# CYPRUS

**National Greenhouse Gases Inventory Report 1990 – 2015**
**2017 Submission**

under the United Nations Convention on Climate Change
and the Kyoto Protocol


**Department of Environment**
**Ministry of Agriculture,**
**Rural Development and Environment**



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# Preface

The previous submission (NIR2016 v.1.4 (CYP_2016_12_Inventory)) was made following the recommendations in the report "Potential Problems formulated in the course of the review of the 2015 and 2016 annual submissions of Cyprus and of the report to facilitate the calculation of the assigned amount for the second commitment period" prepared by the ERT during the in-country review for the 2016 submission. The 2016 submission (NIR2016 v.1.5 (CYP_2016_14_Inventory)) includes additionally two pending issues identified by ERT in response to the explanations/documents provided by Cyprus to the Saturday Paper issues. The changes to the estimates of emissions compared to the submission (NIR2016 v.1.3 (CYP_2016_12_Inventory) submitted 15th of June 2016) are presented in the Table below.

The chapter on Minimisation of Adverse Impacts under Article 3, paragraph 14 that was submitted during the in-country review has been included in the report.

| **Sector** | **Recommendation** | **Implemented** | **Change in report** | **Change in CRF** |
|---|---|---|---|---|
| Industrial Processes and product Use, Cement Production (2.A.1) | Use the emissions data from the National Allocation Plan for 1997–2004 to calculate emissions in the period 1997–2004 and the annual IEF for 1997 to calculate emissions in the period 1990–1996, as it was already recognized by the Party itself and by the previous ERT in the ARR 2013, as being more realistic and more consistent for being used for the 1990–1996 inventory years. | ✓ | ✓ | x |
| | Provide revised estimates for the category 2.A.1 Cement production for the entire time-series. | ✓ | ✓ | ✓ |
| Industrial Processes and product Use, Other Processes Uses of Carbonates (ceramics production) (2.A.4.a) | Use the 2001 IEF (the earliest available IEF value coming from the ETS verified emissions report) for calculating the CO2 emissions from ceramic production for the period 1990-2000; | ✓ | ✓ | x |
| | Provide revised estimates for the category 2.A.4.a Other Processes Uses of Carbonates (ceramics production) for the entire time-series | ✓ | ✓ | ✓ |
| Industrial Processes and product Use, Other Processes Uses of Carbonates (Other uses of soda ash) (2.A.4.b) | Collect the AD on soda ash (Common Nomenclature code 2836 20 00) imports and exports from the Custom Service of Cyprus and identify the soda ash consumption in the country; | ✓ | ✓ | x |
| | Provide estimates of CO2 emissions from category 2.A.4.b Other Processes Uses of Carbonates (other uses of soda ash) for the entire time-series rounded at the level of 4 figures after decimal point (ERT latest comment). | ✓ | ✓ | ✓ |
| Industrial Processes and product Use, Paraffin wax use (2.D.2) | Collect the AD on paraffin waxes (Common Nomenclature code 2712 20) import, export and consumption for the period 2004-2014; | ✓ | ✓ | x |
| | Use one of the splicing techniques (i.e., overlap and/or surrogate data) available in the 2006 IPCC Guidelines to fill the gap in the AD for the period 1990-2003 | Not necessary – data was obtained for 1990-2014 | | |
| | Provide estimates of CO2 emissions from category 2.D.2 Paraffin wax use for the entire time-series based on one of two methodologies available in the 2006 IPCC Guidelines (Volume | ✓ | ✓ | ✓ |

| Sector | Recommendation | Implemented | Change in report | Change in CRF |
|---|---|---|---|---|
| | 3, Chapter 5.3 Paraffin Wax Use), based on the amount of paraffin waxes consumed in a country provided in energy units (TJ), and default, or country-specific emission factors. | | | |
| Industrial Processes and product Use, Refrigeration and air conditioning (2.F.1) | If country-specific information is still not available, recalculate the HFCs emissions from category 2.F.1 Refrigeration and air conditioning in 1995, by using the annual per capita emissions average value of three countries (Spain, Italy and Greece) (4.08 kg CO2 eq/capita), instead of average value of four countries (Malta, Spain, Italy and Greece) (13.60 kg CO2 eq/capita); | ✓ | ✓ | x |
| | Alternatively, check if in the latest available (2016) inventory submission of Malta, the value of per capita HFCs emissions for category 2.F.1 Refrigeration and air conditioning in 1995 year is still outstandingly high, if not, use the average value of four countries (Malta, Spain, Italy and Greece) for that particular year, as reported in the Section 4.2.2 of the NIR of 2016 submission; | Not implemented – first option was applied | | |
| | Provide revised estimates of HFCs emissions from category 2.F.1 Refrigeration and air conditioning for the entire time series. | ✓ | ✓ | ✓ |
| Industrial Processes and product Use, Aerosols (2.F.4) | If country-specific information is still not available, recalculate the HFCs emissions from category 2.F.4 Aerosols (MDI) using the annual per capita emissions average value of the 4 countries (Malta, Spain, Italy and Greece) from their latest available (2016) inventory submission, for the entire time series, as reported in the Section 4.2.2 of the NIR of 2016 submission; | Partly | ✓ | x |
| | Provide revised estimates of HFCs emissions from category 2.F.4 Aerosols for the entire time series. | ✓ | ✓ | ✓ |
| Industrial Processes and product Use, Electrical equipment (2.G.1) | If country-specific information is still not available, recalculate the SF6 emissions from category 2.G.1Electrical equipment using the average value of per capita SF6 emissions of Malta for 1995, 2003, 2011, 2012 and 2013 from the latest available 2016 inventory submission; | Malta excluded from the calculations for all years | ✓ | x |
| | Report the annual per capita emissions average of Cyprus based on corresponding average values of 4 countries (Malta, Spain, Italy and Greece), as per information reported in section 4.5.2 of the NIR; | | ✓ | x |
| | Provide revised estimates of SF6 emissions for the entire time-series. | | x | x |
| 3.A Enteric fermentation<br>3.B Manure management<br>3.D. agricultural soils | Extract the data for horses, mules and asses from the 1985, 1994 and 2010 livestock census reports. | ✓ | ✓ | x |
| | Use the extracted data to do linear interpolation to gap-fill the entire time series. | ✓ | ✓ | ✓ |
| | Recalculate the emissions for the base year and the entire time-series. | ✓ | ✓ | ✓ |
| | Conduct category-specific documentation of the recalculations indicating the percentage differences between previous and latest data and the reason for recalculation. | ✓ | ✓ | x |
| | Identify the possible need to recalculate other estimates (e.g. N2O emissions from agricultural soils) as a consequence of using new data for horses, mules and assess. | ✓ | ✓ | ✓ |
| 5.A - Solid Waste | The ERT recommends that activity data for | ✓ | ✓ | ✓ |

| Sector | Recommendation | Implemented | Change in report | Change in CRF |
|---|---|---|---|---|
| Disposal | waste management system be reported in a segregated manner, taking into account the types of landfill operation (managed shallow / managed deep and unmanaged) over time as well as their respective status of operation (active or inactive). An adequate assessment of the volume of waste handled to each type of landfill has also to be presented in a transparent manner. For consistency, the data presented in the NIR shall adequately represent the information in CRF, therefore it would be appropriate that municipal solid waste disposal activity on landfill be adequately segregated into the appropriate categories. The ERT recommends that Cyprus use the country specific data for solid waste disposal (already presented in the NIR) and apply the available approach to calculate national emissions of the sector. If country-specific data is not available for key parameters, the ERT recommends that the Party estimate emissions using IPCC FOD method with default parameters and country-specific AD. | | | |
| 5.D - Wastewater treatment and discharge | The ERT recommends that Cyprus further enhance the use of country-specific data to support the choice of MCFs in order to better represent the types of activities that have been implemented by the industrial sector to process and dispose all the wastewater generated, as well as in domestic municipal wastewater treatment plants. In that sense, the ERT recommends that Cyprus implement a higher tier approach and estimate emissions based on country-specific activity data and emission factors. | Partly | ✓ | ✓ |
| 4.A Forest Land | Develop its own estimates for the annual biomass growth to be applied to coniferous and broadleaf stands or plantations, taking into account existing country-specific forest data, and/or expert judgement from the Department of Forests, and/or data from other countries with similar characteristics (climate, soil) that can support the default data presently used, as appropriate. | ✓ | ✓ | ✓ |
| 4.A Forest Land | In case Cyprus does not have country specific data to provide estimates for (2) and (3) to replace the default values used, the ERT recommends that the corresponding default values be changed to the default values in the IPCC 2006 Guidelines equal to 0.28 and 0.47, respectively. | ✓ | ✓ | ✓ |
| 4. LULUCF | Provide estimates for deforestation in 1990 using the CORINE land-cover transition matrices for 2000-2006 and 2006-2012 and applies extrapolations and interpolations, as appropriate. In case that country-specific data is not available, Cyprus can use deforestation data contained in the Forest Resources Assessment – FRA, published by FAO. | Partly | x | x |
| 4. LULUCF | Complete the CRF tables 4(I) to 4(V) associated with deforestation, based on actual data estimates or expert judgement. | x | x | x |
| KP LULUCF | Improve the completeness of the LULUCF inventory, so that the ERT is provided with concrete elements to justify that LULUCF in the base year was a source or not. | x | x | x |

| Sector | Recommendation | Implemented | Change in report | Change in CRF |
|---|---|---|---|---|
| KP LULUCF | The ERT recommends that Cyprus provide revised estimates for the different sources of losses (wood removal, fuelwood removal, and disturbances) by using equations 2.12, 2.13 and 2.14 in the 2006 IPCC guidelines and country specific or default data (or expert judgment), as appropriate, in the suitable KP LULUCF CRF tables. The ERT notes the importance to avoid double counting, including, *inter alia*: Harvest of wood and fuelwood: to avoid this, the Party should check how fuelwood data are represented in the country and use the equation that is most appropriate for national conditions. | ✓ Partly included in LULUCF chapter | ✓ included in LULUCF chapter | ✓ included in LULUCF chapter |
| KP LULUCF | Forest fires: in case the $CO_2$ emissions from carbon stock change are reported in tables 4 A-F, then they should not be reported in table 4(V). In case of salvage logging, the ERT recommends that Cyprus indicate how the biomass in the affected areas is being treated | Partly salvage logging was subtracted from roundwood and fuelwood removals | ✓ | ✓ |
| KP LULUCF | The ERT recommends that Cyprus apply the same values of root-to-shoot and carbon fraction of dry matter in the calculation of the emissions as used to estimate the annual removals from growth (biomass gain). | ✓ | x | x |
| KP LULUCF | Provide revised estimates of the background level and the margin based on the following steps:<br>(1) use of the greenhouse gas emissions estimates provided in Table 4(V) (biomass burning) for at least the period from 1990 to 2009, inclusive, ensuring that the emissions have been estimated using the IPCC 2006 Guidelines and that they refer only to forest management areas;<br>(2) clear indication of the methodology used to estimate these emissions, including of the parameters used and respective sources;<br>(3) if not using the default method, a clear description of the method used and information on how it avoids the expectation of net credits and net debits;<br>(4) provide the ERT with the worksheets that include the calculation of the background level and margin.<br><br>For the identification of the forest management areas affected by fires, the ERT recommends that Cyprus apply, as a proxy, and in consultation with the experts from the Forest Department, the following approach:<br>(1) Estimate, for each year, the area of forest land under afforestation and reforestation using, for example, the data reported to the FAO Forest Resources Assessment - FRA;<br>(2) Exclude the area of afforestation and reforestation calculated in (1) from the total area reported under forest land;<br>(3) Divide the result in (2) by the total area under forest land;<br>(4) Multiply the ratio in (3) by the area affected by fires. | Partly | ✓ | ✓ |
| KP LULUCF | The 2013 KP Supplement provides two reporting methods in Chapter 2, section 2.2.2, | Partly | x | x |

| **Sector** | **Recommendation** | **Implemented** | **Change in report** | **Change in CRF** |
|---|---|---|---|---|
| | page 2.15 (*Reporting Methods for Lands Subject to Article 3.3 and Article 3.4 activities*) to address information on geographical location of boundaries of the areas:<br>• The first one delineates the geographic boundaries that contain multiple land units subject to Article 3.3 or 3.4 activities that can be identified using sampling techniques using remote sensing or ground-based data or administrative statistics;<br>• The second one is based on spatially explicit and complete geographical identification of all land units subject to Article 3 paragraph 3 and elected paragraph 4 activities.<br><br>The ERT recommends that Cyprus apply one of these methods that are presented in detail in section 2.2.2 (Reporting Methods for Lands Subject to Article 3.3 and Article 3.4 activities) of the 2013 KP Supplement. Considering the size of the country, the ERT recommends that Cyprus explore the possibility to apply reporting method 2, using satellite imagery of adequate spatial resolution to the size of the forest stands under ARD and FM. Consultation with experts from the Forest Department is essential to define the best type of remotely sensed data to be used. | | | |

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# Executive Summary

**Background information**

The first National Inventory Report for Cyprus was prepared in 2001 and covered the period 1990-1998. The inventory was prepared in the framework of the project "Strategic Plan for the Limitation of Greenhouse Gas Emissions in Cyprus".

