174	184
Total Waste to managed landfills for non hazardous waste (Gg)	16,363	21,897	26,069	20,684	18,825	16,380	14,226	13,600	12,429

Elementary flows: emissions / amount

Emissions	Unit	2010	2011	2012	2013	2014
kg CH_4 / kg of waste	kg/kg	3.15E-02	3.50E-02	3.99E-02	3.61E-02	3.85E-02

Emissions: average and standard deviation

Emissions	Average	Standard deviation (st)
kg CH_4 / kg of waste	3.62E-02	3.25E-03

Output:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	3.62E-02	St 3.25E-03

Biological treatment of solid waste

Composting process

General Information	
Information	Description of content
Process name (***)(*)	Composting process (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	The composting plants are classified in two different kinds: plants that treat a selected waste (food, market, garden waste, sewage sludge and other organic waste, mainly from the agro-food industry) and mechanical biological treatment plants (MBT) where the unselected waste is treated to produce compost, refuse derived fuel (RDF) and a waste with selected characteristics suitable for landfilling or incinerating systems. It is assumed that 100% of the input waste to the composting plants from selected waste is treated as compost, while in mechanical-biological treatment plants 30% of the input waste is treated as compost on the basis of national studies and references (NIR-2015) (see Fig. 1). The system boundary is gate to gate.
Technological representativeness –TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	The uncertainty in CH_4 emissions from biological treatment of waste is estimated to be about 100% in annual emissions, 20% and 100% concerning activity data and emission factors respectively (NIR-

	2016).
Data Acquisition	
Source and Reliability	Information on input waste to composting plants are published yearly by ISPRA since 1996. The amount of waste treated in composting has shown a great increase from 1990 to 2014: from 283,879 Mg to 8,104,905 Mg.
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 and N_2O emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Activity data and emissions

	1990	1995	2000	2005	2010	2011	2012	2013	2014
Activity data									
Amount of waste to composting process (Mg)	283,879	657,215	2,834,309	5,550,888	7,030,808	7,163,543	7,150,442	7,483,499	8,104,905
Amount of waste to anaerobic digestion (Mg)	79,440	127,433	467,803	1,407,203	1,976,357	2,123,466	2,293,812	2,447,977	2,280,095
CH_4									
Compost production (Gg)	0.008	0.019	0.083	0.163	0.206	0.210	0.210	0.220	0.238
Anaerobic digestion (Gg)	0.079	0.127	0.468	1.407	1.976	2.123	2.294	2.448	2.280
N_2O									
Compost production (Gg)	0.014	0.033	0.144	0.282	0.357	0.364	0.363	0.380	0.412

Elementary flows: emissions / amount

Emissions	Unit	2010	2011	2012	2013	2014
kg CH_4 / kg of waste	kg/kg	2.93E-05	2.93E-05	2.94E-05	2.94E-05	2.94E-05
kg N_2O / kg of waste	kg/kg	5.08E-05	5.08E-05	5.08E-05	5.08E-05	5.08E-05

Emissions: average and standard deviation

Emissions	Average	Standard deviation (st)
kg CH_4 / kg of waste	2.93E-05	4.07E-08
kg N_2O / kg of waste	5.08E-05	2.84E-08

Output:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	2.93E-05	St 4.07E-08
Output	Emissions	Emissions to air	N_2O	kg	5.08E-05	St 2.84E-08

Anaerobic digestion process

General Information	
Information	Description of content
Process name (***)(*)	Anaerobic digestion process (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	The anaerobic digestion plants are classified in two different kinds: plants that treat a selected waste (agro-industrial waste, sludge and other organic waste) and mechanical biological treatment plants (MBT), where the unselected waste is treated to produce compost, refuse derived fuel (RDF) and a waste with selected characteristics suitable for landfilling or incinerating systems. It is assumed that 100% of the input waste to the anaerobic digestion plants from selected waste is treated as compost, while in mechanical-biological treatment plants 15% of the input waste is considered as anaerobically digested (see Fig. 1). The system boundary is gate to gate.
Technological representativeness –TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	

Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	The uncertainty in CH_4 emissions from biological treatment of waste is estimated to be about 100% in annual emissions, 20% and 100% concerning activity data and emission factors respectively.
Data Acquisition	
Source and Reliability	Information on input waste to anaerobic digestion are published yearly by ISPRA since 1996. Since 2005 data are more accurate. The amount of waste treated in anaerobic digestion has shown a great increase from 1990 to 2014: from 79,440 Mg to 2,280,095 Mg.
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Activity data and emissions

	1990	1995	2000	2005	2010	2011	2012	2013	2014
Activity data									
Amount of waste to composting process (Mg)	283,879	657,215	2,834,309	5,550,888	7,030,808	7,163,543	7,150,442	7,483,499	8,104,905
Amount of waste to anaerobic digestion (Mg)	79,440	127,433	467,803	1,407,203	1,976,357	2,123,466	2,293,812	2,447,977	2,280,095
CH_4									
Compost production (Gg)	0.008	0.019	0.083	0.163	0.206	0.210	0.210	0.220	0.238
Anaerobic digestion (Gg)	0.079	0.127	0.468	1.407	1.976	2.123	2.294	2.448	2.280
N_2O									
Compost production (Gg)	0.014	0.033	0.144	0.282	0.357	0.364	0.363	0.380	0.412

Elementary flows: emissions / amount

Emissions	Unit	2010	2011	2012	2013	2014
kg CH_4 / kg of waste	kg/kg	1.00E-03	1.00E-03	1.00E-03	1.02E-03	1.00E-03

Emissions: average and standard deviation

Emissions	Average	Standard deviation (st)
kg CH_4 / kg of waste	1.00E-03	7.00417E-06

Output:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	1.00E-03	St 7.00417E-06

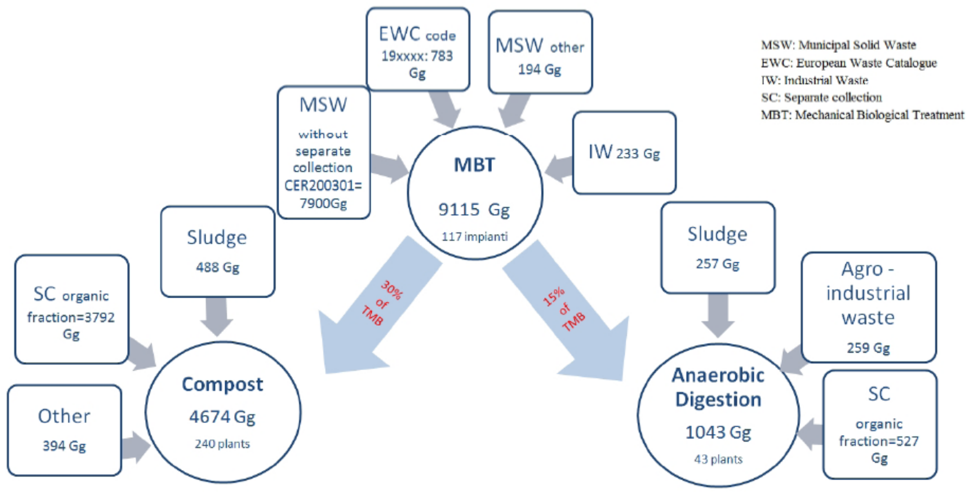

Figure 1 - Waste treated in compost and anaerobic plants in 2013

Waste incineration without energy recovery

	1990	1995	2000	2005	2010	2011	2012	2013	2014
Total Waste incinerated	1,656	2,149	3,062	4,964	6,977	6,761	6,674	6,925	7,439
- with energy recovery	911	1,558	2,750	4,721	6,796	6,579	6,483	6,717	7,221
- without energy recovery	745	591	312	244	181	183	192	208	218
MSW incinerated	1,026	1,437	2,325	3,220	4,337	4,733	4,257	4,314	4,712
- with energy recovery	626	1,185	2,161	3,168	4,284	4,695	4,255	4,314	4,712
- without energy recovery	399	251	164	52	53	38	2	0	0
Industrial Waste incinerated									
Other waste	*473*	*536*	*604*	*1,602*	*2,499*	*1,909*	*2,273*	*2,498*	*2,609*
- with energy recovery	258	330	508	1,446	2,399	1,813	2,158	2,365	2,469
- without energy recovery	215	206	96	155	100	96	115	133	139
Hospital waste	*134*	*152*	*110*	*126*	*135*	*103*	*118*	*87*	*91*
- with energy recovery	25	41	77	106	113	71	70	38	40
- without energy recovery	109	111	34	21	23	33	48	49	51
Sludge	*20.72*	*23.18*	*21.50*	*15.60*	*5.98*	*16.36*	*26.73*	*26.01*	*27.22*
- with energy recovery	0.00	0.00	3.40	0.00	0.00	0.00	0.00	0.00	0.00
- without energy recovery	20.72	23.18	18.11	15.60	5.98	16.36	26.73	26.01	27.22
Waste oil	*2.66*	*1.41*	*0.82*	*0.67*	*0.18*	*0.18*	*0.05*	*0.02*	*0.02*
- with energy recovery	1.77	0.94	0.55	0.54	0.18	0.18	0.05	0.02	0.02
- without energy recovery	0.89	0.47	0.27	0.12	0.00	0.00	0.00	0.00	0.00

	2010	2011	2012	2013	2014
Amount of waste to incinerators (Gg) (last 5 years)					
MSW incinerated	4337.00	4733.00	4257.00	4316.00	4712.00
Industrial Waste incinerated	2499.00	1909.00	2272.00	2437.00	2609.00
Hospital waste	135.00	103.00	118.00	87.00	91.00
Sludge	5.98	16.36	26.73	26.01	27.22
Waste oil	0.18	0.18	0.05	0.02	0.02
TOTAL waste to incinerators (Gg)	6977.16	6761.54	6673.78	6866.03	7439.24

Waste incineration of **MSW** without energy recovery (IT)

General information	
Information	Description of content
Process name (***)(*)	Waste incineration of **MSW** without energy recovery (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	The process includes only municipal solid waste (MSW). Dataset considers only emissions from plants without energy recovery. GHG emissions from incinerators have been calculated applying the methodology reported in IPCC Good Practice Guidance (IPCC, 2000) combined with that reported in the CORINAIR Guidebook (EMEP/CORINAIR, 2007; EMEP/EEA, 2009). A single emission factor for each pollutant has been used combined with plant specific waste activity data. Since 2010, NOx, SO_2 and CO emission factors for urban waste incinerators have been updated on the basis of data provided by plants.
Technological representativeness –TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	The combined uncertainty in emissions from waste incineration is estimated to be about 22.4%: 10% for activity data and 20% for the model.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	

General information (***)(*)	CO_2 emission factor for municipal waste has been calculated considering a carbon content equal to 23%; a distinction was made between CO_2 from fossil fuels (generally plastics) and CO_2 from renewable organic sources (paper, wood, other organic materials). Only emissions from fossil fuels, which are equivalent to 35% of the total, were included in the inventory. CO_2 emission factor for industrial, oils and hospital waste has been derived as the average of values of investigated industrial plants. The data set reports CH_4, CO_2 and N_20 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions: average value from 2010 - without energy recovery

Emissions	Unit	Average	Standard deviation (st)
kg CH_4 / kg of waste	kg/kg	6.00E-05	---
kg CO_2 / kg waste	kg/kg	2.89E-01	---
kg N_2O / kg waste	kg/kg	1.00E-04	---

Waste incineration of **industrial waste** without energy recovery (IT)

General information	
Information	Description of content
Process name (***)(*)	Waste incineration of **industrial waste** without energy recovery (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	The process includes only industrial waste. Dataset considers only emissions from plants without energy recovery. GHG emissions from incinerators have been calculated applying the methodology reported in IPCC Good Practice Guidance (IPCC, 2000) combined with that reported in the CORINAIR Guidebook (EMEP/CORINAIR, 2007; EMEP/EEA, 2009). A single emission factor for each pollutant has been used combined with plant specific waste activity data. Since 2010, NOx, SO_2 and CO emission factors for urban waste incinerators have been updated on the basis of data provided by plants.
Technological representativeness – TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	The combined uncertainty in emissions from waste incineration is estimated to be about 22.4%: 10% for activity data and 20% for the model.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	

General information (***)(*)	CO_2 emission factor for industrial waste has been derived as the average of values of investigated industrial plants. All emissions relating to the incineration of industrial waste were considered. The data set reports CH_4, CO_2 and N_20 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions: average value from 2010 - without energy recovery

Emissions	Unit	Average	Standard deviation (st)
kg CH_4 / kg of waste	kg/kg	6.00E-05	---
kg CO_2 / kg waste	kg/kg	1.20E+00	---
kg N_2O / kg waste	kg/kg	1.00E-04	---

Waste incineration of **hospital waste** without energy recovery (IT)

General information	
Information	Description of content
Process name (***)(*)	Waste incineration of **hospital waste** without energy recovery (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	The process includes only hospital waste. Dataset considers only emissions from plants without energy recovery. GHG emissions from incinerators have been calculated applying the methodology reported in IPCC Good Practice Guidance (IPCC, 2000) combined with that reported in the CORINAIR Guidebook (EMEP/CORINAIR, 2007; EMEP/EEA, 2009). A single emission factor for each pollutant has been used combined with plant specific waste activity data. Since 2010, NOx, SO_2 and CO emission factors for urban waste incinerators have been updated on the basis of data provided by plants.
Technological representativeness – TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	The combined uncertainty in emissions from waste incineration is estimated to be about 22.4%: 10% for activity data and 20% for the model.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	

Validation note	
General information (***)(*)	CO_2 emission factor for hospital waste has been derived as the average of values of investigated industrial plants. All emissions relating to the incineration of hospital waste were considered. The data set reports CH_4, CO_2 and N_20 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions: average value from 2010 - without energy recovery

Emissions	Unit	Average	Standard deviation (st)
kg CH_4 / kg of waste	kg/kg	6.00E-05	---
kg CO_2 / kg waste	kg/kg	1.20E+00	---
kg N_2O / kg waste	kg/kg	1.00E-04	---

Waste incineration of **sewage sludge** without energy recovery (IT)

General information	
Information	Description of content
Process name (***)(*)	Waste incineration of **sewage sludge** without energy recovery (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	The process includes only sewage sludge. Dataset considers only emissions from plants without energy recovery. GHG emissions from incinerators have been calculated applying the methodology reported in IPCC Good Practice Guidance (IPCC, 2000) combined with that reported in the CORINAIR Guidebook (EMEP/CORINAIR, 2007; EMEP/EEA, 2009). A single emission factor for each pollutant has been used combined with plant specific waste activity data. Since 2010, NOx, SO_2 and CO emission factors for urban waste incinerators have been updated on the basis of data provided by plants.
Technological representativeness – TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	The combined uncertainty in emissions from waste incineration is estimated to be about 22.4%: 10% for activity data and 20% for the model.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	

General information (***)(*)	CO_2 emissions from the incineration of sewage sludge were not included at all. The data set reports CH_4 and N_20 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions: average value from 2010 - without energy recovery

Emissions	Unit	Average	Standard deviation (st)
kg CH_4 / kg of waste	kg/kg	6.00E-05	---
kg CO_2 / kg waste	kg/kg	0	---
kg N_2O / kg waste	kg/kg	2.27E-04	---

Waste incineration of **waste oils** without energy recovery (IT)

General information	
Information	Description of content
Process name (***)(*)	Waste incineration of **waste oils** without energy recovery (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	The process includes only waste oils. Dataset considers only emissions from plants without energy recovery. GHG emissions from incinerators have been calculated applying the methodology reported in IPCC Good Practice Guidance (IPCC, 2000) combined with that reported in the CORINAIR Guidebook (EMEP/CORINAIR, 2007; EMEP/EEA, 2009). A single emission factor for each pollutant has been used combined with plant specific waste activity data. Since 2010, NOx, SO_2 and CO emission factors for urban waste incinerators have been updated on the basis of data provided by plants.
Technological representativeness – TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	The combined uncertainty in emissions from waste incineration is estimated to be about 22.4%: 10% for activity data and 20% for the model.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	

General information (***)(*)	CO_2 emission factor for oils has been derived as the average of values of investigated industrial plants. The data set reports CH_4, CO_2 and N_20 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions: average value from 2010 - without energy recovery