The first Inventory report submitted by Cyprus to the European Commission for the purposes of Decision no. 280/2004/EC[1], was in 2006 for the period 1990-2004. Cyprus at the time was a non-Annex I party and therefore had no obligation to submit annual inventories to the UNFCCC secretariat.

The first submission of a National Inventory Report to the UNFCCC secretariat as an Annex I party was made in April 2013.

**Institutional, legal and procedural arrangements**

The Department of Environment of the Ministry of Agriculture, Rural Development and Environment (MARDE) is the single national entity with responsibility for preparing and submitting the National Inventory to the UNFCCC and for managing the supporting processes and procedures.

The institutional arrangements for the preparation of the inventory include: formal agreements supporting data collection and estimate development; a quality management plan, including an improvement plan; the ability to identify key categories and generate quantitative uncertainty analysis; a process for performing recalculations due to improvements; procedures for official approval; and a working archive system to facilitate third-party review.

The MARDE is the governmental body responsible for the co-ordination of all involved ministries, as well as any relevant public or private organisations, in relation to the implementation of the provisions of the national and European legislation associated with climate change. In this context, the MARDE has the responsibility for the planning, preparation, management, compilation of the national greenhouse gas emissions (GHG) inventory report[2].

No legal framework is available that defines the roles, responsibilities and the co-operation between the MARDE and contact points of the involved ministries and agencies.

However, in order to establish the appropriate mechanism a Proposal to the Council of Ministers has been prepared. Within this proposal the appropriate Governance System will be established. It is expected that this Proposal will be approved soon (no later than June 2017).

[1] Decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol. Official Journal of the European Union 1.9.2004 L 49/1-8

[2]Contact person: Dr Nicoletta Kythreotou, Address: Department of Environment, 1498 Nicosia, Cyprus, tel.: +357 22 408947, e-mail: nkythreotou@environment.moa.gov.cy

It is noted that having the approval from the Council of Ministers for the Governance System, there is no need for any additional legal procedures.

**GHG inventory preparation**

The compilation of the inventory starts with the collection of the ETS data in June before the submission deadline (year X-1). After the first comments on the inventory are received by the European Commission and the UNFCCC for the submission of the previous year (approximately June), the necessary changes are made to the calculation sheets by the inventory compiler. Other data is made available from other governmental departments starting in the month of November before the submission deadline (year X-1). In December the final National Inventory Report for air pollutants under Directive 2001/81/EC, prepared by the Department of Labour Inspection (DLI) of the Ministry of Labour, Welfare and Social Insurance, is available and communicated to the inventory compiler.

Data reliability checks

Data for some activities is available from multiple sources, and in cases where differences exist, they are discussed with the dataset compilers. In several cases the data providers may confirm the error and correct the dataset appropriately.

Quality control/ quality assurance

When the calculations have been completed the MS Excel files used for the data collection and the calculations are sent to Ms Niki Papaki (Environment Technician, tel. +357 22408946, email npapaki@environment.moa.gov.cy) and Mr Giorgos Ioannou (Statistics Officer, tel. +357 22602171, email geioannou@cystat.mof.gov.cy) to check the data collected and the calculations. In case any mistakes are identified, these are corrected accordingly by the inventory compiler.

Compilation of inventory report

The compilation of the report starts when the emissions are finalised and the CRF tables are available. Once the final draft is available, the report is sent to Ms Niki Papaki (Environment Technician, tel. +357 22408946, email npapaki@environment.moa.gov.cy), Mr Giorgos Ioannou (Statistics Officer, tel. +357 22602171, email geioannou@cystat.mof.gov.cy) and all the data providers for comments. The comments are taken into consideration for the finalisation of the report.

Approval and submission of report

When the report is finalised, it is reviewed by Dr Theodoulos Mesimeris, Head of climate Action Unit and thereafter to the Director of the Department of Environment Mr Costas Hadjipanayiotou (chadjipanayiotou@environment.moa.gov.cy, tel. no.+357 22 408900) for the final approval. The inventory accompanied by the inventory report is submitted to the European Commission annually by 15 January.

Inventory preparation team

The calculations, report preparation, and overall management of the compilation of the inventory (inventory compiler), is the responsibility of Dr Nicoletta Kythreotou, Environment

Officer at the Department of Environment. Dr Kythreotou holds a BSc in Environmental Science, an MSc in Environmental Engineering, and a PhD in Mechanical Engineering. Nicoletta has been preparing Cyprus' NIR since 2006.

The final assessment of the national inventory is performed by Dr Theodoulos Mesimeris, who is a Senior Environment Officer and the Head of Climate Action Unit at the Department of Environment. Dr Mesimeris has been an Officer at the Department of Environment since 2002 and has been dealing with climate change since then. The academic background of Dr Mesimeris includes an MEng in Chemical Engineering, an MSc in Environmental Management and a PhD in Chemical Engineering.

Dr Mesimeris and Dr Kythreotou are the national contact points of the UNFCCC and the DG Climate Action of the European Commission.

Ms Melina Menelaou (BA Biological Science with emphasis on ecology) is responsible for the Land Use issues.

**Data collection, processing and storage**

Data from all the involved parties come in MS Excel spreadsheets. The main database maintained by the inventory compiler is also in the form of MS Excel spreadsheets. The collected data is, then, transferred to the main database of the inventory compiler. No special software is used or applied for processing or storing the data used in the inventory.

The inventory compiler has one MS Excel spreadsheet containing all the data collected and one spreadsheet containing the calculations performed for the estimation of the GHG emissions. Separate spreadsheets are used for the calculation of emissions from Solid Waste Disposal (4A) and Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning (2F1), following the MS Excel spreadsheets provided in the 2006 IPCC Guidelines[3].

**Brief general description of methodologies and data sources used**

<u>Emission factors</u>

The estimation of GHG emissions / removals per source / sink category is predominately based on the methods described in the revised 2006 IPCC Guidelines. The emission factors used derive from the 2006 IPCC Guidelines and special attention was given to selecting the emission factors that are most representative of practices and conditions in Cyprus. Furthermore, emission factors were obtained from plant-specific information contained in the EU ETS reports. For 2F and 2G, activity data was not available to estimate the emissions using the IPCC methodologies, therefore: (a) the emissions from sectors 2F1, 2F2, 2F3 and 2F4 were estimated using the implied emission factor per capita from the average of Greece, Italy, Malta and Spain; (b) the emissions from sectors 2G1 and 2G3, the implied emission factor per capita from Greece was used. Details on the methods applied for the calculation of emissions / removals are given in the following.

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

The key categories analysis (see Section 1.5) constitutes the basic tool for methodological choice and for the prioritisation of the necessary improvements. In addition, the results of the various review processes (at a national and EU level) represent key input information for the identification of possible improvements. It should be mentioned however, that data availability, as well as availability of resources (both human and financial) also have to be considered.

- Data availability could become a significant restrictive parameter when selecting an estimation methodology. The accuracy and the consistency of the emissions estimated depend on the availability of the data needed for the correct application of the selected methodology.
- Availability of resources also needs to be considered as the data availability and collection is essential in applying a detailed methodology for a source category should not affect the completeness and the on-time preparation of an inventory submission.

Activity data

Data collection, processing, and checks constitute the activity with the longest duration in the annual inventory cycle. The duration of this activity is related to the amount of the required data and the number of the entities involved. The on-time and successful completion of this activity has a major effect on the timely preparation and submission of the inventory as well as on its accuracy, completeness, and consistency.

Data from international organisations and databases are supplementary to the data collected from the above data providers. It should be noted that information and data collected (through questionnaires developed according to the guidelines described in the Commission Decision 2004/156/EC) in the framework of the formulation of the National Allocation Plan (NAP) for the period 2005-2007, according to the Directive 2003/87/EC (and its transposition to the national Law, 110(I)/2011) along with the data from the verified reports from installations under the EU ETS for years 2005-2013 constituted a significant source of information and an additional quality control check.

**General assessment of the completeness**

In the present inventory report, estimates of GHG emissions in Cyprus for the years 1990-2015 are presented. Emissions estimates included in the CRF tables submitted and discussed in the present report, cover the areas of the Republic of Cyprus under the effective control of the Government of the Republic of Cyprus. All major sources are reported including emissions estimates for indirect greenhouse gases and $SO_2$.

Completeness in the present inventory submission will be further discussed in the relevant chapters.

Further details on deficiencies are provided in the appropriate chapter. A national inventory improvement plan is available and implemented.

**Description and interpretation of emission trends for aggregated greenhouse gas emissions**

The GHG emissions in 2015 were 8262 Gg CO2 eq. including LULUCF and 8431 Gg CO2 eq. excluding LULUCF. Between 1990 and 2015, the total national emissions excluding LULUCF increased by 50%.

Carbon dioxide emissions accounted for 81% of total GHG emissions in 2015 without LULUCF and increased by 48% from 1990. Methane emissions accounted for 10% of total GHG emissions in 2015 without LULUCF and increased by 27% since 1990, while nitrous oxide emissions accounted for 3.9% of the total GHG emissions in 2015 without LULUCF and increased by 8% since 1990. Finally, F-gases and SF6 emissions accounted for 4% of total GHG emissions in 2015.

The emissions by gas and sector are presented in Table E1. The GHG emissions in 2015 were 8262 Gg CO2 eq. including LULUCF and 8431 Gg CO2 eq. excluding LULUCF. Between 1990 and 2015, the total national emissions excluding LULUCF increased by 50%.

The emissions by gas and sector are presented in Table E11. The summary tables for each year of the inventory by gas and source as these were generated by CRF reporter v6.0.1.1 are presented in Annex II. Total emissions by sector are also presented in Figure E1.

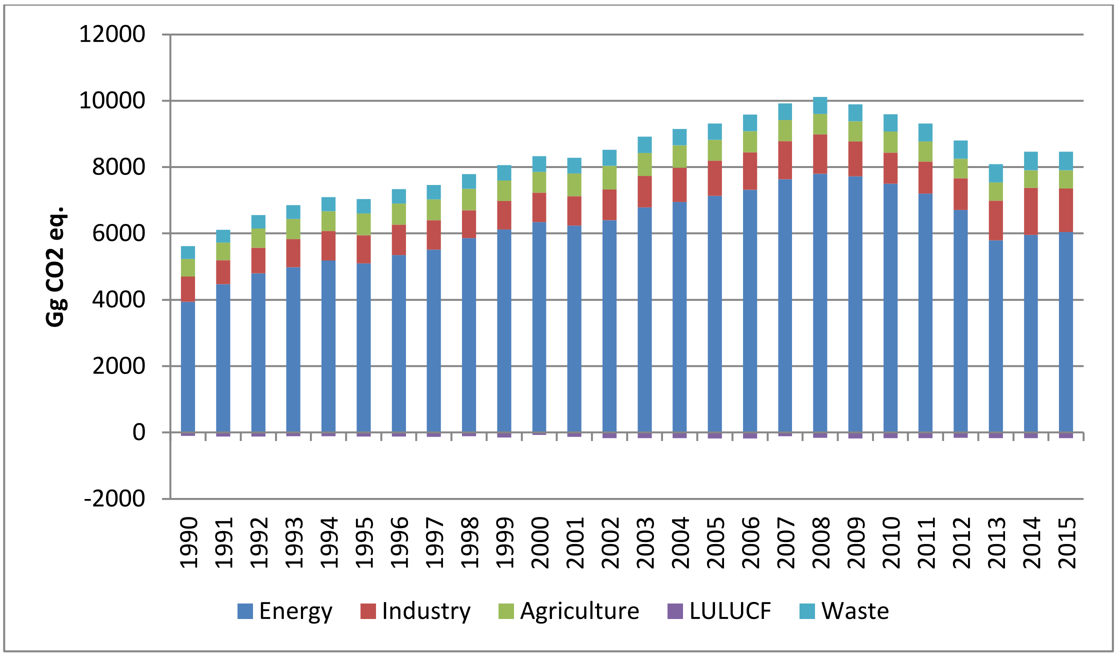


**Figure E1. Total GHG emissions in Cyprus for the period 1990-2015, Gg CO2 eq.**

**Table E1. Total GHG emissions in Cyprus with and without LULUCF for the period 1990-2015, Gg CO2 eq.**

| Gg CO2 eq. | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| CO2 emissions w/o net CO2 from LULUCF | 4620.99 | 5848.04 | 7095.92 | 7961.97 | 8004.90 | 6487.25 | 6878.37 | 6859.65 |
| CO2 emissions w/ net CO2 from LULUCF | 4520.60 | 5721.42 | 7012.79 | 7782.49 | 7837.64 | 6314.71 | 6704.74 | 6691.40 |
| CH4 emissions w/o CH4 from LULUCF | 691.71 | 794.92 | 842.54 | 883.32 | 914.44 | 873.33 | 868.01 | 876.72 |
| CH4 emissions w/ | 691.75 | 795.25 | 848.24 | 883.47 | 915.18 | 873.55 | 868.25 | 876.81 |

| Gg CO2 eq. | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| CH4 from LULUCF | | | | | | | | |
| N2O emissions w/o N2O from LULUCF | 308.92 | 397.41 | 361.82 | 357.80 | 374.24 | 324.04 | 317.69 | 334.76 |
| N2O emissions w/ N2O from LULUCF | 308.95 | 397.62 | 365.59 | 357.91 | 374.73 | 324.19 | 317.85 | 334.82 |
| HFCs | NO,NE | 1.64 | 25.20 | 103.28 | 280.66 | 363.98 | 359.31 | 359.31 |
| PFCs | | | | | | | | |
| SF6 | 0.03 | 0.06 | 0.08 | 0.12 | 0.15 | 0.15 | 0.15 | 0.15 |
| NF3 | | | | | | | | |
| **Total (w/o LULUCF)** | **5621.64** | **7042.07** | **8325.55** | **9306.49** | **9574.70** | **8048.74** | **8423.53** | **8430.58** |
| **Total (w/ LULUCF)** | **5521.32** | **6915.99** | **8251.89** | **9127.27** | **9408.38** | **7876.57** | **8250.30** | **8262.48** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. Energy | 3940.66 | 5093.38 | 6344.87 | 7128.69 | 7494.87 | 5788.58 | 5959.03 | 6039.82 |
| 2. Industrial Processes | 764.91 | 855.64 | 888.38 | 1067.86 | 942.06 | 1199.30 | 1414.12 | 1316.53 |
| 3. Agriculture | 531.02 | 666.42 | 632.31 | 624.16 | 637.48 | 550.18 | 537.75 | 559.30 |
| 4. LULUCF | -100.32 | -126.08 | -73.66 | -179.22 | -166.03 | -172.17 | -173.22 | -168.11 |
| 5. Waste | 385.06 | 426.63 | 460.00 | 485.78 | 499.98 | 510.68 | 512.62 | 514.94 |
| 6. Other | | | | | | | | |
| **Total (w/o LULUCF)** | **5621.64** | **7042.07** | **8325.55** | **9306.49** | **9574.70** | **8048.74** | **8423.53** | **8430.58** |
| **Total (w/ LULUCF)** | **5521.32** | **6915.99** | **8251.89** | **9127.27** | **9408.38** | **7876.57** | **8250.30** | **8262.48** |

***Description and interpretation of emission trends by category***

GHG emissions trends by sector for the period 1990 - 2015 are presented in Table E2.

**Table E2. Total national GHG emissions by sector 1990-2015**

| | **Energy** | **Industry** | **Agriculture** | **LULUCF** | **Waste** | **Total (w/o LULUCF)** | **Total (w/ LULUCF)** |
|---|---|---|---|---|---|---|---|
| **1990** | 3940.7 | 764.9 | 531.02 | -100.3 | 385.06 | 5621.64 | 5521.32 |
| **1991** | 4470.9 | 724.5 | 533.30 | -119.1 | 389.69 | 6118.43 | 5999.29 |
| **1992** | 4798.1 | 776.5 | 582.38 | -126.4 | 399.08 | 6556.09 | 6429.70 |
| **1993** | 4977.6 | 849.7 | 620.22 | -110.4 | 407.78 | 6855.26 | 6744.82 |
| **1994** | 5187.0 | 887.0 | 606.30 | -113.7 | 418.97 | 7099.35 | 6985.64 |
| **1995** | 5093.4 | 855.6 | 666.42 | -126.1 | 426.63 | 7042.07 | 6915.99 |
| **1996** | 5346.0 | 915.5 | 645.37 | -126.4 | 430.91 | 7337.71 | 7211.28 |
| **1997** | 5511.7 | 885.2 | 631.46 | -130.6 | 438.65 | 7467.01 | 7336.41 |
| **1998** | 5854.8 | 844.5 | 651.08 | -109.6 | 444.92 | 7795.25 | 7685.60 |
| **1999** | 6117.8 | 857.7 | 628.66 | -147.7 | 452.02 | 8056.16 | 7908.49 |
| **2000** | 6344.9 | 888.4 | 632.31 | -73.7 | 460.00 | 8325.55 | 8251.89 |
| **2001** | 6236.7 | 885.2 | 690.97 | -134.9 | 468.54 | 8281.49 | 8146.61 |
| **2002** | 6395.4 | 930.4 | 717.35 | -167.8 | 474.84 | 8517.95 | 8350.11 |
| **2003** | 6785.6 | 946.4 | 703.55 | -171.4 | 476.42 | 8912.04 | 8740.66 |
| **2004** | 6950.0 | 1032.4 | 681.98 | -171.6 | 478.97 | 9143.28 | 8971.67 |
| **2005** | 7128.7 | 1067.9 | 624.16 | -179.2 | 485.78 | 9306.49 | 9127.27 |
| **2006** | 7311.5 | 1132.0 | 647.41 | -179.6 | 480.09 | 9571.04 | 9391.46 |
| **2007** | 7632.9 | 1150.4 | 643.89 | -111.7 | 482.06 | 9909.29 | 9797.57 |
| **2008** | 7799.6 | 1185.3 | 616.78 | -160.5 | 489.88 | 10091.56 | 9931.03 |

| | Energy | Industry | Agriculture | LULUCF | Waste | Total (w/o LULUCF) | Total (w/ LULUCF) |
|---|---|---|---|---|---|---|---|
| **2009** | 7724.7 | 1047.0 | 611.74 | -177.7 | 488.68 | 9872.18 | 9694.45 |
| **2010** | 7494.9 | 942.1 | 637.48 | -166.0 | 499.98 | 9574.40 | 9408.37 |
| **2011** | 7202.0 | 958.5 | 619.21 | -168.9 | 495.55 | 9275.27 | 9106.40 |
| **2012** | 6709.1 | 957.2 | 593.81 | -162.9 | 508.13 | 8768.17 | 8605.24 |
| **2013** | 5788.6 | 1199.3 | 550.18 | -172.2 | 510.68 | 8048.74 | 7876.57 |
| **2014** | 5959.0 | 1414.1 | 537.75 | -173.2 | 512.62 | 8423.53 | 8250.30 |
| **2015** | 6039.8 | 1316.5 | 559.30 | -168.1 | 514.94 | 8430.58 | 8262.48 |
| ***Change 1990-2015*** | ***53.3%*** | ***72.1%*** | ***5.33%*** | ***67.6%*** | ***33.73%*** | ***49.97%*** | ***49.65%*** |

Energy

The energy sector in Cyprus relies on fossil fuel combustion for meeting the bulk of energy requirements. Final consumption in 2015 amounted to approximately 80 PJ compared to 78 PJ in 2014 (2.6% increase). 97.77% of the consumption in 2015 was from liquid fuels, 0.19% from solid fuels, 0.04% from other fossil fuels and 2% from biomass. In comparison to 1990, total fuel consumption in 2015 including biomass increased by 54%. Natural gas is not available in Cyprus.

After robust growth rates in the 1980s (average annual growth was 6.1%), economic performance in the 1990s was mixed: real GDP growth was 9.7% in 1992, 1.7% in 1993, 6.0% in 1994, 6.0% in 1995, 1.9% in 1996 and 2.3% in 1997. This pattern underlined the economy's vulnerability to swings in tourist arrivals (i.e. to economic and political conditions in Cyprus, Western Europe, and the Middle East) and the need to diversify the economy. Declining competitiveness in tourism and especially in manufacturing are acting as a drag on growth until structural changes are in effect. This is greatly affecting the energy sector.

The emissions from the energy sector in Cyprus increased by 53% during the period 1990-2015. The greatest increase in emissions was between 1990 and 2008 (98%), the emissions reached their peak (7799 Gg $CO_2$ eq.). All the emissions in 2015 are from fuel combustion. The contribution of the emissions from the energy sector to the total without LULUCF in 2015 was 71% compared to 70% in 1990.

Energy is mainly responsible for carbon dioxide emissions, while it contributes also to methane and nitrous oxide emissions. In 2015, 98.7% of the emissions from the energy sector were carbon dioxide, 0.3% methane and 1% nitrous oxide. Fugitive emissions from fuels have not been estimated since 2004 when the refining activities stopped in Cyprus. The contribution of each source and gas to the total of the energy sector is presented in Figure E2.

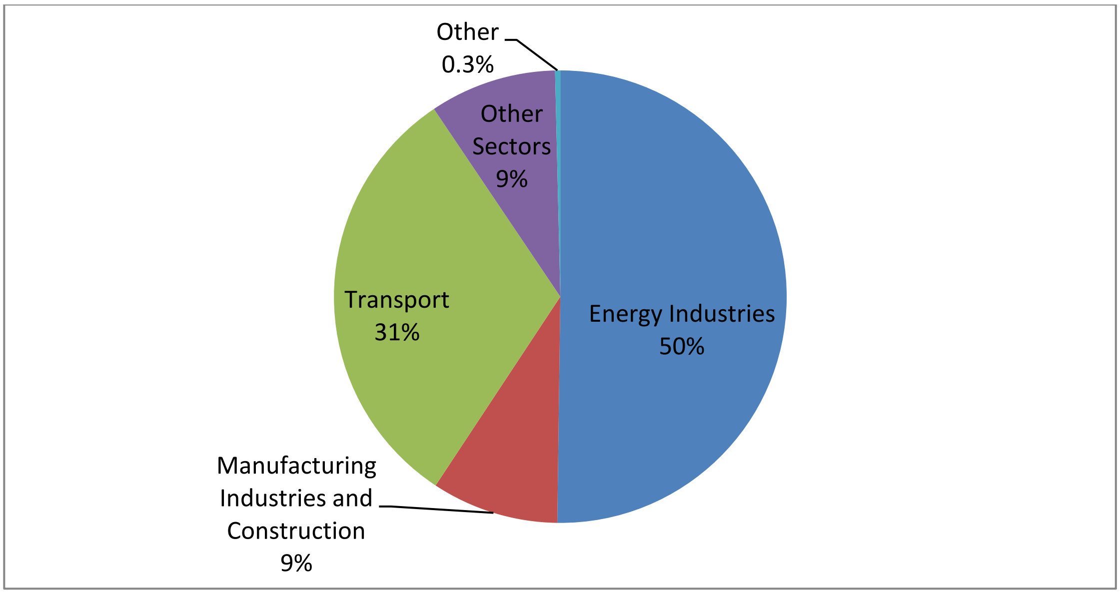


**Figure E2. Contribution of the main energy sources of emissions to the total energy emissions in 2015**

Industrial processes

In 2015, GHG emissions from Industrial processes accounted for 15.6% of total emissions excluding LULUCF compared to 14% in 1990. The emissions have increased by 72% compared to 1990. 67.3% of the industrial processes emissions are from mineral production, 27.3% is from consumption of Halocarbons and SF6, 4.5% is from Other Product Manufacture and Use and the remaining 0.8% is from non-energy products from fuels and solvent use.