Emissions	Unit	Average	Standard deviation (st)
kg CH_4 / kg of waste	kg/kg	6.00E-05	---
kg CO_2 / kg waste	kg/kg	3.00E+00	---
kg N_2O / kg waste	kg/kg	1.00E-04	---

Wastewater handling

Domestic wastewater

General information	
Information	Description of content
Process name (***)(*)	**Domestic wastewater** (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	PE
Technical Description (***)(*)	… … …
Technological representativeness – TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Data are Italian national average of last 5 years.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	The data are expressed in kg/PE (Population equivalent). The data set reports CH_4 and N_20 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Table 7.29 Population data for domestic wastewater, 1990 – 2014 (*1000)

Population Activity Data	1990	1995	2000	2005	2010	2011	2012	2013	2014
Total Population	57,104	57,333	57,844	58,752	60,626	59,434	59,394	59,685	60,783
Urban high-income Population	53,272	53,623	54,255	55,330	57,280	56,111	56,096	56,411	57,533
Rural Population	3,831	3,710	3,589	3,422	3,347	3,322	3,298	3,274	3,250
Population served by collected wastewater systems (%)	57.0	69.8	86.0	83.0	90.1	91.6	93.1	94.5	96.0
Population served by wastewater treatment plants (%)	51.9	58.0	60.0	69.0	76.1	77.3	78.5	79.7	81.0

Emissions: average value

Emissions	Unit	Average	Standard deviation (st)
kg CH_4 / PE	t/m^3	7.65E-04	2.49426E-05
kg N_2O / PE	t/m^3	7.13E-05	5.77E-07

Industrial wastewater

General information	
Information	Description of content
Process name (***)(*)	**Industrial wastewater** (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	m^3
Technical Description (***)(*)	… … …
Technological representativeness – TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Data are Italian national average of last 5 years.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports CH_4 and N_20 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Amount

Wastewater production (1000 m^3)	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**2014**
Iron and steel	9.53	7.78	6.76	6.86	6.17	7.18	6.28	3.98	3.28
Oil refinery	NA	NA	NA	NA	NA	NA	NA	NA	NA
Organic chemicals	210.94	212.32	215.05	214.74	214.12	213.69	213.20	213.24	213.25
Food and beverage	179.12	177.38	182.74	185.66	186.26	182.55	182.94	177.14	160.12
Pulp and paper	377.17	402.95	387.28	366.02	232.69	264.24	250.98	198.75	209.00
Textile industry	108.46	103.05	101.57	75.49	64.36	57.85	49.83	50.38	51.89
Leather industry	23.62	25.00	27.22	18.32	14.25	14.51	13.57	13.84	13.36
Total	908.84	928.48	920.61	867.09	717.85	740.02	716.80	657.32	650.90

Emissions: average value

Emissions	Unit	Average	Standard deviation (st)
kg CH_4 / m^3 industrial wastewater	kg/m^3	8.14E+01	3.74E-03
kg N_2O / m^3 industrial wastewater	kg/m^3	2.50E-01	4.10217E-07

Annex 2 - Metadata, activity data, emissions and emission factors of fuel category

The following emission factors have been reported into different units, according to the NIR. The data are shown in the tables below and are described in the attached excel file.

Natural gas (m^3)

General Information	
Information	Description of content
Process name (***)(*)	Natural gas Italian combustion mix (IT)
Synonym (***)	Methane Italian combustion mix
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	m^3
Technical description	Emission of combustion independent from the type of use, representative of Italian mix consumed. The boundary is gate-to-gate. Data on final consumption of gas refers to the lower heat value (lhv), equal to 8190 kcal/m^3.
Technological representativeness –TeR (*)	
Uncertainty	
Year(s) of validity (*)	
Time representativeness –TiR (*)	
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Italy
Data Quality Statement (***)(*)	The data set reports only the CO2 emissions estimated. Data are Italian national average of last 5 years.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	

Validation note	
General information (***)(*)	This emission doesn't consider the efficiency of different combustion engine. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions:

Emissions	Unit	2010	2011	2012	2013	2014
kg CO_2 / m^3 of natural gas combustion	kg/m^3	1.971	1.955	1.961	1.953	1.952

Emissions	Unit	Average	Deviation standard
kg CO_2 / m^3 of natural gas combustion	kg/m^3 **???**	1.96	7.86E-03
kg CO2/toe of natural gas combustion	kg /toe	2.39E+03	9.92E+00
kg CO2/kWh of natural gas combustion	Kg/kWh	2.06E-01	8.53E-04

Natural gas (kg)

General Information	
Information	Description of content
Process name (***)(*)	Natural gas Italian combustion mix (IT)
Synonym (***)	Methane Italian combustion mix
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical description	Emission of combustion independent from the type of use, representative of Italian mix consumed. The boundary is gate-to-gate.
Technological representativeness –TeR (*)	
Uncertainty	
Year(s) of validity (*)	
Time representativeness –TiR (*)	
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Italy
Data Quality Statement (***)(*)	The data set reports only the CO2 emissions estimated. Data are Italian national average of last 5 years. Data are expressed in kgCO_2/kg natural gas, considering natural gas density 0.778 kg/m3.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	This emission doesn't consider the efficiency of different combustion engine. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions:

Emissions	Unit	2010	2011	2012	2013	2014
kg CO_2 / m^3 of natural gas combustion	kg/m^3	1.971	1.955	1.961	1.953	1.952
kg CO_2 / kg of natural gas combustion	kg/kg	2.53	2.51	2.52	2.51	2.51

Emissions	Unit	Average	Deviation standard
kg CO_2 / kg of natural gas combustion	kg/kg	2.52	1.01E-02

Petrol

General Information	
Information	Description of content
Process name (***)(*)	Petrol (IT)
Synonym (***)	Gasoline (IT)
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Tecnhical description	
Technological representativeness –TeR (*)	
Uncertainty	
Year(s) of validity (*)	
Time representativeness –TiR (*)	
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Italy
Data Quality Statement (***)(*)	The data set reports only the CO_2 emissions estimated. Data derive from experimental average 2012-2014.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions	Unit	Average	Deviation standard
kg CO_2 / kg of petrol combustion	kg/kg	3.140	---
kg CO2/toe of petrol combustion	kg/toe	3.07E+03	---

kg CO_2/kWh of petrol combustion	kg/kWh	2.64E-01	---
kg CO_2/l of petrol combustion	Kg/l	2.345	

Density of petrol : min 720 Kg/m^3, max 770 kg/m3[2], for the unit transformation the medium density 747 kg/m^3 was used

[2] *AA. , 2001,"manuale dell'ingegnere ", Vol. I, chapterC pag. 360, Hoelphi*

Gas oil – engines

General Information	
Information	Description of content
Process name (***)(*)	Gas oil - engines (IT)
Synonym (***)	Diesel oil – engines (IT)
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Tecnhical description	
Technological representativeness –TeR (*)	
Uncertainty	
Year(s) of validity (*)	
Time representativeness –TiR (*)	
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Italy
Data Quality Statement (***)(*)	The data set reports only the CO_2 emissions estimated. Data derive from experimental average 2012-2014.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions	Unit	Average	Deviation standard
kg CO_2 / kg of gas oil combustion	kg/kg	3.151	---
kg CO2/toe of gas oil combustion	kg/toe	3.08E+03	---
kg CO2/kWh of gas oil combustion	kg/kWh	2.65E-01	---
kg CO2/kWh of gas oil combustion	kg /l	2.647	

Density of Gas oil - engines: min 820 Kg/m^3, max 860 kg/m3[3]*, for the unit transformation the medium density 840 kg/m^3 was used.*

[3] AA. , 2001,"manuale dell'ingegnere ", Vol. I, chapter C pag. 362, Hoelphi

Gas oil – heating

General Information	
Information	Description of content
Process name (***)(*)	Gas oil - heating (IT)
Synonym (***)	Diesel oil – heating (IT)
ID Number	
Copyright	**Clim’Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Tecnhical description	
Technological representativeness –TeR (*)	
Uncertainty	
Year(s) of validity (*)	
Time representativeness –TiR (*)	
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Italy
Data Quality Statement (***)(*)	The data set reports only the CO_2 emissions estimated. Data derive from experimental average 2012-2014.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions	Unit	Average	Deviation standard
kg CO_2 / kg of gas oil combustion	kg/kg	3.155	---
kg CO2/toe of gas oil combustion	kg/toe	3.08E+03	---

kg CO2/kWh of gas oil combustion	kg/kWh	2.65E-01	---
kg CO2/l of gas oil combustion	kg/l	2,625	

Density of Gas oil - heating: min 820 Kg/m^3, max 845 kg/m3[4]*, for the unit transformation the medium density 832 kg/m^3 was used.*

[4] http://www.angelipetroli.com/scheda-gasolio.pdf

LPG

General Information	
Information	Description of content
Process name (***)(*)	LPG (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Tecnhical description	
Technological representativeness –TeR (*)	
Uncertainty	
Year(s) of validity (*)	
Time representativeness –TiR (*)	
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Italy
Data Quality Statement (***)(*)	The data set reports only the CO_2 emissions estimated. Data derive from experimental average 2012-2014.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions	Unit	Average	Deviation standard
kg CO_2 / kg of LPG combustion	kg/kg	3.024	---
kg CO2/toe of LPG combustion	kg/toe	2.74E+03	---

kg CO2/kWh of LPG combustion	kg/kWh	2.36E-01	---
kg CO2/l of LPG combustion	kg/l	1.542	

Density of LPG: liquid at 15°C 0,51 Kg/dm^3[5]*,*

[5] http://www.energygas.it/informazioni-tecniche/gpl

Fuel oil

General Information	
Information	Description of content
Process name (***)(*)	Fuel oil (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Tecnhical description	
Technological representativeness –TeR (*)	
Uncertainty	
Year(s) of validity (*)	
Time representativeness –TiR (*)	
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Italy
Data Quality Statement (***)(*)	The data set reports only the CO_2 emissions estimated. The data were elaborated from literature and from an extensive series of samples (more than 400) analysed by ENEL and made available to ISPRA. Data are an average of the last 5 years.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	The main information available nationally of fuel oil EF is a sizable difference in carbon content between high sulphur and light sulphur brands. Carbon content varies to a certain extent also between the medium sulphur content and the very low sulphur products, but the main discrepancies refer to the high sulphur type.

	According to the available statistical data, it was possible to trace back to the year 1990 the produced and imported quantities of fuel oil divided between high and low sulphur products and to estimate the average carbon emission factor for the years of interest. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions	Unit	2010	2011	2012	2013	2014
kg CO_2 / kg of fuel oil combustion	kg/kg	3.142	3.142	3.141	3.142	3.142

Emissions	Unit	Average	Deviation standard
kg CO_2 / kg of fuel oil combustion	kg/kg	3.142	4.472E-04
kg CO_2 / toe of fuel oil combustion	kg /toe	3.195E+03	4.219E+00
kg CO_2/kWh of fuel oil combustion	kg /kWh	2.748E-01	3.628E-04
kg CO_2/l of fuel oil combustion	kg /l	2.639	

Density of Fuel oil: min 750 Kg/m^3, max 940 kg/m3[6], for the unit transformation the medium density 845 kg/m^3 was used.

[6] http://www.engineeringtoolbox.com/fuels-densities-specific-volumes-d_166.html

Coal

General Information	
Information	Description of content
Process name (***)(*)	Coal (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Tecnhical description	
Technological representativeness –TeR (*)	
Uncertainty	
Year(s) of validity (*)	
Time representativeness –TiR (*)	
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Italy
Data Quality Statement (***)(*)	The data set reports only the CO_2 emissions estimated. Data derive from statistical estimation of imported coal data. Data are an average of the last 5 years.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	

General information (***)(*)	Italy has only negligible national production of coal; most part is imported from various countries and there are differences in carbon content of coal mined in different parts of the world. The variations in carbon content can be linked to the hydrogen content and to the LHV of the coal. The quantities shipped by the main exporters change considerably from year to year. Therefore an attempt was made to find out a methodology allowing for a more precise estimation of the carbon content of this fuel. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions	Unit	2010	2011	2012	2013	2014
kg CO_2 / kg of coal combustion	kg/kg	2.318	2.325	2.353	2.350	

Emissions	Unit	Average	Deviation standard
kg CO_2 / kg of coal combustion	kg/kg	2.360	5.47E-02
kg CO2 / toe of coal combustion	kg / toe	3.92E+03	1.30E+01
kg CO2/kWh of coal combustion	kg /kWh	3.37E-01	1.12E-03

Refinery gas

General Information	
Information	Description of content
Process name (***)(*)	Refinery gas (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Tecnhical description	
Technological representativeness –TeR (*)	
Uncertainty	
Year(s) of validity (*)	
Time representativeness –TiR (*)	
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Italy
Data Quality Statement (***)(*)	The data set reports only the CO_2 emissions estimated. Data derive from statistical estimation of imported coal data. Data are an average of the last 5 years.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	Refinery gases are derived gases produced in refineries. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Refinery gas	t CO_2 / TJ (stechiometric)	t CO_2 / TJ	t CO_2 / t	t CO_2 / toe
Refinery gas, 2008	58.187	58.187	2.716	2.435
Refinery gas, 2009	57.625	57.625	2.708	2.411
Refinery gas, 2010	57.622	57.622	2.725	2.411
Refinery gas, 2011	57.485	57.485	2.711	2.405
Refinery gas, 2012	57.306	57.306	2.716	2.398
Refinery gas, 2013	57.368	57.368	2.653	2.400
Refinery gas, 2014	58.109	58.109	2.666	2.431

Emissions	Unit	Average	Deviation standard
kg CO_2 / kg of refinery gas combustion	kg/kg	2.69E+00	3.24E-02
kg CO2 / toe of refinery gas combustion	kg / toe	2.41E+03	1.33E+01
kg CO2/kWh of refinery gas combustion	kg /kWh	2.07E-01	1.14E-03

Coke oven gas

General Information	
Information	Description of content
Process name (***)(*)	Coke oven gas (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Tecnhical description	
Technological representativeness –TeR (*)	
Uncertainty	
Year(s) of validity (*)	
Time representativeness –TiR (*)	
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Italy
Data Quality Statement (***)(*)	The data set reports only the CO_2 emissions estimated. Data derive from statistical estimation of imported coal data. Data are an average of the last 5 years.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	Coke oven gases are derived gases produced in iron and steel integrated plants. Density at 0 °C and 760 mm Hg, or 105 kN/m^2, is 0.50 kg/m^3. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Coke oven gas	t CO_2 / TJ (stechiometric)	t CO_2 / TJ	t CO_2 / 10^3 std cubic mt	t CO_2 / toe
Coke oven gas, 1990-2004	42.111	42.111	0.806	1.762
Coke oven gas, 2005	42.128	42.128	0.754	1.763
Coke oven gas, 2006	42.678	42.678	0.743	1.786
Coke oven gas, 2007	42.416	42.416	0.738	1.775
Coke oven gas, 2008	42.250	42.250	0.733	1.768
Coke oven gas, 2009	42.980	42.980	0.747	1.798
Coke oven gas, 2010	42.816	42.816	0.736	1.791
Coke oven gas, 2011	43.328	43.328	0.747	1.813
Coke oven gas, 2012	44.046	44.046	0.776	1.843
Coke oven gas, 2013	42.861	42.861	0.761	1.793
Coke oven gas, 2014	43.767	43.767	0.776	1.831

Emissions	Unit	Average	Deviation standard
kg CO_2 / m^3 of gas combustion	kg/m^3	7.59E-01	1.77E-02
kg CO_2 / kg of gas combustion	kg/kg	1.52E+00	3.54E-02
kg CO_2 / toe of coke oven gas combustion	kg / toe	1.81E+03	2.29E+01
kg CO_2/kWh of coke oven gas combustion	kg /kWh	1.60E-01	2.02E-03