Agriculture

Emissions from Agriculture accounted for 6.6% of total emissions in 2015 (without LULUCF), compared to 9.4% in 1990. Emissions increased by 5.3% compared to 1990. The peak of Agriculture emissions was in 2002 (717 Gg CO2 eq.) when an increase of 35% compared to 1990 was observed. Since 2002 a reduction in emissions was observed, due to the reduction of $N_2O$ emissions from agricultural soils, because of the reduction in the use of synthetic nitrogen fertilisers. The reduction of the use of fertilisers was caused by the drought that was taking place during the same period that had an extreme in 2008. Further reduction was caused by the recent changes in manure management. Agriculture is responsible for mainly methane and nitrous oxide emissions. In 2015 agriculture has contributed 41% to the total methane emissions and 59% to the total nitrous oxide emissions. The contribution of the main agricultural sources of emissions to the total agriculture emissions in 2015 is presented in Figure E3.

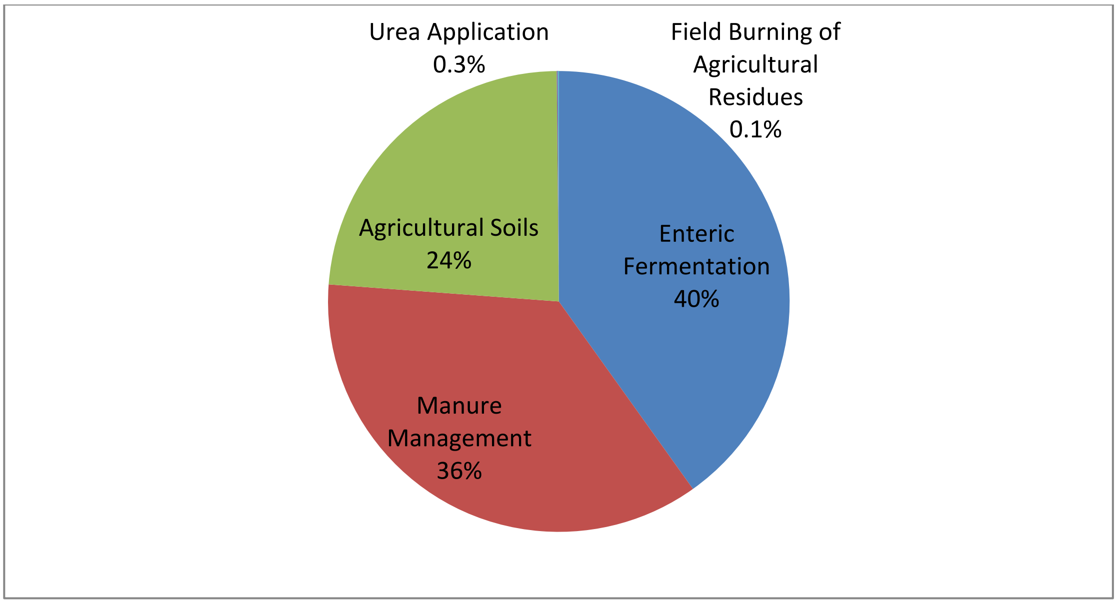


**Figure E3. Contribution of the main agricultural sources of emissions to the total agriculture emissions in 2015**

Land use, land use change and forestry

The emissions from LULUCF changed from about -100 Gg CO2 eq. in 1990 to -168 Gg CO2 in 2015. Overall the trend is one of increased removals from the LULUCF sector, with the exception of peaks in emissions in years with increased wildfires.

Waste

Emissions from the Waste Sector in 2015 contributed 6% of the total emissions without LULUCF. In 2015, 89% of the emissions is from solid waste disposal, 1.5% from biological treatment of solid waste and 9.5% from waste water treatment and discharge. 57% of the total methane emissions and 6.2% of the nitrous oxide emissions of the country are from the sector of waste. The emissions from waste have changed considerably between 1990 and 2015 due to changes that are taking place in the waste and wastewater management practices of the country.

# Chapter 1: Introduction

## 1.1. Background information on greenhouse gas inventories, climate change

Naturally occurring greenhouse gases (GHG) include water vapour, carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$) and ozone ($O_3$). In the last few years, a new category of greenhouse gases has emerged that includes hydrofluorocarbons (HFC), perfluorocarbons (PFC) and sulphur hexafluoride ($SF_6$). These gases are man-made and are mainly used in a number of industrial activities in replacement of CFCs. Other naturally occurring gases, which do not contribute directly to the greenhouse effect are carbon monoxide (CO), oxides of nitrogen ($NO_x$), non-methane volatile organic compounds (NMVOC) and sulphur dioxide ($SO_2$).

### 1.1.1. Background information on climate change

**International framework**

United Nations Framework Convention on Climate Change[4]

In response to the emerging evidence that climate change could have a major global impact, the United Nations Framework Convention on Climate Change (henceforth the Convention) was adopted on 9 May 1992 and was opened for signature in Rio de Janeiro in June 1992.

The ultimate objective of the Convention is the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The Convention recognises that the developed countries should take the lead in combating climate change and calls these countries to:

- Adopt policies and measures to mitigate climate change.
- Return, individually or jointly, to 1990 levels of carbon dioxide and other greenhouse gas by the year 2000.
- Provide technology transfer and financial resources to help developing countries so as to confront climate change impacts and to develop, ensuring at the same time the environmental protection through the restraint of GHG emissions.

Kyoto Protocol[5]

Recognising early the need for an effective instrument to provide confidence in addressing the climate change challenge, the Parties at the third meeting of the Conference of the Parties (COP) to the Convention, held in Kyoto (1-11 December 1997), finalised negotiations related to the establishment of such a legal instrument, the Kyoto Protocol on Climate Change (KP). KP provides a foundation upon which future action can be intensified. It establishes, for the first time, legally binding targets for the reduction of greenhouse gas emissions and it also

[4] More information available at https://unfccc.int/essential_background/convention/items/6036.php
[5] More information available at https://unfccc.int/essential_background/kyoto_protocol/items/6034.php

confirms the capacity of the international community to cooperate in action to deal with a major global environmental problem.

KP calls for legally binding commitments of the developed countries to reduce, individually or jointly, emissions of 6 greenhouse gases ($CO_2$, $CH_4$, $N_2O$, HFC, PFC and $SF_6$) by more than 5% in the period 2008 to 2012, below their 1990 level. The EU and its Member States at the time agreed to an 8% reduction. For the achievement of these targets, the Protocol provides for the use of the following:

- Adoption of national policies and measures,
- Establishment of an emissions trading regime,
- Establishment of the joint implementation mechanism,
- Establishment of a clean development mechanism, and
- Protection and promotion of sinks to enhance $CO_2$ removals.

Detailed rules for the implementation of the Protocol were set out at the 7th Conference of the Parties (in Marrakesh) and are described in the Marrakesh Accords adopted in 2001. The Protocol entered into force on 16 February 2005, after its ratification from 141 Parties including developed countries with a contribution of more than 55% to global $CO_2$ emissions in1990.

The Doha Amendment[6]

At the eighth session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol held in Doha, Qatar, in December 2012, parties to the Kyoto Protocol adopted an amendment to the Kyoto Protocol by decision 1/CMP.8 in accordance with Articles 20 and 21 of the Kyoto Protocol.

Pursuant to Article 21, paragraph 7 and Article 20, paragraph 4, the amendment is subject to acceptance by Parties to the Kyoto Protocol. In accordance with Article 20, paragraph 4, the amendment will enter into force for those Parties having accepted it on the ninetieth day after the date of receipt by the Depositary of an instrument of acceptance by at least three fourths of the Parties to the Kyoto Protocol. A total of 144 instruments of acceptance are required for the entry into force of the amendment.

The Doha Amendment and the KP Decision set out the rules related to the second commitment period of the Kyoto Protocol (CP2). The key aspects of CP2 are as follows:

- CP2 will be eight years long, running from 1 January 2013 until 31 December 2020;
- Parties taking on commitments in CP2 (CP2 Parties) are required to reduce their aggregate emissions by 18% below 1990 levels in CP2. The commitments of individual Parties range from a 24% reduction (in the case of Ukraine) to a 0.5% reduction (in the case of Australia). The European Union, as a whole, is required to reduce its emissions by 20%;
- CP2 Parties are required to review their commitments by the end of 2014 with a view at increasing the level of their mitigation ambition;
- Notwithstanding the commitments set out in Annex B to the Kyoto Protocol (as amended), each CP2 Party's commitment in CP2 must be at least as ambitious as its actual annual average emissions between 2008 and 2010;

[6] More information available at https://unfccc.int/kyoto_protocol/doha_amendment/items/7362.php

- CP2 Parties may carry over surplus CP1 AAUs into CP2 without limit, but may only use or acquire such AAUs in limited circumstances;
- Access to all of the Kyoto Protocol's market mechanisms remains uninterrupted for CP2 Parties; and
- KP Parties agreed to the implementation of the Doha Amendment pending its formal entry into force, thus ensuring the Kyoto Protocol's operational continuity.

The Paris Agreement[7]

The 2015 Paris Agreement is a historically significant landmark in the global fight against climate change. The Agreement provides a lifeline, a last chance to hand over to future generations a world that is more stable, a healthier planet, fairer societies and more prosperous economies, also in the context of the 2030 Agenda on Sustainable Development. The Agreement will steer the world towards a global clean energy transition. This transition will require changes in business and investment behaviour and incentives across the entire policy spectrum.

On 5 October 2016, the threshold for entry into force of the Paris Agreement was achieved. The Paris Agreement entered into force on 4 November 2016. The Paris Agreement builds upon the Convention and – for the first time – brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort.

The key features of the Paris Agreement are as follows:

- It sets out a long term goal to put the world on track to limit global warming to well below 2°C above pre-industrial levels – and pursue efforts to limit the temperature increase to 1.5°C; The aspirational goal of 1.5°C was agreed to drive greater ambition, and to highlight the concerns of the most vulnerable countries that are already experiencing the impacts of climate change.
- It sends a clear signal to all stakeholders, investors, businesses, civil society and policy-makers that the global transition to clean energy is here to stay and that resources have to shift away from fossil fuels; With 189 national climate plans covering some 98% of all emissions, tackling climate change is now become a truly global effort. With Paris, we are moving from action by a few to action by all.
- It provides a dynamic mechanism to take stock and strengthen ambition over time. Starting from 2023, Parties will come together every five years in a "global stocktake" to consider progress in emissions reductions, adaptation and support provided and received in view of the long-term goals of the Agreement.
- Parties have a legally binding obligation to pursue domestic mitigation measures, with the aim of achieving the objectives of their contributions.
- It sets up an enhanced transparency and accountability framework, including the biennial submission by all Parties of greenhouse gas inventories and the information necessary to track their progress, a technical expert review, a facilitative, multilateral consideration of Parties' progress and mechanism to facilitate implementation of and promote compliance.

[7] Available at https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf

- It provides an ambitious solidarity package with adequate provisions on climate finance and on addressing needs linked to adaptation and loss and damage associated with adverse effects of climate change. To promote individual and collective action on adaptation, the Paris Agreement establishes for the first time a global goal with the aim to enhance capacity, climate resilience and reduce climate vulnerability. Internationally, it encourages greater cooperation among Parties to share scientific knowledge on adaptation as well as information on practices and policies.

**Climate change and Cyprus**

The Republic of Cyprus ratified the UNFCCC in 1997 with Law No. 19(III) / 1997 as a non-Annex I party. The Kyoto Protocol was ratified by the Republic of Cyprus in 2003 with Law No. 29(III) / 2003. According to decision 10/CP.17 of COP17, as of 9 January 2013, the status of Cyprus changed from a non-Annex I to an Annex I party to the UNFCCC. As part of the EU, Cyprus has taken up commitments for the CP2 of the KP through the Doha amendment.

The Republic of Cyprus ratified the Paris Agreement on 4 January 2017 with Law No. 30(III)/2016.

### 1.1.2. Background information on greenhouse gas inventories

**International framework**

Annual inventories of greenhouse and other gas emissions form an essential element of each national environmental policy-making process. They can be used to derive information on emissions trends with reference to a pre-selected base year, and can assist in monitoring the progress of existing abatement measures for the reduction of greenhouse gas emissions and the fulfilment of the KP target.

According to Article 4 of the Convention, Annex I Parties have the obligation to submit national inventories of GHG emissions and removals. At COP2, the annual submission of inventories was decided (Decision 9 / CP.2), while the use of the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories"[8] (henceforth IPCC Guidelines) was adopted with Decision 2/CP.3. In order to enhance the transparency of the GHG inventories submitted and improve comparability across sectors and different countries, the use of Common Reporting Format (CRF) tables for the submission of the emissions / removals estimates per source/ sink category was adopted at COP5 (Decision 3/CP.5).

At the 12th session of the Subsidiary Body for Scientific and Technological Advice (SBSTA), the use of the IPCC "Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories"[9] (henceforth IPCC Good Practice Guidance) for inventories due in 2003 and beyond was decided. The IPCC Good Practice Guidance is considered as an elaboration of the IPCC Guidelines.

[8] Available at http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html
[9] Available at http://www.ipcc-nggip.iges.or.jp/public/gp/english/index.html

New reporting guidelines, together with a structure of the National Inventory Report (NIR) were adopted at COP8 (Decision 18/CP.8) for use in reporting annual inventories due in 2004 and beyond. Overall annual national inventories submissions include the submission of both the Common Reporting Format tables and the National Inventory Report by the 15th of April.

At COP9 the use of the IPCC "Good Practice Guidance for Land Use, Land Use Change and Forestry" [10] (henceforth LULUCF Good Practice Guidance) for inventories due in 2005 and beyond was adopted (Decision 13/CP.9). Moreover, new Common Reporting Format tables for LULUCF, to be used for a trial period covering inventory submissions due in 2005, were adopted with the same decision.

The Conference of the Parties (COP), by its decision 14/CP.11, adopted the tables of the common reporting format and their notes for reporting on land use, land-use change and forestry (LULUCF) sector, to be used for the purpose of submission of the annual inventory due in and after 2007.

**Cyprus**

The first national inventory report for Cyprus was prepared in 2001 and covered the period 1990-1998. The inventory was prepared in the framework of the project "Strategic Plan for the Limitation of Greenhouse Gas Emissions in Cyprus".

The first Inventory report submitted by Cyprus to the European Commission for the purposes of Decision no. 280/2004/EC, was in 2006 for the period 1990-2004. Cyprus at the time was a non-Annex I party and therefore had no obligation to submit annual inventories to the UNFCCC secretariat.

The first submission of a national inventory report to the UNFCCC secretariat, as an Annex I party was made in April 2013.

### 1.1.3. Background information on supplementary information required under article 7, paragraph 1, of the Kyoto protocol

Cyprus, as an Annex I Party that is also Party to the Kyoto Protocol is also required to report supplementary information required under Article 7, paragraph 1 of the Kyoto Protocol, with the inventory submission due under the Convention, in accordance with paragraph 3(a) of decision15/CMP.1. Part II of this report (Chapters 10-14) provides information on activities under Article3, paragraph 3 (Afforestation, Reforestation, Deforestation) and the elected activity under Article 3,paragraph 4 (Forest Management), on accounting of Kyoto units, on changes in the national system and the national registry and information on the minimization of adverse impacts of climate change in accordance with Articles 3.14.

## 1.2. Institutional arrangements

### 1.2.1. Institutional, legal and procedural arrangements

In article 5, paragraph 1 of the Protocol, it is specified that "Each Party included in Annex I shall have in place, no later than one year prior to the start of the first commitment period, a

[10] Available at http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html

national system for the estimation of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol". A national system includes all institutional, legal and procedural arrangements made within an Annex I Party of the Convention for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information.

The Department of Environment of the Ministry of Agriculture, Rural Development and Environment (MARDE) is the single national entity with responsibility for preparing and submitting the National Inventory to the UNFCCC and for managing the supporting processes and procedures.

The institutional arrangements for the preparation of the inventory include: formal agreements supporting data collection and estimate development; a quality management plan, including an improvement plan; the ability to identify key categories and generate quantitative uncertainty analysis; a process for performing recalculations due to improvements; procedures for official approval; and a working archive system to facilitate third-party review.

The MARDE is the governmental body responsible for the co-ordination of all involved ministries, as well as any relevant public or private organisations, in relation to the implementation of the provisions of the national and European legislation associated with climate change. In this context, the MARDE has the responsibility for the planning, preparation, management, compilation of the national GHG inventory report[11]. The organisational structure of the National Inventory System is presented in Figure 1.1.

No legal framework is available that defines the roles, responsibilities and the co-operation between the MARDE and contact points of the involved Ministries and agencies.

However, in order to establish the appropriate mechanism a Proposal to the Council of Ministers has been prepared. Within this proposal the appropriate Governance System will be established. . It is expected that this Proposal will be approved soon (no later than June 2017). It is noted that having the approval from the Council of Ministers for the Governance System, there is no need for any additional legal procedures.

There are no changes to the national system or registry, or their descriptions.

### 1.2.2. Overview of inventory planning, preparation and management

The preparation of the Cyprus' GHG emissions inventory is the responsibility of the Climate Action Unit of the Department of Environment of the Ministry of Agriculture, Rural Development and Environment.

The preparation of the Cyprus' GHG emissions inventory is based on the application of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The compilation of the inventory is completed in three main stages (Figure 1.1).

[11]Contact person: Nicoletta Kythreotou, Address: Department of Environment, 1498 Nicosia, Cyprus, tel.: +357 22 408947, e-mail: nkythreotou@environment.moa.gov.cy

Stage 1: The first stage consists of data collection and checks for all source / sink categories. The main data sources used are the National Statistical Service, the national energy balance, the government ministries / agencies involved, along with the verified reports from installations under the EU ETS. Quality control of activity data include the comparison of the same or similar data from alternative data sources (e.g. National Statistical Service, EU ETS reports and energy balance) as well as time-series assessment in order to identify changes that cannot be explained. In cases where problems and / or inconsistencies are identified, the agency's representative, responsible for data providing, is called to explain the inconsistency and / or help solving the problem.

Stage 2: Once the reliability of input data is checked and certified, emissions / removals per source / sink category are estimated. Emissions estimates are then transformed to the format required by the CRF Reporter. This stage also includes the evaluation of the emission factors used and the assessment of the consistency of the methodologies applied in relation to the provisions of the IPCC Guidelines, the IPCC Good Practice Guidance and the LULUCF Good Practice Guidance. Quality control checks, when at this stage, are related to time-series assessment as well as to the identification and correction of any errors / gaps while estimating emissions / removals and entering the data in the CRF Reporter.

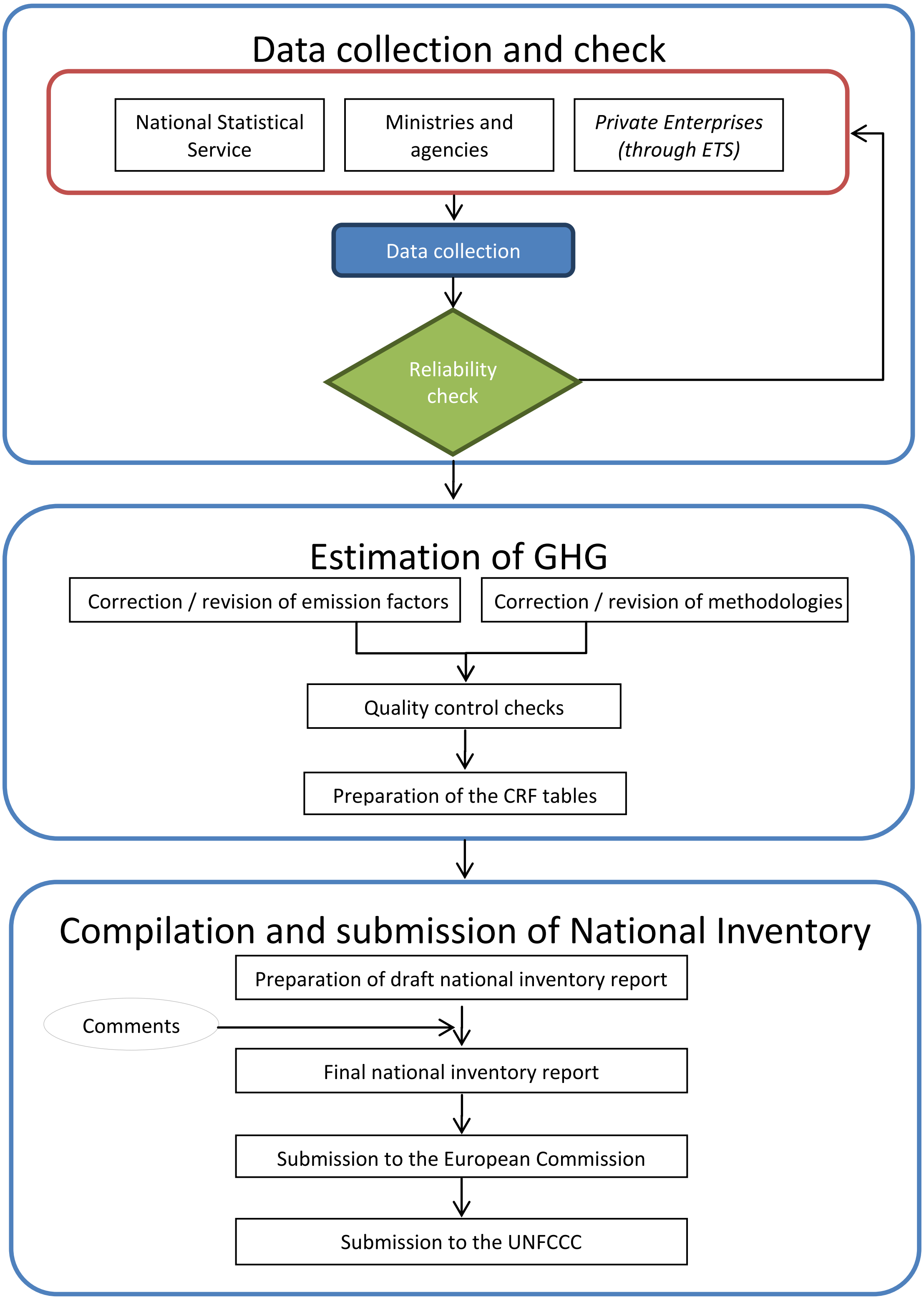


**Figure 1.1. GHG emissions inventory preparation process in Cyprus**

Stage 3: The last stage involves the compilation of the NIR and its internal check. During this period, the Inventory Team has to revise the report according to the observations and recommendations of the supervisor of the team. On the basis of this interaction process, the final version of the report is compiled. The Director of the Department of Environment approves the inventory and then the contact points submit the NIR to the European Commission for compliance with Regulation (EU) No 525/2013 and thereafter to the UNFCCC secretariat.

## 1.3. Inventory preparation

### 1.3.1. GHG inventory

The compilation of the inventory starts with the collection of the ETS data in June before the submission deadline (year X-1). When the first comments on the inventory are received by the European Commission and the UNFCCC for the submission of the previous year (approximately June), the necessary changes are made to the calculation sheets resulting to the CRFreporter data and notes are taken for the National Inventory Report, by the inventory compiler. Other data is made available from other governmental departments from November before the submission deadline (year X-1). In December the final National inventory report for the air pollutants under Directive 2001/81/EC prepared by the Department of Labour Inspection of the Ministry of Labour, Welfare and Social Insurance (DLI), is available and communicated to the inventory compiler.

Data reliability checks: data for some activities is available from several sources. In such cases, the data is compared between all sources. In cases where there are differences, these are discussed with the data sets compilers. In several cases the data providers agree that there is a mistake and they correct appropriately the data set.

Quality control/ quality assurance: when the calculations have been completed the excel files used for the data collection and the calculations are sent to Ms Niki Papaki (Environment Technician, tel. +357 22408946, email npapaki@environment.moa.gov.cy) and Mr Giorgos Ioannou (Statistics Officer, tel. +357 22602171, email geioannou@cystat.mof.gov.cy) to check the data collected and the calculations. In case any mistakes are identified, these are corrected accordingly by the inventory compiler.

Compilation of inventory report: the compilation of the report starts when the emissions are finalised and the CRF tables are available. Once the final draft is available, the report is sent to Ms Niki Papaki (Environment Technician, tel. +357 22408946, email npapaki@environment.moa.gov.cy), Mr Giorgos Ioannou (Statistics Officer, tel. +357 22602171, email geioannou@cystat.mof.gov.cy) and all the data providers for comments. The comments are taken into consideration for the finalisation of the report.

Approval and submission of report: when the report is finalised, it is send to Dr Theodoulos Mesimeris, Head of climate Action Unit and thereafter to the Director of the Department of Environment Mr Costas Hadjipanayiotou (chadjipanayiotou@environment.moa.gov.cy, tel. no.+357 22 408900) for the final approval. The inventory accompanied by the inventory report is submitted to the European Commission annually by 15 January.