Heavy residual fuels

General Information	
Information	Description of content
Process name (***)(*)	Heavy residual fuels (IT)
Synonym (***)	
ID Number	
Copyright	**Clim’Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Tecnhical description	
Technological representativeness –TeR (*)	
Uncertainty	
Year(s) of validity (*)	
Time representativeness –TiR (*)	
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Italy
Data Quality Statement (***)(*)	The data set reports only the CO_2 emissions estimated. Data derive from statistical estimation of imported coal data. Data are an average of the last 5 years.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Heavy residual fuels	t CO_2 / TJ (stechiometric)	t CO_2 / TJ	t CO_2 / t	t CO_2 / toe
Heavy residual fuels, 1999-2006	81.817	81.817	3.211	3.423
Heavy residual fuels, 2007	81.823	81.823	3.212	3.423
Heavy residual fuels, 2008	81.823	81.823	3.212	3.423
Heavy residual fuels, 2009	79.319	79.319	3.113	3.319
Heavy residual fuels, 2010	79.259	79.259	3.116	3.316
Heavy residual fuels, 2011	80.421	80.421	3.130	3.365
Heavy residual fuels, 2012	80,167	80.167	3.121	3.354
Heavy residual fuels, 2013	80.756	80.756	3.145	3.379
Heavy residual fuels, 2014	80.499	80.499	3.135	3.368

Emissions	Unit	Average	Deviation standard
kg CO_2 / kg of heavy residential fuels combustion	kg/kg	3.13E+00	1.15E-02
kg CO_2 / toe of heavy residential fuels combustion	kg / toe	3.36E+03	2.43E+01
kg CO_2/kWh of heavy residential fuels combustion	kg /kWh	2.89E-01	2.09E-03

Synthesis gas

General Information	
Information	Description of content
Process name (***)(*)	Synthesis gas (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Tecnhical description	
Technological representativeness –TeR (*)	
Uncertainty	
Year(s) of validity (*)	
Time representativeness –TiR (*)	
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Italy
Data Quality Statement (***)(*)	The data set reports only the CO_2 emissions estimated. Data derive from statistical estimation of imported coal data. Data are an average of the last 5 years.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	Synthesis gasses are derived gases produced in refineries from heavy residual. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Synthesis gas	t CO_2 / TJ (stechiometric)	t CO_2 / TJ	t CO_2 / t	t CO_2 / toe
Synthesis gas, 1999-2005	98.103	98.103	0.933	4.105
Synthesis gas, 2006	98.566	98.566	1.037	4.124
Synthesis gas, 2007	98.321	98.321	0.812	4.114
Synthesis gas, 2008	98.860	98.860	0.962	4.136
Synthesis gas, 2009	97.555	97.555	0.949	4.082
Synthesis gas, 2010	101.930	101.930	0.902	4.265
Synthesis gas, 2011	100.627	100.627	0.892	4.210
Synthesis gas, 2012	99.823	99.823	0.878	4.177
Synthesis gas, 2013	100.817	100.817	0.960	4.218
Synthesis gas, 2014	100.596	100.596	0.962	4.209

Emissions	Unit	Average	Deviation standard
kg CO_2 / kg of synthesis gas combustion	kg/kg	9.19E-01	3.95E-02
kg CO_2 / toe of synthesis gas combustion	kg/toe	4.22E+03	3.17E+01
kg CO_2 / kWh of synthesis gas combustion	kg/kWh	3.62E-01	2.72E-03

Blast furnace gas

General Information	
Information	Description of content
Process name (***)(*)	Blast furnace gas (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Tecnhical description	
Technological representativeness –TeR (*)	
Uncertainty	
Year(s) of validity (*)	
Time representativeness –TiR (*)	
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Italy
Data Quality Statement (***)(*)	The data set reports only the CO_2 emissions estimated. Data derive from statistical estimation of imported coal data. Data are an average of the last 5 years.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	Blast furnace gases are derived steel gases. Density at 0 °C and 1 atm is 1.250 kg/m^3. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Blast furnace gas	$t\ CO_2$ / TJ (stechiometric)	$t\ CO_2$ / TJ	$t\ CO_2$ / 10^3 std cubic mt	$t\ CO_2$ / toe
Blast furnace gas, 1990-2004	270.575	270.575	0.953	11.321
Blast furnace gas, 2005	263.653	263.653	0.928	11.031
Blast furnace gas, 2006	255.948	255.948	0.901	10.709
Blast furnace gas, 2007	261.469	261.469	0.921	10.940
Blast furnace gas, 2008	256.133	256.133	0.847	10.717
Blast furnace gas, 2009	259.560	259.560	0.858	10.860
Blast furnace gas, 2010	257.390	257.390	0.870	10.769
Blast furnace gas, 2011	255.351	255.351	0.884	10.684
Blast furnace gas, 2012	252.808	252.808	0.892	10.577
Blast furnace gas, 2013	251.428	251.428	0.939	10.520
Blast furnace gas, 2014	245.964	245.964	0.962	10.291

Emissions	Unit	Average	Deviation standard
kg CO_2 / m^3 of gas combustion	kg/m^3	9.09E-01	3.92E-02
kg CO_2 / kg of gas combustion	kg/kg	7.28E-01	3.14E-02
kg CO_2 / toe of blast furnace gas combustion	kg/toe	1.06E+04	1.82E+02
kg CO_2 / kWh of blast furnace gas combustion	kg/kWh	9.09E-01	1.57E-02

Annex 3 - Metadata, activity data, emissions and emission factors of electricity

Information	Description of content
Process name (***)(*)	Italian electricity mix at net production
Synonym (***)	
ID Number	
Copyright	1.1.1.1 Clim'Foot
Data collector's organisation	ENEA
Source	ISPRA report 212/15, 2015
Creation date	25/05/2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kWh
Technical Description (***)(*)	The mix of electricity production is composed for 2013 of 19% Hydroelectric, 67% Electricity from fossil fuels, 2% Geothermic and 5% Electricity from wind and 7% photovoltaic. In the estimation of technology mix of electricity production all plants existing in Italy divided by technology are considered for about 60 typologies, and type of fuel used. The electricity production is the net of the losses grid, that are 6.7%. The boundary is gate-to-gate.
Technological representativeness – TeR (*)	good
Uncertainty	
Year(s) of validity (*)	2013
Time representativeness –TiR (*)	good
Geographic Reference (***) (*)	Italy
Geographical representativeness – GeR (*)	good
Data Quality Statement (***)(*)	Good overall data quality.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	

General information (***)(*)	
Information	The data set report only the CO_2 emissions the CH_4 and N_2O are less than 0.003%

Class	Category level 1	Category lev 2	Flow	Id Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CO_2(fossil)	kg	3.15E-01	

flow	Unit	Quantity	Characterization factor	IdUnit	Quantity	Remarks
CO_2(fossil)	kg	3,37E-01	1	kgCO_2 eq	3.15E-01	

Annex 4 - Metadata, activity data, emissions and emission factors of chemical industry

Table 4.4 Production of chemical industry, 1990 – 2014 (Gg)

ACTIVITY DATA	1990	1995	2000	2005	2010	2011	2012	2013	2014
				(Gg)					
2B.1 - Ammonia	1,455	592	414	607	505	476	576	555	606
2B.2 - Nitric acid	1,037	588	556	572	417	437	431	433	443
2B.3 - Adipic acid	49	64	71	75	85	83	79	80	80
2B.4 - Caprolactame	120	120	111	-	-	-	-	-	-
2B.5 - Calcium carbide production	12	7	7	7	6	6	5	5	5
2B.6 - Titanium dioxide	58	69	72	60	70	69	51	51	50
2B.7 - Soda ash production and use	610	1,070	1,000	915	620	726	824	780	873
2B.8b - Ethylene	1,466	1,807	1,771	1,721	1,551	1,254	1,166	1,117	890
2B.8d - Ethylene oxide	61	54	13	-	-	-	-	-	-
2B.8f - Carbon black	184	208	221	214	205	217	179	183	203
2B.8g - Styrene	365	484	613	520	524	477	518	494	468
2B.8g.i - Propylene	774	693	690	1,037	880	716	673	575	552

Ammonia

General Information	
Information	Description of content
Process name (***)(*)	Ammonia (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	Since 2002 national production of ammonia in Italy has been collected at facility level. Since 2009 only one facility (Enichem Agricoltura) has been producing ammonia in Italy and reporting data to the national PRTR (Pollutant Release and Transfer Register). Ammonia is obtained after processing in ammonia converters a "synthesis gas" which contains hydrogen and nitrogen. CO2 is also contained in the synthesis gas, but it is removed in the decarbonising step within the ammonia production process. Part of CO2 is recovered as a by-product and part is released to atmosphere. The system boundary is gate to gate.
Technological representativeness –TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	The uncertainty in CO_2 emissions is estimated by 10.4%, as combination of uncertainties related to activity data (3%) and for the model/emission factors (10%). Data are Italian national average of last 5 years.

Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CO_2 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions: average and standard deviation

Emissions	Unit	Average	Standard deviation (st)
kg CO_2 / kg ammonia	kg/kg	1.17E+00	6.53E-02

Nitric acid

General Information	
Information	Description of content
Process name (***)(*)	Nitric acid (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	Since 2009 nitric acid production has been carried out in only two plants at national level. Nitric acid is produced from ammonia by catalytic oxidation (with air) of NH3 to NO2 and subsequent reaction with water. Currently the reactions involved take place in low and medium pressure processes. The N_2O average emission factors are calculated from 1990 on the basis of the emission factors provided by the existing production plants in the national EPER/E-PRTR registry. Activity data have been collected at plant level for the whole time series. The system boundary is gate to gate.
Technological representativeness –TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	The uncertainty in N_2O emissions is estimated by 10.4%, as combination of uncertainties related to activity data (3%) and for the model/emission factors (10%).
Data Acquisition	
Source and Reliability	
Information sources	

Validation	
Validation note	
General information (***)(*)	The data set reports only the N_2O emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions: average and standard deviation

Emissions	Unit	Average	Standard deviation (st)
kg N_2O / kg nitric acid	kg/kg	9.85E-04	3.68E-04

Adipic acid

General Information	
Information	Description of content
Process name (***)(*)	Adipic acid (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	Adipic acid production is a multistep process which starts with the oxidation of cyclohexanol using nitric acid and Cu catalysts. Adipic acid is then used to produce nylon or is fed to other production processes. Emissions data from adipic acid production are provided and referenced by one plant, which is the only producer in Italy (Radici Chimica, several years). The system boundary is gate to gate.
Technological representativeness –TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	The uncertainty in N_2O and CO2 emissions is estimated by 10.4%, as combination of uncertainties related to activity data (3%) and for the model/emission factors (10%).
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	

General information (***)(*)	The data set reports CO_2 and N_2O emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions: average and standard deviation

Emissions	Unit	Average	Standard deviation (st)
kg CO_2 / kg adipic acid	kg/kg	2.12E-02	9.92E-04
kg N_2O / kg adipic acid	kg/kg	6.77E-03	6.67E-03

Calcium carbide

General Information	
Information	Description of content
Process name (***)(*)	Calcium carbide (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	Calcium carbide production process takes place in electric furnaces. CARBITALIA S.p.A. is the only facility which can operate calcium carbide production in Italy. Since the previous submission CO_2 emissions from calcium carbide production process and use have been estimated on the basis of the activity data provided by the sole Italian producer/retailer. Activity data relating to the manufacture of calcium carbide are referred to the years from 1990 to 1995 when the production stopped; activity data concerning the use of calcium carbide have been provided for the whole timeseries too. The default IPCC CO_2 emission factors (IPCC, 2006) have been used to estimate the emissions from manufacture and use along the whole timeseries. The system boundary is gate to gate.
Technological representativeness –TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	The uncertainty in CO_2 emissions is

	estimated by 10.4%, as combination of uncertainties related to activity data (3%) and for the model/emission factors (10%).
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only CO_2 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions: average and standard deviation

Emissions	Unit	Average	Standard deviation (st)
kg CO_2 / kg Calcium carbide	kg/kg	1.05E+00	4.59E-02

Titanium dioxide

General Information	
Information	Description of content
Process name (***)(*)	Titanium dioxade (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	CO2 emissions from dioxide titanium production have been estimated on the basis of information supplied directly by the Italian maker. In Italy there is only one facility where this production occurs and titanium dioxide is produced through the "sulphate process" that involves the use of sulphuric acid to concentrate the input raw mineral in terms of titanium dioxide content, then selective precipitation and calcination allow getting the final product. The system boundary is gate to gate.
Technological representativeness –TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	The uncertainty in CO2 emissions is estimated by 10.4%, as combination of uncertainties related to activity data (3%) and for the model/emission factors (10%).
Data Acquisition	
Source and Reliability	
Information sources	
Validation	

Validation note	
General information (***)(*)	TiO_2 is the most used white pigment especially for paint and plastic industries. The data set reports only CO_2 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions: average and standard deviation

Emissions	Unit	Average	Standard deviation (st)
kg CO_2 / kg titanium dioxide	kg/kg	7.01E-01	1.90E-01

Soda ash production and use

General Information	
Information	Description of content
Process name (***)(*)	Soda ash production and use (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	CO2 emissions from soda ash production have been estimated on account of information available about the Solvay process, the only one facility that operates soda ash production. The CO2 emission factor for those years is based on the estimation process of the GHG emissions inventory of Spain and on the information that Solvay has made available to the Spanish inventory team for a plant with the same technology as the Italian one. Solvay process allows producing soda ash through the conversion of sodium chloride into sodium carbonate using calcium carbonate and ammonia. CO2 is released and calcium chloride is the waste. Up to the second half of year 2000 in the unit for the production of peroxidates there was one sodium carbonate line and a sodium perborate line which was then converted to sodium carbonate production. Soda ash is also used in glass production processes. The system boundary is gate to gate.
Technological representativeness –TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018

Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	The uncertainty in CO2 emissions is estimated by 10.4%, as combination of uncertainties related to activity data (3%) and for the model/emission factors (10%).
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only CO_2 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions: average and standard deviation

Emissions	Unit	Average	Standard deviation (st)
kg CO_2 / kg soda ash	kg/kg	3.03E-01	4.66E-02

Ethylene

General Information	
Information	Description of content
Process name (***)(*)	Ethylene (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	The system boundary is gate to gate.
Technological representativeness –TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Ethylene belongs to the organic chemical processes. It is produced in petrochemical industry by steam cracking to manufacture ethylene oxide, styrene monomer and polyethylenes. Syndial Spa (ex Enichem) and Polimeri Europa (Syndial, several years; Polimeri Europa, several years) were the main producers in Italy up to 2006. Since 2007 Polimeri Europa has become the main producer for those products, while it has been the main producer of styrene since 2002. Data have been provided by the Italian producers. The system boundary is gate to gate.
Data Acquisition	
Source and Reliability	
Information sources	
Validation	

Validation note	
General information (***)(*)	The data set reports only CH_4 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions: average and standard deviation

Emissions	Unit	Average	Standard deviation (st)
kg CH_4 / kg ethylene	kg/kg	2.31E-04	3.22E-04

Carbon black

General Information	
Information	Description of content
Process name (***)(*)	Carbon black (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	CO2 and CH4 emissions from carbon black production process have been estimated on the basis of information supplied by the Italian production plants in the framework of the national EPER/E-PRTR registry and the EU emissions trading scheme. The system boundary is gate to gate.
Technological representativeness –TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports CH_4 and CO_2 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions: average and standard deviation

Emissions	Unit	Average	Standard deviation (st)
kg CH_4 / kg carbon black	kg/kg	5.09E-04	4.16E-05
kg CO_2 / kg carbon black	kg/kg	2.39E+00	1.09E-01

Propylene

General Information	
Information	Description of content
Process name (***)(*)	Propylene (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	ENEA
Source	Italian National Inventory Report (2016)
Creation date	2015
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	Propylene belongs to the organic chemical processes. It is obtained by cracking of oil and is used to manufacture polypropylene, acetone and phenol. Syndial Spa (ex Enichem) and Polimeri Europa (Syndial, several years; Polimeri Europa, several years) were the main producers in Italy up to 2006. Since 2007 Polimeri Europa has become the main producer for those products, while it has been the main producer of styrene since 2002. Since 1995 data have been provided by the manufacturing companies. The system boundary is gate to gate.
Technological representativeness –TeR (*)	Good
Uncertainty	
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	
Data Acquisition	
Source and Reliability	
Information sources	

Validation	
Validation note	
General information (***)(*)	The data set reports only CH_4 emissions. Italian Greenhouse Gas Inventory 1990 – 2014 - National Inventory Report 2016.