The timetable for the completion of these stages in the annual inventory cycle is presented in Table 1.1.

**Table 1.1. Timetable for the preparation and submission of GHG emissions/ removals inventory in Cyprus where x is the submission year**

| Task | Month |
|---|---|
| Corrections based on EC comments for previous submission | June year x-1 |
| Collection of ETS data | June year x-1 |
| Data collection from other ministries and agencies | November year x-1 |
| Calculations, checks, CRF preparation | December year x-1 |
| NIR preparation, revision, submission to the European Commission | January year x |
| CRF and NIR revision (if necessary) and final submission to the European Commission | March year x |
| CRF and NIR revision (if necessary) and submission UNFCCC secretariat | April year x |

**Inventory preparation team**

The calculations, report preparation and overall management of the compilation of the inventory (inventory compiler) is the responsibility of Dr Nicoletta Kythreotou, Environment Officer at the Department of Environment since 2006. Dr Kythreotou holds a BSc in Environmental Science, an MSc in Environmental Engineering and a PhD in Mechanical Engineering.

The final assessment of the national inventory is performed by Dr Theodoulos Mesimeris, who is a Senior Environment Officer and the head of Climate Action Unit at the Department of Environment. Dr Mesimeris has been an officer at the Department of Environment since 2002 and has been dealing with climate change since then. The academic background of Dr Mesimeris is an MEng in Chemical Engineering, MSc in Environmental Management and PhD in Chemical Engineering.

Dr Mesimeris and Dr Kythreotou are the national contact points of the UNFCCC and the DG Climate Action of the European Commission.

Ms Melina Menelaou (BA Biological Science with emphasis on ecology) is responsible Land Use issues.

The contact details of the team are provided in Table 1.2.

**Table 1.2. Contact details of the inventory compilation team**

| Person | Position | Telephone no. | Email |
|---|---|---|---|
| Dr Theodoulos Mesimeris | Senior Environment Officer | +357 22 408948 | tmesimeris@environment.moa.gov.cy |
| Dr Nicoletta Kythreotou | Environment Officer | +357 22 408947 | nkythreotou@environment.moa.gov.cy |
| Ms Niki Papaki | Environment Technician | +357 22 408946 | npapaki@environment.moa.gov.cy |
| Ms Melina Menelaou | Environment Technician | +357 22 408959 | mmenelaou@environment.moa.gov.cy |
| Mr Pavlos Pavlou | Environment Officer | +357 24 202866 | ppavlou@environment.moa.gov.cy |

| | | | |
|---|---|---|---|
| Ms Maria Loizou | Environment Officer | +357 22408955 | mloizou@environment.moa.gov.cy |
| Mr Savvas Aspris | Technician | +357 22408955 | saspris@environment.moa.gov.cy |

### 1.3.2. Data collection, processing and storage

Data from all the involved parties come in MS Excel spread-sheets. The main database maintained by the inventory compiler is also in the form of MS Excel spread-sheets. The collected data is transferred to the main database of the inventory compiler. No special software is used or applied for processing or storage of the data used in the inventory.

The inventory compiler has one MS Excel spread-sheet containing all the data collected and one MS Excel spread-sheet containing the calculations performed for the estimation of the GHG emissions.

**Contact points for data collection**

Data from the annual ETS submissions from installations participating is the EU-ETS scheme has been obtained since 2006 from the ETS team, which is also part of the Climate Action Unit of the Department of Environment. Apart from the fuel consumption data is also obtained for $CO_2$ emissions (combustion and process emissions) and net calorific value (NCV) of fuels consumed.

The energy balance is obtained from the Energy Service of the Ministry of Commerce, Industry and Tourism. The contact point is Dr Christina Karapitta – Zachariadou (tel. no. +357 22409388, ckarapitta@mcit.gov.cy).

The contact point for the energy balance prepared by the National Statistical Service (CYstat) for the submission to EUROSTAT is Ms Nafsika Apostolou (tel. no. +357 22602199, napostolou@cystat.mof.gov.cy). Other contacts at CYstat are: for waste data Mrs Marilena Kythreotou (tel. no. +357 22602137, mkythreotou@cystat.mof.gov.cy), for population data Ms Loukia Makri (tel. no.+357 22602150, lmakri@cystat.mof.gov.cy), for industrial production Mr Charalambos Alkiviadous (tel. 22602189, calkiviadous@cystat.mof.gov.cy) and for agricultural data (cultivated areas and animal population) Mrs Sofia Pelagia (spelagia@cystat.mof.gov.cy).

Department of Labour Inspection is the competent authority for the preparation of air pollutants inventories under Directive 2001/81/EC. The inventory is communicated to the GHG inventory compiler, Mr Christos Papadopoulos (tel. no. +357 22405683, cpapadopoulos@dli.mlsi.gov.cy).

The activity data for the estimation of emissions from F-gases (sectors 2F) is obtained by Mr Pavlos Pavlou, part of the Climate Action Unit, Department of Environment (tel. no. +357 24 202866, ppavlou@environment.moa.gov.cy).

Other data on municipal solid waste management is obtained from Mrs Elena Christodoulidou, part of the Waste Management Unit, at the Department of Environment (tel. no. +357 22408951, echristodoulidou@environment.moa.gov.cy).

Municipal liquid waste production and management data is obtained from Mrs Stella Perikenti part of the Pollution Control Unit, Department of Environment (tel. no. +357 22408942, sperikenti@environment.moa.gov.cy).

Agricultural waste management information on practices applied is obtained from Mr Antis Athanasiades part of the Pollution Control Unit, Department of Environment (tel. no. +357 22408935, aathanasiades@environment.moa.gov.cy).

Industrial liquid waste management data is obtained from Dr Chrystalla Stylianou head of the Pollution Control Unit, Department of Environment (tel. no. +357 22408941, cstylianou@environment.moa.gov.cy).

Fertiliser consumption data is provided by Mr George Theofanous, Department of Agriculture (tel. no. +357 22464028). Details necessary for the implementation of Tier 2 methodology for dairy cattle was obtained from Mr Georgios Papaioannou, Department of Agriculture (tel. no. +357 22408566).

Land cover data (which includes forest cover data) is obtained from Mr Andreas Antoniou, part of the Nature Protection Unit, Department of Environment (tel. no. +357 22408918, aantoniou@envrironment.moa.gov.cy).

Forest wildfire data is obtained from Mr George Georgiou, Department of Forests (tel. no. +357 22459003, management@fd.moa.gov.cy).

Lime, cement and ceramics (bricks and tiles) production data was obtained directly from the installations.

### 1.3.3. Quality assurance / quality control (QA / QC) procedures and extensive review of GHG inventory

See Section 1.6.

## 1.4. Brief general description of methodologies and data sources used

### 1.4.1. Emission factors

The estimation of GHG emissions / removals per source / sink category is predominately based on the methods described in the revised 2006 IPCC Guidelines. The emission factors used were derived from the 2006 IPCC Guidelines and special attention was paid in selecting the emission factors that are most representative of practices and conditions in Cyprus. Furthermore, emission factors were obtained from plant specific information contained in EU ETS reports. Due to data unavailability, for the estimation of the emissions of the sectors Refrigeration and Air Conditioning (2F1), Foam Blowing Agents (2F2), Fire Protection (2F3) and Metered Dose Inhalers (2F4a) the implied emission factors per capita from the average of Greece, Italy, Malta and Spain (NIR2015) have been used. For Use of Electrical Equipment (2G1) and N2O from Product Uses (2G3), the implied emission factor per capita from Greece was used. Details on the methods applied for the calculation of emissions / removals are given the chapters that follow.

The key categories analysis (see Section 1.6) constitutes the basic tool for methodological choice and for the prioritisation of the necessary improvements. In addition, the results of the various review processes (at national and EU level) represent key input information for the identification of possible improvements. It should be mentioned however, that data availability as well as availability of resources (both human and financial) also have to be considered.

- Data availability could become a significant restrictive parameter when selecting an estimation methodology. The accuracy and the consistency of the emissions estimated depend on the availability of the data needed for the correct application of the selected methodology.
- Availability of resources needs also to be considered as the searching for and the collection of the necessary data in order to apply a detailed methodology for a source category should not affect the completeness and the on-time preparation of an inventory submission.

### 1.4.2. Activity data

Data collection, processing and check constitute the activity with the longest duration in the annual inventory cycle. The duration of this activity is related to the amount of the necessary data and the number of the entities involved. The on-time and successful completion of this activity has a major effect on the timeliness preparation and submission of the inventory as well as on its accuracy, completeness and consistency.

**Table 1.3. Data sources and data sets per IPCC sector, source category**

| Sector | Data | Sources |
|---|---|---|
| 1A1 Electricity generation | Fuel consumption | ETS verified reports<br>Statistical Service<br>Energy Service<br>DLI |
| 1A2 Manufacturing industry<br>and construction | Fuel consumption | ETS verified reports<br>Statistical Service<br>Energy Service<br>DLI |
| 1A3 Transport | Fuel consumption | Statistical Service<br>Energy Service<br>EUROCONTROL |
| 1A4 Residential / Commercial / Agriculture | Fuel consumption | Statistical Service<br>Energy Service<br>DLI |
| 1B Fugitive emissions from fuels | Fuel consumption | Statistical Service<br>Energy Service<br>DLI |
| 2 Industrial processes | Industrial production<br>NMVOCs emissions<br>Population | ETS verified reports<br>Statistical Service<br>DLI |
| 3 Agriculture | Cultivated areas<br>Agricultural production<br>Livestock population<br>Fertilizer use | Statistical Service<br>Department of Agriculture<br>FAOSTAT |
| 4LULUCF | Land cover data (which includes forest cover data)<br>Forest Areas affected by wildfires | Department of Environment<br>Department of Forestry |
| 5 Waste | Quantities/composition of solid waste generated<br>Recycling | Department of Environment<br>Statistical Service |

| Sector | Data | Sources |
|---|---|---|
| | Population<br>Industrial production | |
| 6 KP-LULUCF | Land cover data (which includes forest cover data)<br>Forest Areas affected by wildfires | Department of Environment<br>Department of Forestry |

Table 1.3 gives an overview of the main data sets used for the estimation of GHG emissions /removals. Data from international organisations and databases are supplementary to the data collected from the above data providers. It should be noted that information and data collected (through questionnaires developed according to the guidelines described in the Commission Decision 2004/156/EC) in the framework of the formulation of the National Allocation Plan (NAP) for the period 2005-2007, according to the Directive 2003/87/EC (and its transposition to the national Law, 110(I)/2011) along with the data from the verified reports from installations under the EU ETS for years 2005-2015 constituted significant source of information and an additional quality control check.

### 1.4.3. Global Warming Potential

Emissions from anthropogenic activities affect the concentration and distribution of greenhouse gases in the atmosphere. These changes can potentially produce a radiative forcing of the Earth's surface and lower atmosphere, by changing either the reflection or absorption of solar radiation or the emissions and absorption of long-wave radiation. A simple measure of the relative radiative effects of the emissions of various greenhouse gases is the Global Warming Potential (GWP) index. This index is defined as the cumulative radiative forcing between the present and some chosen time-horizon caused by a unit mass of gas emitted now, expressed relative to that for some reference gas. The values for GWP for the greenhouse gases that are used in this inventory are according to Decision 24/CP.19[12] (Annex II).

Corresponding values of GWP for other gases (NOx, CO, NMVOC) are not given by the IPCC (nor by other sources for this purpose), since at present it is impossible to calculate the indirect results of these gases, as the scientific knowledge on their chemical reactions taking place in the atmosphere is not sufficient.

**Table 1.4. Direct Global Warming Potentials (mass basis) relative to carbon dioxide for the 100-year horizon**

| Gas | Chemical Compound | 100-year Global Warming Potential |
|---|---|---|
| Carbon dioxide | $CO_2$ | 1 |
| Methane | $CH_4$ | 25 |
| Nitrous Oxide | $N_2O$ | 298 |
| HFC-32 | $CH_2F_2$ | 675 |
| HFC-125 | $CHF_2CF_2$ | 3500 |
| HFC-134a | $CH_2FCF_3$ | 1430 |
| HFC-143a | $CF_3CH_3$ | 4470 |
| HFC-227ea | $CF_3CHFCF_3$ | 3220 |
| HFC-245fa | $CH_2FCF_2CHF_2$ | 1030 |
| HCF-365mfc | $CH_3CF_2CH_2CH_2CF_3$ | 794 |

[12] Decision 24/CP.19 Revision of the UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention

| | | |
|---|---|---|
| Sulphur hexafluoride | $SF_6$ | 22800 |
| Nitrogen trifluoride | $NF_3$ | 17200 |

## 1.5. Brief description of key categories

The IPCC Good Practice Guidance defines procedures (in the form of decision trees) for the choice of estimation methods within the context of the IPCC Guidelines. Decision trees formalise the choice of the estimation method most suited to national circumstances considering at the same time the need for accuracy and the available resources (both financial and human). Generally, inventory uncertainty is lower when emissions are estimated using the most rigorous methods, but due to finite resources, this may not be feasible for every source category. Therefore it is good practice to identify those source categories (key source categories) that have the greatest contribution to overall inventory uncertainty in order to make the most efficient use of available resources.

In that context, a key source category is one that is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level of emissions (level assessment) or/and to the trend of emissions (trend assessment). As far as possible, key source categories should receive special consideration in terms of two important inventory aspects:

1. The use of source category-specific good practice methods is preferable, unless resources are unavailable.
2. The key source categories should receive additional attention with respect to quality assurance (QA) and quality control (QC).

As a result of the adoption of the LULUCF Good Practice Guidance (Decision 13/CP.9) the concept of key sources has been expanded in order to cover LULUCF emissions by sources and removals by sinks. Therefore the term key category is used in order to include both sources and sinks.

The determination of the key categories for the Cyprus' inventory system is based on the application of the Tier 1 methodology (see Annex I for presentation of calculations) described in the IPCC Good Practice Guidance, adopting the categorization of sources that is presented in Table 7.1 of the IPCC Good Practice Guidance.

Tier 1 methodology for the identification of key categories assesses the impacts of various source categories on the level and the trend of the national emissions inventory. Key categories are those which, when summed together in descending order of magnitude, add up to over 95% of total emissions (level assessment) or the trend of the inventory in absolute terms.

In line with the specifications and options set out in the Kyoto Protocol and it´s follow up procedures, Cyprus identifies 1990 as its base year for carbon dioxide, methane and nitrous oxide and 1995 as its base year for hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride.

The summary of the key categories assessment for the Cyprus' inventory system for the years 1990 and 2015 with and without LULUCF are presented in the following Tables. The key categories analysis for all the years is available in the xml file submitted.

## 1.6. Information on the QA / QC plan including verification and treatment of confidentiality issues

### 1.6.1. QA / QC procedures

The development and the implementation of an inventory Quality Assurance / Quality Control (QA/QC) plan represents a key tool for meeting the objectives of National Systems under Article 5 Paragraph 1 of the Protocol as described in Decision 20/CP.7.

With the Protocol's application, the pressure upon national GHG emissions inventories increases and therefore quality management is essential in order to comply with the requirements of (a) producing transparent, consistent, comparable, complete and accurate emissions estimates, (b) establishing a reliable central archiving system concerning all necessary information for GHG emissions inventories development and (c) compiling national reports according to the provisions of the adopted decisions.

In this framework, a QA/QC system is being implemented since the May 2007. A second version of the Quality Control (QC) and Quality Assurance (QA) procedures of Cyprus, updating the first version that was prepared in 2012. The manual is in accordance with the guidelines provided by the UNFCCC (UNFCCC, 2007), the 2006 IPCC guidelines for the preparation of greenhouse gas emissions inventories (IPCC, 2006) and the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000). This manual sets up guidelines for the work by inventory team. The inventory team is located in the Department of Environment, Ministry of Agriculture, Rural Development and Environment, Cyprus.

First, the concept of quality is defined using conventional terminology and the interaction between different elements is briefly outlined. The quality goal is defined and from that, a listing of basic factors to take into account is made. This forms the basis for tasks to be performed to fulfil the quality goal. Finally a reporting structure is outlined in which each task is addressed.

The updated version is attached as Annex V.

### 1.6.2. Treatment of confidentiality issues

No data is reported as confidential in the national inventory with the exception of the fuel consumption for military purposes. The fuel consumption for military purposes is included in the total of the country, but emissions are not estimated separately.

## 1.7. General uncertainty evaluation

In order to evaluate the accuracy of an emissions inventory, an uncertainty analysis has to be carried out for both annual estimates of emissions and emissions trends over time.

Detailed explanation regarding the choice of the uncertainty values on the activity data and emission factors estimations is presented in Annex I. The uncertainty analysis for the Cyprus' GHG inventory is based on Tier 1 methodology described in the IPCC Good Practice

Guidance and the LULUCF Good Practice Guidance, with 1990 as base year for $CO_2$, $CH_4$, and $N_2O$.

For the estimation of uncertainties per gas, a combination of the information provided by the IPCC and critical evaluation of information from indigenous sources was applied.

The uncertainty analysis was carried out without the LULUCF sector.[13]

Figure 1.4 presents the change in uncertainty estimates through during the period 1990-2014. The detailed results of the uncertainty analysis are presented in Annex I. The total uncertainty in 2014 inventory is 6.1% and the trend uncertainty 9.3%. The uncertainty analysis for the period 1990-2015 will be carried out by next submission.

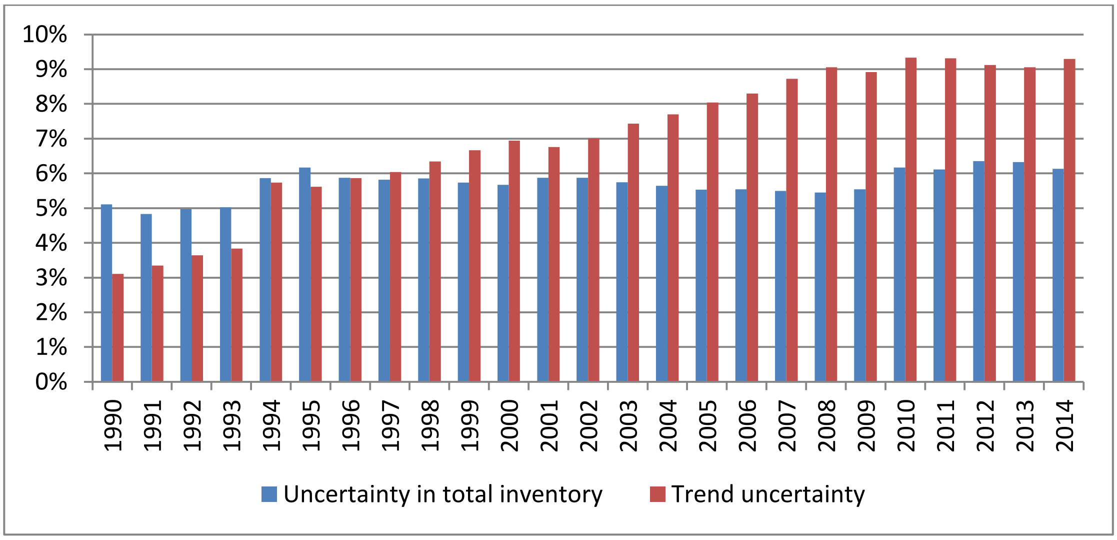


**Figure 1.4. Uncertainty without LULUCF through during the period 1990-2014**

## 1.8. General assessment of the completeness

In the present inventory report, estimates of GHG emissions in Cyprus for the years 1990-2015 are presented. Emissions estimates included in the CRF tables submitted and discussed in the present report, cover the areas of the Republic of Cyprus under the effective control of the Government of the Republic of Cyprus. All major sources are reported including emissions estimates for indirect greenhouse gases and $SO_2$.Completeness in the present inventory submission will be further discussed in the relevant chapters. Nevertheless, the main deficiencies are the following:

**LULUCF**: most important deficiency. Emissions for the LULUCF sector have never been fully reported. Available data has been collected for land uses and land use changes in Cyprus by utilizing the CORINE Land Cover data of 2000, 2006 and 2012 and the CORINE Land change data of 2006-2000 and 2012-2006, thus establishing the time series. Further work is however necessary to setup the complete methodologies to estimate the GHG emissions. Extensive work is going to take place during 2017 and have asked for technical assistance from DGCLIMA. The goal is by the 2018 submission to have a full LULUCF and KP

[13] As recommended by the UNFCCC review team in the “Provisional findings and recommendations” document for the National Inventory Report of 2013

LULUCF GHG inventory in line with the 2006 IPCC guidelines, the IPCC "Good Practice Guidance for Land Use, Land Use Change and Forestry" and the 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol.

**Transport of oil (1.B.2.a.3), Distribution of oil products (1.B.2.a.5), venting of oil (1.B.2.c.1.i) and flaring oil (1.B.2.c.2.i):** no data/method is available to estimate the emissions.

**Use of notation keys:** there are still some empty cells in the xml. Work is in progress to fill all the cells and use the correct notation keys.

Further details on deficiencies are provided in the appropriate chapter. A national inventory improvement plan is available and implemented.

## 1.9. Information on national registry

No issue, acquisition, holding, transfer, cancellation, retirement and carry-over of AAUs, RMUs, ERUs, CERs, tCERs and lCERs has been performed for the year X-1.

## 1.10. Use of Kyoto Protocol Mechanisms

Joint implementation, CDM and international emissions trading have not been used for the year X-2.

## 1.11. Additional information

The following elements are submitted as electronic attachments to the current report:

- xml file and crf tables generated by the CRFreporter,

# Chapter 2: Trends in greenhouse gas emissions

## 2.1. Description and interpretation of emission trends for aggregated greenhouse gas emissions

The GHG emissions in 2015 were 8262 Gg CO2 eq. including LULUCF and 8431 Gg CO2 eq. excluding LULUCF. Between 1990 and 2015, the total national emissions excluding LULUCF increased by 50%.

Carbon dioxide emissions accounted for 81% of total GHG emissions in 2015 without LULUCF and increased by 48% from 1990. Methane emissions accounted for 10% of total GHG emissions in 2015 without LULUCF and increased by 27% since 1990, while nitrous oxide emissions accounted for 3.9% of the total GHG emissions in 2015 without LULUCF and increased by 8% since 1990. Finally, F-gases and SF6 emissions accounted for 4% of total GHG emissions in 2015.

The emissions by gas and sector are presented in Table 2.1. The GHG emissions in 2015 were 8262 Gg CO2 eq. including LULUCF and 8431 Gg CO2 eq. excluding LULUCF. Between 1990 and 2015, the total national emissions excluding LULUCF increased by 50%.

The emissions by gas and sector are presented in Table 2.1. The summary tables for each year of the inventory by gas and source as these were generated by CRF reporter v6.0.1.1 are presented in Annex II. Total emissions by sector are also presented in Figure 2.1.