Emissions: average and standard deviation

Emissions	Unit	Average	Standard deviation (st)
kg CH_4 / kg propylene	kg/kg	8.60E-05	4.43E-06

Annex 5 - Metadata, activity data, emissions and emission factors of agriculture

Vegetable

Irrigated Barley, No tillage

General Information	
Information	Description of content
Process name (***)(*)	Irrigated Barley, No tillage (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Leap Database, Global Database of GHG emissions related to feed crops (FAO)
Creation date	2010
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg-DM (Dry Matter)
Technical Description (***)(*)	The EFs is extrapolated from the Leap Database made from the FAO association. It takes into account also carbon stock changes associated with land-use change. The main stages considered in the Life Cycle are Crop Nutrition, Plant Protection, Weed Management, Irrigation and Harvesting. No Tillage practice is applied. The system boundaries of the system are cradle-to-gate. Link to the database: http://www.fao.org/partnerships/leap/database/ghg-crops/en/
Technological representativeness –TeR (*)	Very good
Uncertainty	The uncertainty is related to the representativeness of the dataset. Regarding agricultural management and fertilizer application, sub-national variability should be considered.
Year(s) of validity (*)	2013

Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Good
Geographical representativeness – GeR (*)	Good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	The dataset is expressed in kg CO2-eq and it derives from the sum of the components CO2, N2O and CH4. The unit of this EF is expressed in kg CO2-eq per kg DM (Dry Matter).

Crop	**Production System**	**Production Practice**	**Unit**	**EF**
Barley	Irrigated	No Tillage	Kg CO2-eq/kg DM	4.46E-01

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	4.46E-01

Irrigated Barley, Minimal Tillage

General Information	
Information	Description of content
Process name (***)(*)	Irrigated Barley, Minimal Tillage (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Leap Database, Global Database of GHG emissions related to feed crops (FAO)
Creation date	2010
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg-DM (Dry Matter)
Technical Description (***)(*)	The EFs is extrapolated from the Leap Database made from the FAO association. It takes into account also carbon stock changes associated with land-use change. The main stages considered in the Life Cycle are Crop Nutrition, Plant Protection, Weed Management, Irrigation and Harvesting. Minimal Tillage practice is applied. The system boundaries of the system are cradle-to-gate. Link to the database: http://www.fao.org/partnerships/leap/database/ghg-crops/en/
Technological representativeness –TeR (*)	Very good
Uncertainty	The uncertainty is related to the representativeness of the dataset. Regarding agricultural management and fertilizer application, sub-national variability should be considered.
Year(s) of validity (*)	2013
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Good
Geographical representativeness – GeR (*)	Good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	

Information sources	
Validation	
Validation note	
General information (***)(*)	The dataset is expressed in kg CO2-eq and it derives from the sum of the components CO2, N2O and CH4. The unit of this EF is expressed in kg CO2-eq per kg DM (Dry Matter).

Crop	**Production System**	**Production Practice**	**Unit**	**EF**
Barley	Irrigated	Minimal Tillage	Kg CO2-eq/kg DM	5.13E-01

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	5.13E-01

Irrigated Barley, Conventional

General Information	
Information	Description of content
Process name (***)(*)	Irrigated Barley, Conventional (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Leap Database, Global Database of GHG emissions related to feed crops (FAO)
Creation date	2010
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg-DM (Dry Matter)
Technical Description (***)(*)	The EFs is extrapolated from the Leap Database made from the FAO association. It takes into account also carbon stock changes associated with land-use change. The main stages considered in the Life Cycle are Crop Nutrition, Plant Protection, Weed Management, Irrigation and Harvesting. Conventional production practice is applied. The system boundaries of the system are cradle-to-gate. Link to the database: http://www.fao.org/partnerships/leap/database/ghg-crops/en/
Technological representativeness –TeR (*)	Very good
Uncertainty	The uncertainty is related to the representativeness of the dataset. Regarding agricultural management and fertilizer application, sub-national variability should be considered.
Year(s) of validity (*)	2013
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Good
Geographical representativeness – GeR (*)	Good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	

Information sources	
Validation	
Validation note	
General information (***)(*)	The dataset is expressed in kg CO2-eq and it derives from the sum of the components CO2, N2O and CH4. The unit of this EF is expressed in kg CO2-eq per kg DM (Dry Matter).

Crop	**Production System**	**Production Practice**	**Unit**	**EF**
Barley	Irrigated	Conventional	Kg CO2-eq/kg DM	5.24E-01

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	5.24E-01

Rainfed Barley, No Tillage

General Information	
Information	Description of content
Process name (***)(*)	Rainfed Barley, No Tillage (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Leap Database, Global Database of GHG emissions related to feed crops (FAO)
Creation date	2010
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg-DM (Dry Matter)
Technical Description (***)(*)	The EFs is extrapolated from the Leap Database made from the FAO association. It takes into account also carbon stock changes associated with land-use change. The main stages considered in the Life Cycle are Crop Nutrition, Plant Protection, Weed Management and Harvesting. No Tillage production practice is applied. The system boundaries of the system are cradle-to-gate. Link to the database: http://www.fao.org/partnerships/leap/database/ghg-crops/en/
Technological representativeness –TeR (*)	Very good
Uncertainty	The uncertainty is related to the representativeness of the dataset. Regarding agricultural management and fertilizer application, sub-national variability should be considered.
Year(s) of validity (*)	2013
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Good
Geographical representativeness – GeR (*)	Good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	
Information sources	

Validation	
Validation note	
General information (***)(*)	The dataset is expressed in kg CO_2-eq and it derives from the sum of the components CO_2, N_2O and CH_4. The unit of this EF is expressed in kg CO_2-eq per kg DM (Dry Matter).

Crop	**Production System**	**Production Practice**	**Unit**	**EF**
Barley	Rainfed	No Tillage	Kg CO2-eq/kg DM	6.63E-01

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	6.63E-01

Rainfed Barley, Minimal Tillage

General Information	
Information	Description of content
Process name (***)(*)	Rainfed Barley, Minimal Tillage (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Leap Database, Global Database of GHG emissions related to feed crops (FAO)
Creation date	2010
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg-DM (Dry Matter)
Technical Description (***)(*)	The EFs is extrapolated from the Leap Database made from the FAO association. It takes into account also carbon stock changes associated with land-use change. The main stages considered in the Life Cycle are Crop Nutrition, Plant Protection, Weed Management and Harvesting. Minimal Tillage production practice is applied. The system boundaries of the system are cradle-to-gate. Link to the database: http://www.fao.org/partnerships/leap/database/ghg-crops/en/
Technological representativeness –TeR (*)	Very good
Uncertainty	The uncertainty is related to the representativeness of the dataset. Regarding agricultural management and fertilizer application, sub-national variability should be considered.
Year(s) of validity (*)	2013
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Good
Geographical representativeness – GeR (*)	Good
Data Quality Statement (***)(*)	Overall the data quality is good

Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	The dataset is expressed in kg CO2-eq and it derives from the sum of the components CO2, N2O and CH4. The unit of this EF is expressed in kg CO2-eq per kg DM (Dry Matter).

Crop	**Production System**	**Production Practice**	**Unit**	**EF**
Barley	Rainfed	Minimal Tillage	Kg CO2-eq/kg DM	7.79E-01

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	7.79E-01

Rainfed Barley, Conventional

General Information	
Information	Description of content
Process name (***)(*)	Rainfed Barley, Conventional (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Leap Database, Global Database of GHG emissions related to feed crops (FAO)
Creation date	2010
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg-DM (Dry Matter)
Technical Description (***)(*)	The EFs is extrapolated from the Leap Database made from the FAO association. It takes into account also carbon stock changes associated with land-use change. The main stages considered in the Life Cycle are Crop Nutrition, Plant Protection, Weed Management and Harvesting. Conventional production practice is applied. The system boundaries of the system are cradle-to-gate. Link to the database: http://www.fao.org/partnerships/leap/database/ghg-crops/en/
Technological representativeness –TeR (*)	Very good
Uncertainty	The uncertainty is related to the representativeness of the dataset. Regarding agricultural management and fertilizer application, sub-national variability should be considered.
Year(s) of validity (*)	2013
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Good
Geographical representativeness – GeR (*)	Good
Data Quality Statement (***)(*)	Overall the data quality is good

Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	The dataset is expressed in kg CO2-eq and it derives from the sum of the components CO2, N2O and CH4. The unit of this EF is expressed in kg CO2-eq per kg DM (Dry Matter).

Crop	**Production System**	**Production Practice**	**Unit**	**EF**
Barley	Rainfed	Conventional	Kg CO2-eq/kg DM	7.99E-01

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	7.99E-01

Irrigated Maize, Conventional

General Information	
Information	Description of content
Process name (***)(*)	Irrigated Maize, Conventional (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Leap Database, Global Database of GHG emissions related to feed crops (FAO)
Creation date	2010
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg-DM (Dry Matter)
Technical Description (***)(*)	The EFs is extrapolated from the Leap Database made from the FAO association. It takes into account also carbon stock changes associated with land-use change. The main stages considered in the Life Cycle are Crop Nutrition, Plant Protection, Weed Management, Irrigation and Harvesting. Conventional production practice is applied. The system boundaries of the system are cradle-to-gate. Link to the database: http://www.fao.org/partnerships/leap/database/ghg-crops/en/
Technological representativeness –TeR (*)	Very good
Uncertainty	The uncertainty is related to the representativeness of the dataset. Regarding agricultural management and fertilizer application, sub-national variability should be considered.
Year(s) of validity (*)	2013
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Good
Geographical representativeness – GeR (*)	Good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	

Information sources	
Validation	
Validation note	
General information (***)(*)	The dataset is expressed in kg CO2-eq and it derives from the sum of the components CO2, N2O and CH4. The unit of this EF is expressed in kg CO2-eq per kg DM (Dry Matter).

Crop	**Production System**	**Production Practice**	**Unit**	**EF**
Maize	Irrigated	Conventional	Kg CO2-eq/kg DM	2.28E-01

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	2.28E-01

Rainfed Maize, Conventional

General Information	
Information	Description of content
Process name (***)(*)	Rainfed Maize, Conventional (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Leap Database, Global Database of GHG emissions related to feed crops (FAO)
Creation date	2010
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg-DM (Dry Matter)
Technical Description (***)(*)	The EFs is extrapolated from the Leap Database made from the FAO association. It takes into account also carbon stock changes associated with land-use change. The main stages considered in the Life Cycle are Crop Nutrition, Plant Protection, Weed Management and Harvesting. Conventional production practice is applied. The system boundaries of the system are cradle-to-gate. Link to the database: http://www.fao.org/partnerships/leap/database/ghg-crops/en/
Technological representativeness –TeR (*)	Very good
Uncertainty	The uncertainty is related to the representativeness of the dataset. Regarding agricultural management and fertilizer application, sub-national variability should be considered.
Year(s) of validity (*)	2013
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Good
Geographical representativeness – GeR (*)	Good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	

Information sources	
Validation	
Validation note	
General information (***)(*)	The dataset is expressed in kg CO2-eq and it derives from the sum of the components CO2, N2O and CH4. The unit of this EF is expressed in kg CO2-eq per kg DM (Dry Matter).

Crop	**Production System**	**Production Practice**	**Unit**	**EF**
Maize	Rainfed	Conventional	Kg CO2-eq/kg DM	3.12E-01

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	3.12E-01

Irrigated Wheat, No Tillage

General Information	
Information	Description of content
Process name (***)(*)	Irrigated Wheat, No Tillage (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Leap Database, Global Database of GHG emissions related to feed crops (FAO)
Creation date	2010
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg-DM (Dry Matter)
Technical Description (***)(*)	The EFs is extrapolated from the Leap Database made from the FAO association. It takes into account also carbon stock changes associated with land-use change. The main stages considered in the Life Cycle are Crop Nutrition, Plant Protection, Weed Management, Irrigation and Harvesting. No Tillage production practice is applied. The system boundaries of the system are cradle-to-gate. Link to the database: http://www.fao.org/partnerships/leap/database/ghg-crops/en/
Technological representativeness –TeR (*)	Very good
Uncertainty	The uncertainty is related to the representativeness of the dataset. Regarding agricultural management and fertilizer application, sub-national variability should be considered.
Year(s) of validity (*)	2013
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Good
Geographical representativeness – GeR (*)	Good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	

Information sources	
Validation	
Validation note	
General information (***)(*)	The dataset is expressed in kg CO2-eq and it derives from the sum of the components CO2, N2O and CH4. The unit of this EF is expressed in kg CO2-eq per kg DM (Dry Matter).

Crop	**Production System**	**Production Practice**	**Unit**	**EF**
Wheat	Irrigated	No Tillage	Kg CO2-eq/kg DM	4.43E-01

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	4.43E-01

Irrigated Wheat, Minimal Tillage

General Information	
Information	Description of content
Process name (***)(*)	Irrigated Wheat, Minimal Tillage (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Leap Database, Global Database of GHG emissions related to feed crops (FAO)
Creation date	2010
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg-DM (Dry Matter)
Technical Description (***)(*)	The EFs is extrapolated from the Leap Database made from the FAO association. It takes into account also carbon stock changes associated with land-use change. The main stages considered in the Life Cycle are Crop Nutrition, Plant Protection, Weed Management, Irrigation and Harvesting. Minimal Tillage production practice is applied. The system boundaries of the system are cradle-to-gate. Link to the database: http://www.fao.org/partnerships/leap/database/ghg-crops/en/
Technological representativeness –TeR (*)	Very good
Uncertainty	The uncertainty is related to the representativeness of the dataset. Regarding agricultural management and fertilizer application, sub-national variability should be considered.
Year(s) of validity (*)	2013
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Good
Geographical representativeness – GeR (*)	Good
Data Quality Statement (***)(*)	Overall the data quality is good

Data Acquisition	
Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	The dataset is expressed in kg CO2-eq and it derives from the sum of the components CO2, N2O and CH4. The unit of this EF is expressed in kg CO2-eq per kg DM (Dry Matter).

Crop	**Production System**	**Production Practice**	**Unit**	**EF**
Wheat	Irrigated	Minimal Tillage	Kg CO2-eq/kg DM	5.15E-01

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	5.15E-01

Irrigated Wheat, Conventional

General Information	
Information	Description of content
Process name (***)(*)	Irrigated Wheat, Conventional (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Leap Database, Global Database of GHG emissions related to feed crops (FAO)
Creation date	2010
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg-DM (Dry Matter)
Technical Description (***)(*)	The EFs is extrapolated from the Leap Database made from the FAO association. It takes into account also carbon stock changes associated with land-use change. The main stages considered in the Life Cycle are Crop Nutrition, Plant Protection, Weed Management, Irrigation and Harvesting. Conventional production practice is applied. The system boundaries of the system are cradle-to-gate. Link to the database: http://www.fao.org/partnerships/leap/database/ghg-crops/en/
Technological representativeness –TeR (*)	Very good
Uncertainty	The uncertainty is related to the representativeness of the dataset. Regarding agricultural management and fertilizer application, sub-national variability should be considered.
Year(s) of validity (*)	2013
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Good
Geographical representativeness – GeR (*)	Good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	

Information sources	
Validation	
Validation note	
General information (***)(*)	The dataset is expressed in kg CO2-eq and it derives from the sum of the components CO2, N2O and CH4. The unit of this EF is expressed in kg CO2-eq per kg DM (Dry Matter).

Crop	**Production System**	**Production Practice**	**Unit**	**EF**
Wheat	Irrigated	Conventional	Kg CO2-eq/kg DM	5.28E-01

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	5.28E-01

Rainfed Wheat, No Tillage

General Information	
Information	Description of content
Process name (***)(*)	Rainfed Wheat, No Tillage (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Leap Database, Global Database of GHG emissions related to feed crops (FAO)
Creation date	2010
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg-DM (Dry Matter)
Technical Description (***)(*)	The EFs is extrapolated from the Leap Database made from the FAO association. It takes into account also carbon stock changes associated with land-use change. The main stages considered in the Life Cycle are Crop Nutrition, Plant Protection, Weed Management and Harvesting. No Tillage production practice is applied. The system boundaries of the system are cradle-to-gate. Link to the database: http://www.fao.org/partnerships/leap/database/ghg-crops/en/
Technological representativeness –TeR (*)	Very good
Uncertainty	The uncertainty is related to the representativeness of the dataset. Regarding agricultural management and fertilizer application, sub-national variability should be considered.
Year(s) of validity (*)	2013
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Good
Geographical representativeness – GeR (*)	Good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	
Information sources	

Validation	
Validation note	
General information (***)(*)	The dataset is expressed in kg CO2-eq and it derives from the sum of the components CO2, N2O and CH4. The unit of this EF is expressed in kg CO2-eq per kg DM (Dry Matter).

Crop	**Production System**	**Production Practice**	**Unit**	**EF**
Wheat	Rainfed	No Tillage	Kg CO2-eq/kg DM	5.12E-01

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	5.12E-01

Rainfed Wheat, Minimal Tillage

General Information	
Information	Description of content
Process name (***)(*)	Rainfed Wheat, Minimal Tillage (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Leap Database, Global Database of GHG emissions related to feed crops (FAO)
Creation date	2010
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg-DM (Dry Matter)
Technical Description (***)(*)	The EFs is extrapolated from the Leap Database made from the FAO association. It takes into account also carbon stock changes associated with land-use change. The main stages considered in the Life Cycle are Crop Nutrition, Plant Protection, Weed Management and Harvesting. Minimal Tillage production practice is applied. The system boundaries of the system are cradle-to-gate. Link to the database: http://www.fao.org/partnerships/leap/database/ghg-crops/en/
Technological representativeness –TeR (*)	Very good
Uncertainty	The uncertainty is related to the representativeness of the dataset. Regarding agricultural management and fertilizer application, sub-national variability should be considered.
Year(s) of validity (*)	2013
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Good
Geographical representativeness – GeR (*)	Good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	

Information sources	
Validation	
Validation note	
General information (***)(*)	The dataset is expressed in kg CO2-eq and it derives from the sum of the components CO2, N2O and CH4. The unit of this EF is expressed in kg CO2-eq per kg DM (Dry Matter).

Crop	**Production System**	**Production Practice**	**Unit**	**EF**
Wheat	Rainfed	Minimal Tillage	Kg CO2-eq/kg DM	6.07E-01

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	6.07E-01

Rainfed Wheat, Conventional

General Information	
Information	Description of content
Process name (***)(*)	Rainfed Wheat, Conventional (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Leap Database, Global Database of GHG emissions related to feed crops (FAO)
Creation date	2010
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg-DM (Dry Matter)
Technical Description (***)(*)	The EFs is extrapolated from the Leap Database made from the FAO association. It takes into account also carbon stock changes associated with land-use change. The main stages considered in the Life Cycle are Crop Nutrition, Plant Protection, Weed Management and Harvesting. Conventional production practice is applied. The system boundaries of the system are cradle-to-gate. Link to the database: http://www.fao.org/partnerships/leap/database/ghg-crops/en/
Technological representativeness –TeR (*)	Very good
Uncertainty	The uncertainty is related to the representativeness of the dataset. Regarding agricultural management and fertilizer application, sub-national variability should be considered.
Year(s) of validity (*)	2013
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Good
Geographical representativeness – GeR (*)	Good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	

Information sources	
Validation	
Validation note	
General information (***)(*)	The dataset is expressed in kg CO2-eq and it derives from the sum of the components CO2, N2O and CH4. The unit of this EF is expressed in kg CO2-eq per kg DM (Dry Matter).

Crop	**Production System**	**Production Practice**	**Unit**	**EF**
Wheat	Rainfed	Conventional	Kg CO2-eq/kg DM	6.24E-01

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	6.24E-01

Annex 6 - Metadata, activity data, emissions and emission factors of process and fugitives related to animals

Enteric Fermentation

Enteric Fermentation – Dairy Cattle (Head)

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Dairy Cattle, Head (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	Head
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. The parameters used to calculate the EF for dairy cattle are listed at page 171 of the Italian National Inventory Report of 2016 (NIR 2016) and include parameters such as the average weight (602.7 kg) of the cattle and milk production (11.5-18.6 kg/head/year) (NIR 2016). The coefficient for calculating the net energy for maintenance (NE_m) and the methane conversion factor (Y_m) for cattle have been updated on the basis of the default values published in the 2006 IPCC Guidelines. The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good

Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	Unit	2010	2011	2012	2013	2014
kg-CH4/head/year	kg/head/y	138.8	138.0	134.9	134.2	138.7

Emissions: average and standard deviation:

Emissions	Average	Standard deviation (st)
kg-CH4/head/year	136.92	2.20

Emissions: EF in CO2-eq:

Emissions	Emission Factor	Unit	Characterization Factor in CO2-eq
kg-CH4/head/year	3833.76	kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	136.92	St 2.20

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	3833.76

Enteric Fermentation – Dairy Cattle (Weight)

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Dairy Cattle, Weight (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. The parameters used to calculate the EF for dairy cattle are listed at page 171 of the Italian National Inventory Report of 2016 (NIR 2016) and include parameters such as the average weight (602.7 kg) of the cattle and milk production (11.5-18.6 kg/head/year) (NIR 2016). The coefficient for calculating the net energy for maintenance (NE_m) and the methane conversion factor (Y_m) for cattle have been updated on the basis of the default values published in the 2006 IPCC Guidelines. The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018

Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	Unit	2010	2011	2012	2013	2014
kg-CH4/head/year	kg/head/y	138.8	138.0	134.9	134.2	138.7

Emissions: average and standard deviation:

Emissions	Average	Average Weight (kg)	Emissions	Average	Standard deviation (st)
kg-CH4/head/year	136.92	602.7	kg CH4/kg/year	0.23	2.20

Emissions: EF in CO2-eq:

Emissions	Emission Factor	Unit	Characterization Factor in CO2-eq
kg-CH4/kg/year	6.361	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	0.227	St 2.20

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	6.361

Enteric Fermentation – Non Dairy Cattle, Head

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Non Dairy Cattle, Head (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	Head
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. The parameters used to calculate the EF for non-dairy cattle are listed at page 173 of the Italian National Inventory Report of 2016 (NIR 2016). The non-dairy cattle category is composed of different sub-categories. For this reason, the EF is calculated as a weighted average. The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good

Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	Unit	2010	2011	2012	2013	2014
kg-CH4/head/year	kg/head/y	45.9	45.6	48	47.5	46.9

Emissions: average and standard deviation:

Emissions	Average	Standard deviation (st)
kg-CH4/head/year	46.78	1.02

Emissions: EF in CO2-eq:

Emission Factor	Unit	Characterization Factor in CO2-eq
1309.84	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	46.78	St 1.02

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	1309.84

Enteric Fermentation – Non Dairy Cattle, Weight

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Non Dairy Cattle, Weight (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. The parameters used to calculate the EF for non-dairy cattle are listed at page 173 of the Italian National Inventory Report of 2016 (NIR 2016). The non-dairy cattle category is composed of different sub-categories. For this reason, the EF is calculated as a weighted average. The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good

Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 $head^{-1}$ $year^{-1}$)

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 $head^{-1}$ $year^{-1}$)									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	**Unit**	**2010**	**2011**	**2012**	**2013**	**2014**
kg-CH4/head/year	kg/head/y	45.9	45.6	48	47.5	46.9

Emissions: average and standard deviation:

Emissions	**Average**	**Average Weight (kg)**	**Emissions**	**Average**	**Standard deviation (st)**
kg-CH4/unit/year	46.78	391.2	kg CH4/kg/year	0.12	1.02

Emissions: EF in CO2-eq:

Emissions	**Emission Factor**	**Unit**	**Characterization Factor in CO2-eq**
kg-CH4/kg/year	3.436	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	0.12	St 1.02

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	3.436

Enteric Fermentation – Buffalo, Head

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Buffalo, Head (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	Head
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. For this process, two country specific EFs were developed, one for "cow buffalo" and one for "other buffaloes". This EF is an average value of the two categories (Italian National Inventory Report of 2016, p. 173. NIR 2016). The parameters used to calculate the EF for Buffaloes are listed at page 173 and 174 of the Italian National Inventory Report of 2016 (NIR 2016). The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good

Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	Unit	2010	2011	2012	2013	2014
kg CH4 / head / year	kg/head/y	76.4	77.4	77.1	75.7	76.8

Emissions: average and standard deviation:

Emissions	Average	Standard deviation (st)
kg-CH4/head/year	76.68	0.66

Emissions: EF in CO2-eq:

Emission Factor	Unit	Characterization Factor in CO2-eq
2147.04	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	76.68	St 0.66

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	2147.04

Enteric Fermentation – Buffalo, Weight

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Buffalo, Weight (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. For this process, two country specific EFs were developed, one for "cow buffalo" and one for "other buffaloes". This EF is an average value of the two categories (Italian National Inventory Report of 2016, p. 173. NIR 2016). The parameters used to calculate the EF for Buffaloes are listed at page 173 and 174 of the Italian National Inventory Report of 2016 (NIR 2016). The system boundaries of the system are

	gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	Unit	2010	2011	2012	2013	2014
kg-CH4/head/year	kg/head/y	76.4	77.4	77.1	75.7	76.8

Emissions: average and standard deviation:

Emissions	Average	Average Weight (kg)	Emissions	Average	Standard deviation (st)
kg-CH4/unit/year	76.68	519.9	kg CH4/kg/year	0.15	0.66

Emissions: EF in CO2-eq:

Emissions	Emission Factor	Unit	Characterization Factor in CO2-eq
kg CH4 / kg / year	4.130	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	0.15	St 0.66

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	4.130

Enteric Fermentation – Sheep, Head

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Sheep, Head (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	Head
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. A Tier 1 approach, with IPCC default EFs, is used to estimate CH4 emissions from sheep. The description of the methodology used to calculate the EF can be found under "other livestock categories" in the Italian National Inventory Report, p.174 (NIR, 2016). The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good

Data Acquisition	
Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	**Unit**	**2010**	**2011**	**2012**	**2013**	**2014**
kg CH4 / head / year	kg/head/y	8	8	8	8	8

Emissions: average and standard deviation:

Emissions	**Average**	**Standard deviation (st)**
kg-CH4/head/year	8	0.00

Emissions: EF in CO2-eq:

Emission Factor	**Unit**	**Characterization Factor in CO2-eq**
224	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	8	St 0.00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	224

Enteric Fermentation – Sheep, Weight

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Sheep, Weight (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. A Tier 1 approach, with IPCC default EFs, is used to estimate CH4 emissions from sheep. The description of the methodology used to calculate the EF can be found under "other livestock categories" in the Italian National Inventory Report, p.174 (NIR, 2016). The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	

Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	**Unit**	**2010**	**2011**	**2012**	**2013**	**2014**
kg-CH4/head/year	kg/head/y	8	8	8	8	8

Emissions: average and standard deviation:

Emissions	**Average**	**Average Weight (kg)**	**Emissions**	**Average**	**Standard deviation (st)**
kg CH4 / unit / year	8	47	kg CH4/kg/year	0.17	0.00

Emissions: EF in CO2-eq:

Emissions	**Emission**	**Unit**	**Characterization Factor in**

	Factor		CO2-eq
kg-CH4/kg/year	4.77	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	0.17	St 0.00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	4.766

Enteric Fermentation – Goat, Head

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Goat, Head (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	Head
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. A Tier 1 approach, with IPCC default EFs, is used to estimate CH4 emissions from goats. The description of the methodology used to calculate the EF can be found under "other livestock categories" in the Italian National Inventory Report, p.174 (NIR, 2016). The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	

Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	Unit	2010	2011	2012	2013	2014
kg-CH4/head/year	kg/head/y	5	5	5	5	5

Emissions: average and standard deviation:

Emissions	Average	Standard deviation (st)
kg-CH4/head/year	5	0.00

Emissions: EF in CO2-eq:

Emission Factor	Unit	Characterization Factor in CO2-eq
140	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	5	St 0.00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	140

Enteric Fermentation – Goat, Weight

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Goat, Weight (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. A Tier 1 approach, with IPCC default EFs, is used to estimate CH4 emissions from goats. The description of the methodology used to calculate the EF can be found under "other livestock categories" in the Italian National Inventory Report, p.174 (NIR, 2016). The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	

Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	**Unit**	**2010**	**2011**	**2012**	**2013**	**2014**
kg CH4 / head / year	kg/head/y	5	5	5	5	5

Emissions: average and standard deviation:

Emissions	**Average**	**Average Weight (kg)**	**Emissions**	**Average**	**Standard deviation (st)**
kg CH4 / unit / year	5	46.7	kg CH4/kg/year	0.11	0.00

Emissions: EF in CO2-eq:

Emissions	**Emission Factor**	**Unit**	**Characterization Factor in CO2-eq**
kg CH4 / kg / year	2.998	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	0.11	St 0.00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	2.998

Enteric Fermentation – Horses, Head

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Horses, Head (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	Head
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. A Tier 1 approach, with IPCC default EFs, is used to estimate CH4 emissions from horses. The description of the methodology used to calculate the EF can be found under "other livestock categories" in the Italian National Inventory Report, p.174 (NIR, 2016). The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good

Data Acquisition	
Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	**Unit**	**2010**	**2011**	**2012**	**2013**	**2014**
kg-CH4/head/year	kg/head/y	18	18	18	18	18

Emissions: average and standard deviation:

Emissions	**Average**	**Standard deviation (st)**
kg-CH4/head/year	18	0.00

Emissions: EF in CO2-eq:

Emission Factor	**Unit**	**Characterization Factor in CO2-eq**
504	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	18	St 0.00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	504

Enteric Fermentation – Horses, Weight

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Horses, Weight (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. A Tier 1 approach, with IPCC default EFs, is used to estimate CH4 emissions from horses. The description of the methodology used to calculate the EF can be found under "other livestock categories" in the Italian National Inventory Report, p.174 (NIR, 2016). The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good

Data Acquisition	
Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	**Unit**	**2010**	**2011**	**2012**	**2013**	**2014**
kg-CH4/head/year	kg/head/y	18	18	18	18	18

Emissions: average and standard deviation:

Emissions	**Average**	**Average Weight (kg)**	**Emissions**	**Average**	**Standard deviation (st)**
kg-CH4/unit/year	18	550	kg CH4/kg/year	0.03	0.00

Emissions: EF in CO2-eq:

Emissions	Emission Factor	Unit	Characterization Factor in CO2-eq
kg-CH4/kg/year	0.916	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	0.03	St 0.00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	0.916

Enteric Fermentation – Mules and Asses, Head

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Mules and Asses, Head (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	Head
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. A Tier 1 approach, with IPCC default EFs, is used to estimate CH4 emissions from mules and asses. The description of the methodology used to calculate the EF can be found under "other livestock categories" in the Italian National Inventory Report, p.174 (NIR, 2016). The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good

Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	Unit	2010	2011	2012	2013	2014
kg-CH4/head/year	kg/head/y	10	10	10	10	10

Emissions: average and standard deviation:

Emissions	Average	Standard deviation (st)
kg-CH4/head/year	10	0.00

Emissions: EF in CO2-eq:

Emission Factor	Unit	Characterization Factor in CO2-eq
280	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	10	St 0.00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	280

Enteric Fermentation – Mules and Asses, Weight

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Mules and Asses, Weight (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. A Tier 1 approach, with IPCC default EFs, is used to estimate CH4 emissions from mules and asses. The description of the methodology used to calculate the EF can be found under "other livestock categories" in the Italian National Inventory Report, p.174 (NIR, 2016). The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good

Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	**Unit**	**2010**	**2011**	**2012**	**2013**	**2014**
kg-CH4/head/year	kg/head/y	10	10	10	10	10

Emissions: average and standard deviation:

Emissions	**Average**	**Standard deviation (st)**
kg CH4 / head / year	10	0.00

Emissions	Average	Average Weight (kg)	Emissions	Average	Standard deviation (st)
kg CH4 / unit / year	10	300	kg CH4/kg/year	0.03	0.00

Emissions: EF in CO2-eq:

Emissions	Emission Factor	Unit	Characterization Factor in CO2-eq
kg CH4 / kg / year	0.933	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	0.03	St 0.00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	0.933

Enteric Fermentation – Sows, Head

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Sows, Head (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	Head
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. A Tier 1 approach, with IPCC default EFs, is used to estimate CH4 emissions from sows. The description of the methodology used to calculate the EF can be found under "other livestock categories" in the Italian National Inventory Report, p.174 (NIR, 2016). The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	

Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	**Unit**	**2010**	**2011**	**2012**	**2013**	**2014**
kg-CH4/head/year	kg/head/y	1.5	1.5	1.5	1.5	1.5

Emissions: average and standard deviation:

Emissions	**Average**	**Standard deviation (st)**
kg-CH4/head/year	1.5	0.00

Emissions: EF in CO2-eq:

Emission Factor	**Unit**	**Characterization Factor in CO2-eq**
42	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	1.5	St 0.00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	42

Enteric Fermentation – Sows, Weight

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Sows, Weight (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. A Tier 1 approach, with IPCC default EFs, is used to estimate CH4 emissions from sows. The description of the methodology used to calculate the EF can be found under "other livestock categories" in the Italian National Inventory Report, p.174 (NIR, 2016). The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	

Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	Unit	2010	2011	2012	2013	2014
kg-CH4/head/year	kg/head/y	1.5	1.5	1.5	1.5	1.5

Emissions: average and standard deviation:

Emissions	Average	Standard deviation (st)
kg-CH4/head/year	1.5	0.00

Emissions	Average	Average Weight (kg)	Emissions	Average	Standard deviation (st)
kg-CH4/unit/year	1.5	172.1	kg CH4/kg/year	0.01	0.00

Emissions: EF in CO2-eq:

Emissions	Emission Factor	Unit	Characterization Factor in CO2-eq
kg-CH4/kg/year	0.244	kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	0.01	St 0.00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	0.244

Enteric Fermentation – Other Swine, Head

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Other Swine, Head (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	Head
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. A Tier 1 approach, with IPCC default EFs, is used to estimate CH4 emissions from other swine. The description of the methodology used to calculate the EF can be found under "other livestock categories" in the Italian National Inventory Report, p.174 (NIR, 2016). The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good

Data Acquisition	
Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	**Unit**	**2010**	**2011**	**2012**	**2013**	**2014**
kg-CH4/head/year	kg/head/y	1.5	1.5	1.5	1.5	1.5

Emissions: average and standard deviation:

Emissions	**Average**	**Standard deviation (st)**
kg-CH4/head/year	1.5	0.00

Emissions: EF in CO2-eq:

Emission Factor	**Unit**	**Characterization Factor in CO2-eq**
42	kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	1.5	St 0.00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	42

Enteric Fermentation – Other Swine, Weight

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Other Swine, Weight (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. A Tier 1 approach, with IPCC default EFs, is used to estimate CH4 emissions from other swine. The description of the methodology used to calculate the EF can be found under "other livestock categories" in the Italian National Inventory Report, p.174 (NIR, 2016). The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good

Data Acquisition	
Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	**Unit**	**2010**	**2011**	**2012**	**2013**	**2014**
kg-CH4/head/year	kg/head/y	1.5	1.5	1.5	1.5	1.5

Emissions: average and standard deviation:

Emissions	**Average**	**Standard deviation (st)**
kg-CH4/head/year	1.5	0.00

Emissions	**Average**	**Average Weight (kg)**	**Emissions**	**Average**	**Standard deviation (st)**
kg CH4 / unit / year	1.5	88.3	kg CH4/kg/year	0.02	0.00

Emissions: EF in CO2-eq:

Emissions	Emission Factor	Unit	Characterization Factor in CO2-eq
kg CH4 / kg / year	0.476	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	0.02	St 0.00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	0.476

Enteric Fermentation – Rabbits, Head

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Rabbits, Head (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	Head
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. Methane emissions from rabbits have been estimated using a country-specific EF suggested by the Research Centre on Animal Production (CRPA). The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH_4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	

Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	**Unit**	**2010**	**2011**	**2012**	**2013**	**2014**
kg-CH4/head/year	kg/head/y	0.08	0.08	0.08	0.08	0.08

Emissions: average and standard deviation:

Emissions	**Average**	**Standard deviation (st)**
kg-CH4/head/year	0.08	0.00

Emissions: EF in CO2-eq:

Emission Factor	**Unit**	**Characterization Factor in CO2-eq**
2.24	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	0.08	St 0.00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	2.24

Enteric Fermentation – Rabbits, Weight

General Information	
Information	Description of content
Process name (***)(*)	Enteric Fermentation – Rabbits, Weight (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	Methane is produced as a by-product of enteric fermentation, which is a digestive process where carbohydrates are degraded by microorganisms into simple molecules. Methane emissions from enteric fermentation are the major key category. Methane emissions from rabbits have been estimated using a country-specific EF suggested by the Research Centre on Animal Production (CRPA). The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty related to CH4 emissions from enteric fermentation was 20.2% for annual emissions, resulting from the combination of 3% of uncertainty for activity data and 20% for emission factors (NIR-2016)
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	Regarding the livestock number, results from the MeditAIRaneo project focusing in the

	assessment of critical points of the enteric fermentation category have been incorporated. Information related to the 2010 Agricultural census has been analysed and verified (NIR-2015).
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports only the CH_4 emissions. National Inventory Report 2016.

Table 5.6 Average CH_4 emission factors for enteric fermentation (kg CH_4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Sows	Other swine	Rabbits
	average CH_4 EF (kg CH_4 head^{-1} year^{-1})									
1990	111.2	45.6	74.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
1995	123.6	47.4	75.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2000	124.7	47.0	78.2	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2005	132.9	46.4	84.6	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2010	138.8	45.9	76.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2011	138.0	45.6	77.4	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2012	134.9	48.0	77.1	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2013	134.2	47.5	75.7	8.0	5.0	18.0	10.0	1.5	1.5	0.08
2014	138.7	46.9	76.8	8.0	5.0	18.0	10.0	1.5	1.5	0.08

Elementary flows: emissions / amount:

Emissions	Unit	2010	2011	2012	2013	2014
kg CH4 / head / year	kg/head/y	0.08	0.08	0.08	0.08	0.08

Emissions: average and standard deviation:

Emissions	Average	Standard deviation (st)
kg-CH4/head/year	0.08	0.00

Emissions	Average	Average Weight (kg)	Emissions	Average	Standard deviation (st)
kg-CH4/unit/year	0.08	1.6	kg CH4/kg/year	0.05	0.00

Emissions: EF in CO2-eq:

Emissions	Emission Factor	Unit	Characterization Factor in CO2-eq
kg-CH4/kg/year	1.4	Kg CO2-eq	28

Output flow in CH4 (biogenic):

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	0.05	St 0.00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	1.4

Manure Management – Dairy Cattle, Head

General Information	
Information	Description of content
Process name (***)(*)	Manure management – Dairy Cattle, Head (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	Head
Technical Description (***)(*)	The EF is composed from methane and nitrous oxide (direct and indirect) emissions. N_2O direct and indirect emissions are produced during the storage and treatment of manure before it is applied to land. Data and methodology are extrapolated from the Italian National Inventory Report 2016 (NIR 2016) under the section "Manure Management". The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty of CH_4 and N_2O direct emissions from manure management has been estimated equal to 20.6%. Uncertainty of indirect N_2O emissions from manure management has been estimated equal to 50.2% (NIR, 2016).
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	

Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports emissions from CH_4 and N_2O. National Inventory Report 2016.

Table 5.13 Average methane EF for manure management (kg CH⁴ head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sows	Other swine
	(kg CH_4 head^{-1} year^{-1})				
1990	15.04	7.46	12.22	22.14	8.54
1995	15.04	7.81	12.00	21.96	8.52
2000	15.04	7.66	11.77	21.97	8.43
2005	15.04	7.77	12.33	22.30	8.35
2010	15.04	7.74	12.34	22.34	8.36
2011	15.04	7.69	12.32	22.40	8.40
2012	15.04	7.84	11.79	22.17	8.94
2013	15.04	7.81	11.71	22.39	8.86
2014	15.04	7.75	12.12	22.33	8.77

(*) These are the EFs used for estimating CH_4 emissions from manure management. CH_4 reductions are not included.

Table 5.15 Nitrogen excretion rates for main livestock categories (kg N head^{-1} yr^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Other swine	Sows
	(kg N head^{-1} yr^{-1})				
1990	116.00	50.00	94.32	13.13	28.10
1995	116.00	49.86	92.84	13.10	27.86
2000	116.00	50.08	91.20	12.96	27.87
2005	116.00	49.76	95.28	12.84	28.30
2010	116.00	49.83	95.33	12.85	28.36
2011	116.00	49.46	95.17	12.92	28.44
2012	116.00	51.62	91.41	13.74	28.13
2013	116.00	51.37	90.88	13.62	28.42
2014	116.00	50.99	93.79	13.48	28.34

Elementary flows: emissions:

Emissions	2010	2011	2012	2013	2014
kg CH4/head/y	1.50E+01	1.50E+01	1.50E+01	1.50E+01	1.50E+01
kg N/head/y	1.16E+02	1.16E+02	1.16E+02	1.16E+02	1.16E+02
kg-N20/head/year	5.80E-01	5.80E-01	5.80E-01	5.80E-01	5.80E-01

Emissions: EF in CO2-eq:

Emissions	Average	Standard deviation (st)
kg-CH4/head/year	1.50E+01	0.0E+00
kg-N20/head/year	5.80E-01(*)	0.0E+00

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions	Unit	Unit	Characterization Factor in CO2-eq	Emission Factor
1,50E+01	Kg-CH4/head/y	Kg CO2-eq	28	4.21E+02
5,80E-01	Kg-N2O/head/y	Kg CO2-eq	265	2.17E+02

Output flow in CH4 (biogenic) and N_2O:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	1.50E+01	St 0.0E+00
Output	Emissions	Emissions to air	N_20	kg	5.80E-01	St 0.0E+00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	5.75E+02

Manure Management – Dairy Cattle, Weight

General Information	
Information	Description of content
Process name (***)(*)	Manure management – Dairy Cattle, Weight (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	The EF is composed from methane and nitrous oxide (direct and indirect) emissions. N_2O direct and indirect emissions are produced during the storage and treatment of manure before it is applied to land. Data and methodology are extrapolated from the Italian National Inventory Report 2016 (NIR 2016) under the section "Manure Management". The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty of CH_4 and N_2O direct emissions from manure management has been estimated equal to 20.6%. Uncertainty of indirect N_2O emissions from manure management has been estimated equal to 50.2% (NIR, 2016).
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	

Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports emissions from CH_4 and N_2O. National Inventory Report 2016.

Table 5.13 Average methane EF for manure management (kg CH^4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sows	Other swine
	(kg CH_4 head^{-1} year^{-1})				
1990	15.04	7.46	12.22	22.14	8.54
1995	15.04	7.81	12.00	21.96	8.52
2000	15.04	7.66	11.77	21.97	8.43
2005	15.04	7.77	12.33	22.30	8.35
2010	15.04	7.74	12.34	22.34	8.36
2011	15.04	7.69	12.32	22.40	8.40
2012	15.04	7.84	11.79	22.17	8.94
2013	15.04	7.81	11.71	22.39	8.86
2014	15.04	7.75	12.12	22.33	8.77

(*) These are the EFs used for estimating CH_4 emissions from manure management. CH_4 reductions are not included.

Table 5.15 Nitrogen excretion rates for main livestock categories (kg N head^{-1} yr^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Other swine	Sows
	(kg N head^{-1} yr^{-1})				
1990	116.00	50.00	94.32	13.13	28.10
1995	116.00	49.86	92.84	13.10	27.86
2000	116.00	50.08	91.20	12.96	27.87
2005	116.00	49.76	95.28	12.84	28.30
2010	116.00	49.83	95.33	12.85	28.36
2011	116.00	49.46	95.17	12.92	28.44
2012	116.00	51.62	91.41	13.74	28.13
2013	116.00	51.37	90.88	13.62	28.42
2014	116.00	50.99	93.79	13.48	28.34

Elementary flows: emissions:

Emissions	**2010**	**2011**	**2012**	**2013**	**2014**
kg-CH4/kg/y	2.50E-02	2.50E-02	2.50E-02	2.50E-02	2.50E-02
kg-N/kg/y	1.92E-01	1.92E-01	1.92E-01	1.92E-01	1.92E-01
kg-N20 / kg / year	9.62E-04	9.62E-04	9.62E-04	9.62E-04	9.62E-04

Emissions: EF in CO2-eq:

Emissions	**Average**	**Standard deviation (st)**
kg-CH4/kg/year	2.50E-02	0.00E+00
Kg-N20/kg/year	9.62E-04(*)	0.00E+00

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions	Unit	Unit	Characterization Factor in CO2-eq	Emission Factor
2.50E-02	Kg-CH4/kg/y	Kg CO2-eq	28	6.99E-01
9.62E-04	Kg-N2O/kg/y	Kg CO2-eq	265	2.55E-01

Output flow in CH4 (biogenic) and N_2O:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	2.50E-02	St 0.00E+00
Output	Emissions	Emissions to air	N_20	kg	9.62E-04	St 0.00E+00

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	9.54E-01

Manure Management – Non-Dairy Cattle, Head

General Information	
Information	Description of content
Process name (***)(*)	Manure management – Non-Dairy Cattle, Head (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	Head
Technical Description (***)(*)	The EF is composed from methane and nitrous oxide (direct and indirect) emissions. N_2O direct and indirect emissions are produced during the storage and treatment of manure before it is applied to land. Data and methodology are extrapolated from the Italian National Inventory Report 2016 (NIR 2016) under the section "Manure Management". The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty of CH_4 and N_2O direct emissions from manure management has been estimated equal to 20.6%. Uncertainty of indirect N_2O emissions from manure management has been estimated equal to 50.2% (NIR, 2016).
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	

Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports emissions from CH_4 and N_2O. National Inventory Report 2016.

Table 5.13 Average methane EF for manure management (kg CH^4 $head^{-1}$ $year^{-1}$)

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sows	Other swine
	(kg CH_4 $head^{-1}$ $year^{-1}$)				
1990	15.04	7.46	12.22	22.14	8.54
1995	15.04	7.81	12.00	21.96	8.52
2000	15.04	7.66	11.77	21.97	8.43
2005	15.04	7.77	12.33	22.30	8.35
2010	15.04	7.74	12.34	22.34	8.36
2011	15.04	7.69	12.32	22.40	8.40
2012	15.04	7.84	11.79	22.17	8.94
2013	15.04	7.81	11.71	22.39	8.86
2014	15.04	7.75	12.12	22.33	8.77

(*) These are the EFs used for estimating CH_4 emissions from manure management. CH_4 reductions are not included.

Table 5.15 Nitrogen excretion rates for main livestock categories (kg N $head^{-1}$ yr^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Other swine	Sows
	(kg N $head^{-1}$ yr^{-1})				
1990	116.00	50.00	94.32	13.13	28.10
1995	116.00	49.86	92.84	13.10	27.86
2000	116.00	50.08	91.20	12.96	27.87
2005	116.00	49.76	95.28	12.84	28.30
2010	116.00	49.83	95.33	12.85	28.36
2011	116.00	49.46	95.17	12.92	28.44
2012	116.00	51.62	91.41	13.74	28.13
2013	116.00	51.37	90.88	13.62	28.42
2014	116.00	50.99	93.79	13.48	28.34

Elementary flows: emissions:

Emissions	2010	2011	2012	2013	2014
kg-CH4/head/y	7.74E+00	7.69E+00	7.84E+00	7.81E+00	7.75E+00
kg-N/head/y	4.98E+01	4.95E+01	5.16E+01	5.14E+01	5.10E+01
kg-N20 / head / year(*)	2.49E-01	2.47E-01	2.58E-01	2.57E-01	2.55E-01

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions: EF in CO2-eq:

Emissions	Average	Standard deviation (st)
kg-CH4/head/year	7.77E+00	5.9E-02
kg-N20/head/year	2.53E-01(*)	4.8E-03

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions	Unit	Unit	Characterization Factor in CO2-eq	Emission Factor
7.77E+00	Kg-CH4/head/y	Kg CO2-eq	28	2.17E+02
2.53E-01	Kg-N2O/head/y	Kg CO2-eq	265	6.71E+01

Output flow in CH4 (biogenic) and N_2O:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	7.77E+00	St 5.9E-02
Output	Emissions	Emissions to air	N_20	kg	2.53E-01	St 4.8E-03

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	2.85E+02

Manure Management – Non-Dairy Cattle, Weight

General Information	
Information	Description of content
Process name (***)(*)	Manure management – Non-Dairy Cattle, Weight (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	The EF is composed from methane and nitrous oxide (direct and indirect) emissions. N_2O direct and indirect emissions are produced during the storage and treatment of manure before it is applied to land. Data and methodology are extrapolated from the Italian National Inventory Report 2016 (NIR 2016) under the section "Manure Management". The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty of CH_4 and N_2O direct emissions from manure management has been estimated equal to 20.6%. Uncertainty of indirect N_2O emissions from manure management has been estimated equal to 50.2% (NIR, 2016).
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	

Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports emissions from CH_4 and N_2O. National Inventory Report 2016.

Table 5.13 Average methane EF for manure management (kg CH^4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sows	Other swine
	(kg CH_4 head^{-1} year^{-1})				
1990	15.04	7.46	12.22	22.14	8.54
1995	15.04	7.81	12.00	21.96	8.52
2000	15.04	7.66	11.77	21.97	8.43
2005	15.04	7.77	12.33	22.30	8.35
2010	15.04	7.74	12.34	22.34	8.36
2011	15.04	7.69	12.32	22.40	8.40
2012	15.04	7.84	11.79	22.17	8.94
2013	15.04	7.81	11.71	22.39	8.86
2014	15.04	7.75	12.12	22.33	8.77

(*) These are the EFs used for estimating CH_4 emissions from manure management. CH_4 reductions are not included.

Table 5.15 Nitrogen excretion rates for main livestock categories (kg N head^{-1} yr^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Other swine	Sows
	(kg N head^{-1} yr^{-1})				
1990	116.00	50.00	94.32	13.13	28.10
1995	116.00	49.86	92.84	13.10	27.86
2000	116.00	50.08	91.20	12.96	27.87
2005	116.00	49.76	95.28	12.84	28.30
2010	116.00	49.83	95.33	12.85	28.36
2011	116.00	49.46	95.17	12.92	28.44
2012	116.00	51.62	91.41	13.74	28.13
2013	116.00	51.37	90.88	13.62	28.42
2014	116.00	50.99	93.79	13.48	28.34

Elementary flows: emissions:

Emissions	2010	2011	2012	2013	2014
Kg CH4/kg/y	2.03E-02	2.02E-02	2.06E-02	2.05E-02	2.03E-02
Kg N/kg/y	1.31E-01	1.30E-01	1.35E-01	1.35E-01	1.34E-01
Kg N20 / kg / year(*)	6.54E-04	6.49E-04	6.77E-04	6.74E-04	6.69E-04

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions: EF in CO2-eq:

Emissions	Average	Standard deviation (st)
kg-CH4/kg/year	2.04E-02	1.56E-04
kg-N20/kg/year	6.64E-04(*)	1.26E-05

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions	Unit	Unit	Characterization Factor in CO2-eq	Emission Factor
2.04E-02	Kg-CH4/kg/y	Kg CO2-eq	28	5.70E-01
6.64E-04	Kg-N2O/kg/y	Kg CO2-eq	265	1.76E-01

Output flow in CH4 (biogenic) and N_2O:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	2.04E-02	St 1.56E-04
Output	Emissions	Emissions to air	N_20	kg	6.64E-04	St 1.26E-05

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	7.46E-01

Manure Management – Buffalo, Head

General Information	
Information	Description of content
Process name (***)(*)	Manure management – Buffalo, Head (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	Head
Technical Description (***)(*)	The EF is composed from methane and nitrous oxide (direct and indirect) emissions. N_2O direct and indirect emissions are produced during the storage and treatment of manure before it is applied to land. Data and methodology are extrapolated from the Italian National Inventory Report 2016 (NIR 2016) under the section "Manure Management". The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty of CH_4 and N_2O direct emissions from manure management has been estimated equal to 20.6%. Uncertainty of indirect N_2O emissions from manure management has been estimated equal to 50.2% (NIR, 2016).
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	

Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports emissions from CH_4 and N_2O. National Inventory Report 2016.

Table 5.13 Average methane EF for manure management (kg CH^4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sows	Other swine
	(kg CH_4 head^{-1} year^{-1})				
1990	15.04	7.46	12.22	22.14	8.54
1995	15.04	7.81	12.00	21.96	8.52
2000	15.04	7.66	11.77	21.97	8.43
2005	15.04	7.77	12.33	22.30	8.35
2010	15.04	7.74	12.34	22.34	8.36
2011	15.04	7.69	12.32	22.40	8.40
2012	15.04	7.84	11.79	22.17	8.94
2013	15.04	7.81	11.71	22.39	8.86
2014	15.04	7.75	12.12	22.33	8.77

(*) These are the EFs used for estimating CH_4 emissions from manure management. CH_4 reductions are not included.

Table 5.15 Nitrogen excretion rates for main livestock categories (kg N head^{-1} yr^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Other swine	Sows
	(kg N head^{-1} yr^{-1})				
1990	116.00	50.00	94.32	13.13	28.10
1995	116.00	49.86	92.84	13.10	27.86
2000	116.00	50.08	91.20	12.96	27.87
2005	116.00	49.76	95.28	12.84	28.30
2010	116.00	49.83	95.33	12.85	28.36
2011	116.00	49.46	95.17	12.92	28.44
2012	116.00	51.62	91.41	13.74	28.13
2013	116.00	51.37	90.88	13.62	28.42
2014	116.00	50.99	93.79	13.48	28.34

Elementary flows: emissions:

Emissions	2010	2011	2012	2013	2014
kg-CH4/head/y	1.23E+01	1.23E+01	1.18E+01	1.17E+01	1.21E+01
kg-N/head/y	9.53E+01	9.52E+01	9.14E+01	9.09E+01	9.38E+01
kg-N20/head/year(*)	4.77E-01	4.76E-01	4.57E-01	4.54E-01	4.69E-01

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions: EF in CO2-eq:

Emissions	Average	Standard deviation (st)
kg-CH4/head/year	1.21E+01	2.9E-01
kg-N20/head/year	4.67E-01(*)	1.0E-02

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions	Unit	Unit	Characterization Factor in CO2-eq	Emission Factor
1.21E+01	kg-CH4/head/y	kg CO2-eq	28	3.38E+02
4.67E-01	kg-N2O/head/y	kg CO2-eq	265	1.24E+02

Output flow in CH4 (biogenic) and N_2O:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	1.21E+01	St 2.9E-01
Output	Emissions	Emissions to air	N_20	kg	4.67E-01	St 1.0E-02

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	4.61E+02

Manure Management – Buffalo, Weight

General Information	
Information	Description of content
Process name (***)(*)	Manure management – Buffalo, Weight (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	The EF is composed from methane and nitrous oxide (direct and indirect) emissions. N_2O direct and indirect emissions are produced during the storage and treatment of manure before it is applied to land. Data and methodology are extrapolated from the Italian National Inventory Report 2016 (NIR 2016) under the section "Manure Management". The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty of CH_4 and N_2O direct emissions from manure management has been estimated equal to 20.6%. Uncertainty of indirect N_2O emissions from manure management has been estimated equal to 50.2% (NIR, 2016).
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	
Information sources	

Validation	
Validation note	
General information (***)(*)	The data set reports emissions from CH_4 and N_2O. National Inventory Report 2016.

Table 5.13 Average methane EF for manure management (kg CH^4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sows	Other swine
	(kg CH_4 head^{-1} year^{-1})				
1990	15.04	7.46	12.22	22.14	8.54
1995	15.04	7.81	12.00	21.96	8.52
2000	15.04	7.66	11.77	21.97	8.43
2005	15.04	7.77	12.33	22.30	8.35
2010	15.04	7.74	12.34	22.34	8.36
2011	15.04	7.69	12.32	22.40	8.40
2012	15.04	7.84	11.79	22.17	8.94
2013	15.04	7.81	11.71	22.39	8.86
2014	15.04	7.75	12.12	22.33	8.77

(*) These are the EFs used for estimating CH_4 emissions from manure management. CH_4 reductions are not included.

Table 5.15 Nitrogen excretion rates for main livestock categories (kg N head^{-1} yr^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Other swine	Sows
	(kg N head^{-1} yr^{-1})				
1990	116.00	50.00	94.32	13.13	28.10
1995	116.00	49.86	92.84	13.10	27.86
2000	116.00	50.08	91.20	12.96	27.87
2005	116.00	49.76	95.28	12.84	28.30
2010	116.00	49.83	95.33	12.85	28.36
2011	116.00	49.46	95.17	12.92	28.44
2012	116.00	51.62	91.41	13.74	28.13
2013	116.00	51.37	90.88	13.62	28.42
2014	116.00	50.99	93.79	13.48	28.34

Elementary flows: emissions:

Emissions	2010	2011	2012	2013	2014
kg-CH4/kg/y	2.37E-02	2.37E-02	2.27E-02	2.25E-02	2.33E-02
kg-N/kg/y	1.83E-01	1.83E-01	1.76E-01	1.75E-01	1.80E-01
kg-N20/kg/year(*)	9.17E-04	9.15E-04	8.79E-04	8.74E-04	9.02E-04

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions: EF in CO2-eq:

Emissions	Average	Standard deviation (st)
Kg CH4 / kg / year	2.32E-02	5.65E-04
Kg N20 / kg / year	8.97E-04(*)	2.00E-05

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions	**Unit**	**Unit**	**Characterization Factor in CO2-eq**	**Emission Factor**
2.32E-02	kg-CH4/kg/y	kg CO2-eq	28	6.49E-01
8.97E-04	kg-N2O/kg/y	kg CO2-eq	265	2.38E-01

Output flow in CH4 (biogenic) and N_2O:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	2.32E-02	St 5.65E-04
Output	Emissions	Emissions to air	N_20	kg	8.97E-04	St 2.00E-05

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	8.87E-01

Manure Management – Sows, Head

General Information	
Information	Description of content
Process name (***)(*)	Manure management – Sows, Head (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	Head
Technical Description (***)(*)	The EF is composed from methane and nitrous oxide (direct and indirect) emissions. N_2O direct and indirect emissions are produced during the storage and treatment of manure before it is applied to land. Data and methodology are extrapolated from the Italian National Inventory Report 2016 (NIR 2016) under the section "Manure Management". The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty of CH_4 and N_2O direct emissions from manure management has been estimated equal to 20.6%. Uncertainty of indirect N_2O emissions from manure management has been estimated equal to 50.2% (NIR, 2016).
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	
Information sources	

Validation	
Validation note	
General information (***)(*)	The data set reports emissions from CH_4 and N_2O. National Inventory Report 2016.

Table 5.13 Average methane EF for manure management (kg CH^4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sows	Other swine
	(kg CH_4 head^{-1} year^{-1})				
1990	15.04	7.46	12.22	22.14	8.54
1995	15.04	7.81	12.00	21.96	8.52
2000	15.04	7.66	11.77	21.97	8.43
2005	15.04	7.77	12.33	22.30	8.35
2010	15.04	7.74	12.34	22.34	8.36
2011	15.04	7.69	12.32	22.40	8.40
2012	15.04	7.84	11.79	22.17	8.94
2013	15.04	7.81	11.71	22.39	8.86
2014	15.04	7.75	12.12	22.33	8.77

(*) These are the EFs used for estimating CH_4 emissions from manure management. CH_4 reductions are not included.

Table 5.15 Nitrogen excretion rates for main livestock categories (kg N head^{-1} yr^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Other swine	Sows
	(kg N head^{-1} yr^{-1})				
1990	116.00	50.00	94.32	13.13	28.10
1995	116.00	49.86	92.84	13.10	27.86
2000	116.00	50.08	91.20	12.96	27.87
2005	116.00	49.76	95.28	12.84	28.30
2010	116.00	49.83	95.33	12.85	28.36
2011	116.00	49.46	95.17	12.92	28.44
2012	116.00	51.62	91.41	13.74	28.13
2013	116.00	51.37	90.88	13.62	28.42
2014	116.00	50.99	93.79	13.48	28.34

Elementary flows: emissions:

Emissions	2010	2011	2012	2013	2014
kg-CH4/head/y	2.23E+01	2.24E+01	2.22E+01	2.24E+01	2.23E+01
kg-N/head/y	2.84E+01	2.84E+01	2.81E+01	2.84E+01	2.83E+01
kg-N20/head/year(*)	1.42E-01	1.42E-01	1.41E-01	1.42E-01	1.42E-01

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions: EF in CO2-eq:

Emissions	Average	Standard deviation (st)
kg-CH4/head/year	2.23E+01	9.2E-02
kg-N20/head/year	1.42E-01(*)	6.2E-04

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions	**Unit**	**Unit**	**Characterization Factor in CO2-eq**	**Emission Factor**
2.23E+01	kg-CH4/head/y	kg CO2-eq	28	6.25E+02
1.42E-01	kg-N2O/head/y	kg CO2-eq	265	3.75E+01

Output flow in CH4 (biogenic) and N_2O:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	2.23E+01	St 9.2E-02
Output	Emissions	Emissions to air	N_20	kg	1.42E-01	St 6.2E-04

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	6.63E+02

Manure Management – Sows, Weight

General Information	
Information	Description of content
Process name (***)(*)	Manure management – Sows, Weight (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	The EF is composed from methane and nitrous oxide (direct and indirect) emissions. N_2O direct and indirect emissions are produced during the storage and treatment of manure before it is applied to land. Data and methodology are extrapolated from the Italian National Inventory Report 2016 (NIR 2016) under the section "Manure Management". The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty of CH_4 and N_2O direct emissions from manure management has been estimated equal to 20.6%. Uncertainty of indirect N_2O emissions from manure management has been estimated equal to 50.2% (NIR, 2016).
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	
Information sources	

Validation	
Validation note	
General information (***)(*)	The data set reports emissions from CH_4 and N_2O. National Inventory Report 2016.

Table 5.13 Average methane EF for manure management (kg CH^4 $head^{-1}$ $year^{-1}$)

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sows	Other swine
	(kg CH_4 $head^{-1}$ $year^{-1}$)				
1990	15.04	7.46	12.22	22.14	8.54
1995	15.04	7.81	12.00	21.96	8.52
2000	15.04	7.66	11.77	21.97	8.43
2005	15.04	7.77	12.33	22.30	8.35
2010	15.04	7.74	12.34	22.34	8.36
2011	15.04	7.69	12.32	22.40	8.40
2012	15.04	7.84	11.79	22.17	8.94
2013	15.04	7.81	11.71	22.39	8.86
2014	15.04	7.75	12.12	22.33	8.77

(*) These are the EFs used for estimating CH_4 emissions from manure management. CH_4 reductions are not included.

Table 5.15 Nitrogen excretion rates for main livestock categories (kg N $head^{-1}$ yr^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Other swine	Sows
	(kg N $head^{-1}$ yr^{-1})				
1990	116.00	50.00	94.32	13.13	28.10
1995	116.00	49.86	92.84	13.10	27.86
2000	116.00	50.08	91.20	12.96	27.87
2005	116.00	49.76	95.28	12.84	28.30
2010	116.00	49.83	95.33	12.85	28.36
2011	116.00	49.46	95.17	12.92	28.44
2012	116.00	51.62	91.41	13.74	28.13
2013	116.00	51.37	90.88	13.62	28.42
2014	116.00	50.99	93.79	13.48	28.34

Elementary flows: emissions:

Emissions	2010	2011	2012	2013	2014
kg-CH4/kg/y	1.30E-01	1.30E-01	1.29E-01	1.30E-01	1.30E-01
kg-N/kg/y	1.65E-01	1.65E-01	1.63E-01	1.65E-01	1.65E-01
kg-N20/kg/year(*)	8.24E-04	8.26E-04	8.17E-04	8.26E-04	8.23E-04

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions: EF in CO2-eq:

Emissions	Average	Standard deviation (st)
kg CH4 / kg / year	1.30E-01	5.37E-04
kg N20 / kg / year	8.23E-04(*)	3.58E-06

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions	Unit	Unit	Characterization Factor in CO2-eq	Emission Factor
1.30E-01	kg-CH4/kg/y	kg CO2-eq	28	3.63E+00
8.23E-04	kg-N2O/kg/y	kg CO2-eq	265	2.18E-01

Output flow in CH4 (biogenic) and N_2O:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	1.30E-01	St 5.37E-04
Output	Emissions	Emissions to air	N_20	kg	8.23E-04	St 3.58E-06

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	3.85

Manure Management – Other Swine, Head

General Information	
Information	Description of content
Process name (***)(*)	Manure management – Other Swine, Head (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	Head
Technical Description (***)(*)	The EF is composed from methane and nitrous oxide (direct and indirect) emissions. N_2O direct and indirect emissions are produced during the storage and treatment of manure before it is applied to land. Data and methodology are extrapolated from the Italian National Inventory Report 2016 (NIR 2016) under the section "Manure Management". The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty of CH_4 and N_2O direct emissions from manure management has been estimated equal to 20.6%. Uncertainty of indirect N_2O emissions from manure management has been estimated equal to 50.2% (NIR, 2016).
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	

Source and Reliability	
Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports emissions from CH_4 and N_2O. National Inventory Report 2016.

Table 5.13 Average methane EF for manure management (kg CH^4 head^{-1} year^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sows	Other swine
	(kg CH_4 head^{-1} year^{-1})				
1990	15.04	7.46	12.22	22.14	8.54
1995	15.04	7.81	12.00	21.96	8.52
2000	15.04	7.66	11.77	21.97	8.43
2005	15.04	7.77	12.33	22.30	8.35
2010	15.04	7.74	12.34	22.34	8.36
2011	15.04	7.69	12.32	22.40	8.40
2012	15.04	7.84	11.79	22.17	8.94
2013	15.04	7.81	11.71	22.39	8.86
2014	15.04	7.75	12.12	22.33	8.77

(*) These are the EFs used for estimating CH_4 emissions from manure management. CH_4 reductions are not included.

Table 5.15 Nitrogen excretion rates for main livestock categories (kg N head^{-1} yr^{-1})

Year	Dairy cattle	Non-dairy cattle	Buffalo	Other swine	Sows
	(kg N head^{-1} yr^{-1})				
1990	116.00	50.00	94.32	13.13	28.10
1995	116.00	49.86	92.84	13.10	27.86
2000	116.00	50.08	91.20	12.96	27.87
2005	116.00	49.76	95.28	12.84	28.30
2010	116.00	49.83	95.33	12.85	28.36
2011	116.00	49.46	95.17	12.92	28.44
2012	116.00	51.62	91.41	13.74	28.13
2013	116.00	51.37	90.88	13.62	28.42
2014	116.00	50.99	93.79	13.48	28.34

Elementary flows: emissions:

Emissions	2010	2011	2012	2013	2014
kg-CH4/head/y	8.36E+00	8.40E+00	8.94E+00	8.86E+00	8.77E+00
kg-N/head/y	1.29E+01	1.29E+01	1.37E+01	1.36E+01	1.35E+01
kg-N20/head/year(*)	6.43E-02	6.46E-02	6.87E-02	6.81E-02	6.74E-02

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions: EF in CO2-eq:

Emissions	Average	Standard deviation (st)
kg-CH4/head/year	8.67E+00	2.7E-01
kg-N20/head/year	6.66E-02(*)	2.1E-03

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions	Unit	Unit	Characterization Factor in CO2-eq	Emission Factor
8.67E+00	kg-CH4/head/y	kg CO2-eq	28	2.43E+02
6.66E-02	kg-N2O/head/y	kg CO2-eq	265	1.77E+01

Output flow in CH4 (biogenic) and N_2O:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	8.67E+00	St 2.7E-01
Output	Emissions	Emissions to air	N_20	kg	6.66E-02	St 2.1E-03

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	2.60E+02

Manure Management – Other Swine, Weight

General Information	
Information	Description of content
Process name (***)(*)	Manure management – Other Swine, Weight (IT)
Synonym (***)	
ID Number	
Copyright	**Clim'Foot project**
Data collector's organisation	Ecoinnovazione S.r.l.
Source	Italian National Inventory Report (2016)
Creation date	2017
Modification Date	
Activity Description	
Amount	1
Unit (*)	kg
Technical Description (***)(*)	The EF is composed from methane and nitrous oxide (direct and indirect) emissions. N_2O direct and indirect emissions are produced during the storage and treatment of manure before it is applied to land. Data and methodology are extrapolated from the Italian National Inventory Report 2016 (NIR 2016) under the section "Manure Management". The system boundaries of the system are gate to gate.
Technological representativeness –TeR (*)	Very good
Uncertainty	Uncertainty of CH_4 and N_2O direct emissions from manure management has been estimated equal to 20.6%. Uncertainty of indirect N_2O emissions from manure management has been estimated equal to 50.2% (NIR, 2016).
Year(s) of validity (*)	2018
Time representativeness –TiR (*)	Very good
Geographic Reference (***) (*)	Very good
Geographical representativeness – GeR (*)	Very good
Data Quality Statement (***)(*)	Overall the data quality is good
Data Acquisition	
Source and Reliability	

Information sources	
Validation	
Validation note	
General information (***)(*)	The data set reports emissions from CH_4 and N_2O. National Inventory Report 2016.

Table 5.13 Average methane EF for manure management (kg CH⁴ head⁻¹ year⁻¹)

Year	Dairy cattle	Non-dairy cattle	Buffalo	Sows	Other swine
	(kg CH_4 head^{-1} year^{-1})				
1990	15.04	7.46	12.22	22.14	8.54
1995	15.04	7.81	12.00	21.96	8.52
2000	15.04	7.66	11.77	21.97	8.43
2005	15.04	7.77	12.33	22.30	8.35
2010	15.04	7.74	12.34	22.34	8.36
2011	15.04	7.69	12.32	22.40	8.40
2012	15.04	7.84	11.79	22.17	8.94
2013	15.04	7.81	11.71	22.39	8.86
2014	15.04	7.75	12.12	22.33	8.77

(*) These are the EFs used for estimating CH_4 emissions from manure management. CH_4 reductions are not included.

Table 5.15 Nitrogen excretion rates for main livestock categories (kg N head⁻¹ yr⁻¹)

Year	Dairy cattle	Non-dairy cattle	Buffalo	Other swine	Sows
	(kg N head^{-1} yr^{-1})				
1990	116.00	50.00	94.32	13.13	28.10
1995	116.00	49.86	92.84	13.10	27.86
2000	116.00	50.08	91.20	12.96	27.87
2005	116.00	49.76	95.28	12.84	28.30
2010	116.00	49.83	95.33	12.85	28.36
2011	116.00	49.46	95.17	12.92	28.44
2012	116.00	51.62	91.41	13.74	28.13
2013	116.00	51.37	90.88	13.62	28.42
2014	116.00	50.99	93.79	13.48	28.34

Elementary flows: emissions:

Emissions	2010	2011	2012	2013	2014
kg-CH4/head/y	9.47E-02	9.51E-02	1.01E-01	1.00E-01	9.93E-02
kg-N/head/y	1.46E-01	1.46E-01	1.56E-01	1.54E-01	1.53E-01
kg-N20/head/year(*)	7.28E-04	7.32E-04	7.78E-04	7.71E-04	7.63E-04

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions: EF in CO2-eq:

Emissions	Average	Standard deviation (st)
kg-CH4/head/year	9.81E-02	3.04E-03
kg-N20/head/year	7.54E-04(*)	2.32E-05

*A factor of 0,005 have been applied to convert kg-N into kg-N_2O (NIR, 2016).

Emissions	Unit	Unit	Characterization Factor in CO2-eq	Emission Factor
9.81E-02	kg-CH4/head/y	kg CO2-eq	28	2.75E+00
7.54E-04	kg-N2O/head/y	kg CO2-eq	265	2.00E-01

Output flow in CH4 (biogenic) and N_2O:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity	Remarks
Output	Emissions	Emissions to air	CH_4 (biogenic)	kg	9.81E-02	St 3.04E-03
Output	Emissions	Emissions to air	N_20	kg	7.54E-04	St 2.32E-05

Output flow in CO2-eq:

Class	Category level 1	Category lev 2	Flow	Unit	Quantity
Output	Emissions	Emissions to air	CO2-eq	kg	2.95E+00

Annex 7 - Metadata, activity data, emissions and emission factors road transport

Source: http://slideplayer.com/slide/4027552/

Vehicles fueled by fuel mix, any route.

Emissions in kg gas/km.

Sector	CO_2 TOTALE (kg/km) 2014	CH_4 TOTALE (kg/km), 2014	-------------	N_2O TOTALE (kg/km), 2014
Passenger Cars	0.163084646	1.12795E-05	0	4.9984E-06
Buses	0.702895502	8.4573E-05	0	1.62177E-05
Mopeds	0.058648842	8.86036E-05	0	0.000001
Motorcycles	0.091151185	9.81094E-05	0	0.000002
Light Duty Vehicles	0.240667256	2.54642E-06	0	6.58186E-06

Heavy Duty Trucks	0.606961396	2.23824E-05	0	1.91399E-05

Vehicles fueled by fuel mix, on specific route (urban, rural, highway).

Emissions in kg gas/km.

Sector	CO_2 URBAN (kg/km) 2014	CH_4 URBAN (kg/km), 2014	-------------	N_2O URBAN (kg/km), 2014
Passenger Cars	0.230838922	4.16271E-05	0	1.41969E-05
Buses	1.049368977	0.000247518	0	1.5562E-05
Mopeds	0.058648842	8.86036E-05	0	0.000001
Motorcycles	0.091956257	0.000110712	0	0.000002
Light Duty Vehicles	0.326980449	6.6144E-06	0	1.3888E-05
Heavy Duty Trucks	0.882150551	6.41418E-05	0	1.7825E-05

Sector	CO_2 RURAL (kg/km) 2014	CH_4 RURAL (kg/km), 2014	-------------	N_2O RURAL (kg/km), 2014
Passenger Cars	0.136670788	3.18276E-06	0	2.43614E-06
Buses	0.666443495	4.75326E-05	0	1.8256E-05
Mopeds	0.058648842	8.86036E-05	0	0.000001
Motorcycles	0.086350795	7.93201E-05	0	0.000002
Light Duty Vehicles	0.182785528	1.34006E-06	0	4.12563E-06
Heavy Duty Trucks	0.566306534	2.41908E-05	0	2.02244E-05

Sector	CO_2 HIGHWAY (kg/km) 2014	CH_4 HIGHWAY (kg/km), 2014	-------------	N_2O HIGHWAY (kg/km), 2014
Passenger Cars	0.160174445	3.46502E-06	0	2.81275E-06
Buses	0.558948713	2.68246E-05	0	1.54406E-05
Mopeds P	Doesn't exist	Doesn't exist	Doesn't exist	Doesn't exist
Motorcycles	0.115654279	7.84075E-05	0	0.000002
Light Duty Vehicles	0.292403282	7.78936E-07	0	4.20386E-06
Heavy Duty Trucks	0.579342977	1.25289E-05	0	1.86677E-05

Vehicles fueled by specific fuel on any route.

Emissions in kg gas/km.

Sector		CO_2 TOTALE (kg/km) 2014	CH_4 TOTALE (kg/km), 2014	-------------	N_2O TOTALE (kg/km), 2014
Passenger Cars	Gasoline	0.177937716	2.49379E-05	0	2.79739E-06
Passenger Cars	Diesel	0.151704844	5.7502E-07	0	6.79173E-06
Passenger Cars	LPG	0.188162252	2.297E-05	0	3.08112E-06
Passenger Cars	E85*	0.272683062	1.76085E-05	0	1.31784E-06
Passenger Cars	Natural Gas	0.156776502	3.16503E-05	0	9.87575E-07
Passenger Cars	Hybrid Gasoline	0.106364083	0	0	2.3554E-07
Buses	Diesel	0.687182255	3.59579E-05	0	1.69157E-05
Buses	Natural Gas	1.068008934	0.001214194	0	0
Mopeds P	Gasoline	Already included			
Motorcycles P	Gasoline	Already included			
Light Duty Vehicles	Gasoline	0.283358077	2.60536E-05	0	1.22515E-05
Light Duty Vehicles	Diesel	0.238993264	1.62466E-06	0	6.35955E-06
Heavy Duty Trucks	Gasoline	0.487851445	0.000108	0	0.000006
Heavy Duty Trucks	Diesel	0.606967813	2.23778E-05	0	1.91406E-05

** 85% ethanol + 15% gasoline*

Vehicles fueled by specific fuel on specific route (urban, rural, highway).

Emissions in kg gas/km.

Sector		CO_2 URBAN (kg/km) 2014	CH_4 URBAN (kg/km), 2014	-------------	N_2O URBAN (kg/km), 2014
Passenger Cars	Gasoline	0.256947604	6.86074E-05	0	6.65483E-06
Passenger Cars	Diesel	0.202976043	3.27627E-06	0	2.65557E-05
Passenger Cars	LPG	0.237422641	7.09166E-05	0	7.05529E-06
Passenger Cars	E85*	0.385672468	5.0427E-05	0	3.52633E-06
Passenger Cars	Natural Gas	0.198373767	3.26976E-05	0	2.54997E-06
Passenger Cars	Hybrid Gasoline	0.101947195	0	0	2.24592E-07
Buses	Diesel	1.039755894	6.76638E-05	0	1.84574E-05
Buses	Natural Gas	1.101037082	0.001214194	0	0
Mopeds	Gasoline	0.058648842	8.86036E-05	0	0.000001
Motorcycles	Gasoline	0.091956257	0.000110712	0	0.000002
Light Duty Vehicles	Gasoline	0.496454897	8.02892E-05	0	3.28318E-05
Light Duty Vehicles	Diesel	0.320335017	3.72547E-06	0	1.31452E-05
Heavy Duty Trucks	Gasoline	0.61281243	0.00014	0	0.000006
Heavy Duty Trucks	Diesel	0.882177166	6.41343E-05	0	1.78262E-05

** 85% ethanol + 15% gasoline*

Sector		CO_2 RURAL (kg/km) 2014	CH_4 RURAL (kg/km), 2014	-------------	N_2O RURAL (kg/km), 2014
Passenger Cars	Gasoline	0.139265492	7.43667E-06	0	1.34843E-06
Passenger Cars	Diesel	0.135500253	1.28665E-07	0	3.14889E-06
Passenger Cars	LPG	0.139049113	3.2923E-06	0	1.51355E-06
Passenger Cars	E85*	0.220160474	2.68986E-06	0	2.25669E-07
Passenger Cars	Natural Gas	0.131616564	2.55759E-05	0	3.75908E-07
Passenger Cars	Hybrid Gasoline	0.098696807	0	0	2.67289E-07
Buses	Diesel	0.664798813	2.91379E-05	0	1.85439E-05
Buses	Natural Gas	0.770755603	0.001214194	0	0
Mopeds	Gasoline	0.058648842	8.86036E-05	0	0.000001
Motorcycles	Gasoline	0.086350795	7.93201E-05	0	0.000002
Light Duty Vehicles	Gasoline	0.21329186	8.73718E-06	0	5.87987E-06
Light Duty Vehicles	Diesel	0.181589314	1.05E-06	0	4.05684E-06
Heavy Duty Trucks	Gasoline	0.452672223	0.00011	0	0.000006
Heavy Duty Trucks	Diesel	0.566316671	2.41831E-05	0	2.02257E-05

** 85% ethanol + 15% gasoline*

Sector		CO_2 HIGHWAY (kg/km) 2014	CH_4 HIGHWAY (kg/km), 2014	-------------	N_2O HIGHWAY (kg/km), 2014
Passenger Cars	Gasoline	0.157635784	6.78596E-06	0	1.02651E-06
Passenger Cars	Diesel	0.156736333	1.09364E-07	0	4.04063E-06
Passenger Cars	LPG	0.204800653	1.26046E-06	0	1.19704E-06
Passenger Cars	E85*	0.232034431	0.00000508	0	6.33545E-07
Passenger Cars	Natural Gas	0.149138818	3.87024E-05	0	2.40733E-07
Passenger Cars	Hybrid Gasoline	0.125863446	0	0	1.91528E-07
Buses	Diesel	0.558948713	2.68246E-05	0	1.54406E-05
Buses	Natural Gas	0	0	0	0
Mopeds	Gasoline	0	0	0	0
Motorcycles	Gasoline	0.115654279	7.84075E-05	0	0.000002
Light Duty Vehicles	Gasoline	0.210132684	5.87904E-06	0	4.04797E-06
Light Duty Vehicles	Diesel	0.295629276	5.78951E-07	0	4.20997E-06
Heavy Duty Trucks	Gasoline	0.470418124	0.00007	0	0.000006
Heavy Duty Trucks	Diesel	0.579345198	1.25278E-05	0	1.86679E-05

** 85% ethanol + 15% gasoline*