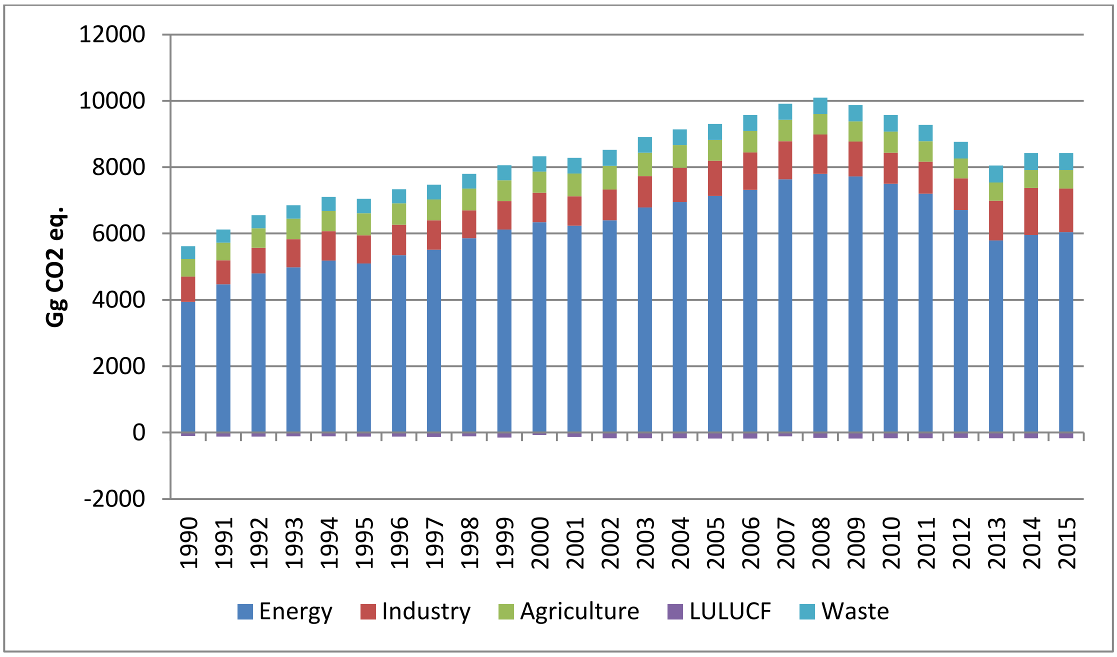

**Figure 2.1. Total GHG emissions in Cyprus for the period 1990-2015, Gg $CO_2$ eq.**

**Table 2.1. Total GHG emissions in Cyprus with and without LULUCF for the period 1990-2015, Gg $CO_2$ eq.**

| **Gg $CO_2$ eq.** | **1990** | **1995** | **2000** | **2005** | **2010** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|
| $CO_2$ emissions w/o net $CO_2$ from LULUCF | 4620.99 | 5848.04 | 7095.92 | 7961.97 | 8004.90 | 6487.25 | 6878.37 | 6859.65 |
| $CO_2$ emissions w/ net $CO_2$ from LULUCF | 4520.60 | 5721.42 | 7012.79 | 7782.49 | 7837.64 | 6314.71 | 6704.74 | 6691.40 |
| $CH_4$ emissions w/o $CH_4$ from LULUCF | 691.71 | 794.92 | 842.54 | 883.32 | 914.44 | 873.33 | 868.01 | 876.72 |
| $CH_4$ emissions w/ $CH_4$ from LULUCF | 691.75 | 795.25 | 848.24 | 883.47 | 915.18 | 873.55 | 868.25 | 876.81 |
| $N_2O$ emissions w/o $N_2O$ from LULUCF | 308.92 | 397.41 | 361.82 | 357.80 | 374.24 | 324.04 | 317.69 | 334.76 |
| $N_2O$ emissions w/ $N_2O$ from LULUCF | 308.95 | 397.62 | 365.59 | 357.91 | 374.73 | 324.19 | 317.85 | 334.82 |
| HFCs | NO,NE | 1.64 | 25.20 | 103.28 | 280.66 | 363.98 | 359.31 | 359.31 |
| PFCs | | | | | | | | |
| $SF_6$ | 0.03 | 0.06 | 0.08 | 0.12 | 0.15 | 0.15 | 0.15 | 0.15 |
| $NF_3$ | | | | | | | | |
| **Total (w/o LULUCF)** | **5621.64** | **7042.07** | **8325.55** | **9306.49** | **9574.70** | **8048.74** | **8423.53** | **8430.58** |
| **Total (w/ LULUCF)** | **5521.32** | **6915.99** | **8251.89** | **9127.27** | **9408.38** | **7876.57** | **8250.30** | **8262.48** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. Energy | 3940.66 | 5093.38 | 6344.87 | 7128.69 | 7494.87 | 5788.58 | 5959.03 | 6039.82 |
| 2. Industrial Processes | 764.91 | 855.64 | 888.38 | 1067.86 | 942.06 | 1199.30 | 1414.12 | 1316.53 |
| 3. Agriculture | 531.02 | 666.42 | 632.31 | 624.16 | 637.48 | 550.18 | 537.75 | 559.30 |
| 4. LULUCF | -100.32 | -126.08 | -73.66 | -179.22 | -166.03 | -172.17 | -173.22 | -168.11 |
| 5. Waste | 385.06 | 426.63 | 460.00 | 485.78 | 499.98 | 510.68 | 512.62 | 514.94 |
| 6. Other | | | | | | | | |
| **Total (w/o LULUCF)** | **5621.64** | **7042.07** | **8325.55** | **9306.49** | **9574.70** | **8048.74** | **8423.53** | **8430.58** |
| **Total (w/ LULUCF)** | **5521.32** | **6915.99** | **8251.89** | **9127.27** | **9408.38** | **7876.57** | **8250.30** | **8262.48** |

## 2.2. Description and interpretation of emission trends by category

GHG emissions trends by sector for the period 1990 - 2015 are presented in Table 2.2.

**Table 2.2. Total national GHG emissions by sector 1990-2015**

| | **Energy** | **Industry** | **Agriculture** | **LULUCF** | **Waste** | **Total (w/o LULUCF)** | **Total (w/ LULUCF)** |
|---|---|---|---|---|---|---|---|
| **1990** | 3940.7 | 764.9 | 531.02 | -100.3 | 385.06 | 5621.64 | 5521.32 |

| | Energy | Industry | Agriculture | LULUCF | Waste | Total (w/o LULUCF) | Total (w/ LULUCF) |
|---|---|---|---|---|---|---|---|
| **1991** | 4470.9 | 724.5 | 533.30 | -119.1 | 389.69 | 6118.43 | 5999.29 |
| **1992** | 4798.1 | 776.5 | 582.38 | -126.4 | 399.08 | 6556.09 | 6429.70 |
| **1993** | 4977.6 | 849.7 | 620.22 | -110.4 | 407.78 | 6855.26 | 6744.82 |
| **1994** | 5187.0 | 887.0 | 606.30 | -113.7 | 418.97 | 7099.35 | 6985.64 |
| **1995** | 5093.4 | 855.6 | 666.42 | -126.1 | 426.63 | 7042.07 | 6915.99 |
| **1996** | 5346.0 | 915.5 | 645.37 | -126.4 | 430.91 | 7337.71 | 7211.28 |
| **1997** | 5511.7 | 885.2 | 631.46 | -130.6 | 438.65 | 7467.01 | 7336.41 |
| **1998** | 5854.8 | 844.5 | 651.08 | -109.6 | 444.92 | 7795.25 | 7685.60 |
| **1999** | 6117.8 | 857.7 | 628.66 | -147.7 | 452.02 | 8056.16 | 7908.49 |
| **2000** | 6344.9 | 888.4 | 632.31 | -73.7 | 460.00 | 8325.55 | 8251.89 |
| **2001** | 6236.7 | 885.2 | 690.97 | -134.9 | 468.54 | 8281.49 | 8146.61 |
| **2002** | 6395.4 | 930.4 | 717.35 | -167.8 | 474.84 | 8517.95 | 8350.11 |
| **2003** | 6785.6 | 946.4 | 703.55 | -171.4 | 476.42 | 8912.04 | 8740.66 |
| **2004** | 6950.0 | 1032.4 | 681.98 | -171.6 | 478.97 | 9143.28 | 8971.67 |
| **2005** | 7128.7 | 1067.9 | 624.16 | -179.2 | 485.78 | 9306.49 | 9127.27 |
| **2006** | 7311.5 | 1132.0 | 647.41 | -179.6 | 480.09 | 9571.04 | 9391.46 |
| **2007** | 7632.9 | 1150.4 | 643.89 | -111.7 | 482.06 | 9909.29 | 9797.57 |
| **2008** | 7799.6 | 1185.3 | 616.78 | -160.5 | 489.88 | 10091.56 | 9931.03 |
| **2009** | 7724.7 | 1047.0 | 611.74 | -177.7 | 488.68 | 9872.18 | 9694.45 |
| **2010** | 7494.9 | 942.1 | 637.48 | -166.0 | 499.98 | 9574.40 | 9408.37 |
| **2011** | 7202.0 | 958.5 | 619.21 | -168.9 | 495.55 | 9275.27 | 9106.40 |
| **2012** | 6709.1 | 957.2 | 593.81 | -162.9 | 508.13 | 8768.17 | 8605.24 |
| **2013** | 5788.6 | 1199.3 | 550.18 | -172.2 | 510.68 | 8048.74 | 7876.57 |
| **2014** | 5959.0 | 1414.1 | 537.75 | -173.2 | 512.62 | 8423.53 | 8250.30 |
| **2015** | 6039.8 | 1316.5 | 559.30 | -168.1 | 514.94 | 8430.58 | 8262.48 |
| ***Change 1990-2015*** | ***53.3%*** | ***72.1%*** | ***5.33%*** | ***67.6%*** | ***33.73%*** | ***49.97%*** | ***49.65%*** |

### 2.2.1. Energy

The energy sector in Cyprus relies on fossil fuel combustion for meeting the bulk of energy requirements. Final consumption in 2015 amounted to approximately 80 PJ compared to 78 PJ in 2014 (2.6% increase). 97.77% of the consumption in 2015 was from liquid fuels, 0.19% from solid fuels, 0.04% from other fossil fuels and 2% from biomass. In comparison to 1990, total fuel consumption in 2015 including biomass increased by 54%. Natural gas is not available in Cyprus.

After robust growth rates in the 1980s (average annual growth was 6.1%), economic performance in the 1990s was mixed: real GDP growth was 9.7% in 1992, 1.7% in 1993, 6.0% in 1994, 6.0% in 1995, 1.9% in 1996 and 2.3% in 1997. This pattern underlined the economy's vulnerability to swings in tourist arrivals (i.e. to economic and political conditions in Cyprus, Western Europe, and the Middle East) and the need to diversify the economy. Declining competitiveness in tourism and especially in manufacturing are acting as a drag on growth until structural changes are in effect. This is greatly affecting the energy sector.

The emissions from the energy sector in Cyprus increased by 53% during the period 1990-2015. The greatest increase in emissions was between 1990 and 2008 (98%), the emissions reached their peak (7799 Gg $CO_2$ eq.). All the emissions in 2015 are from fuel combustion. The contribution of the emissions from the energy sector to the total without LULUCF in 2015 was 72% compared to 70% in 1990.

Energy is mainly responsible for carbon dioxide emissions, while it contributes also to methane and nitrous oxide emissions. In 2015, 98.7% of the emissions from the energy sector were carbon dioxide, 0.3% methane and 1% nitrous oxide. Fugitive emissions from fuels have not been estimated since 2004 when the refining activities stopped in Cyprus. The contribution of each source and gas to the total of the energy sector is presented in Figure 2.2.

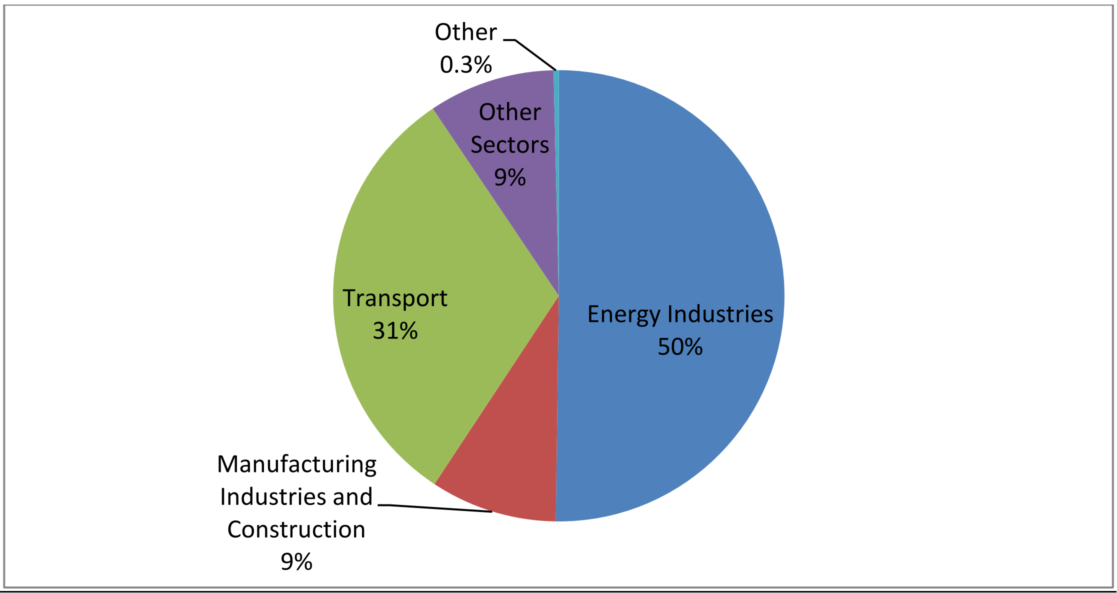


**Figure 2.2. Contribution of the main energy sources of emissions to the total energy emissions in 2015**

### 2.2.2. Industrial processes

In 2015, GHG emissions from Industrial processes accounted for 15.6% of total emissions excluding LULUCF compared to 14% in 1990. The emissions have increased by 72% compared to 1990. 67.3% of the industrial processes emissions are from mineral production, 27.3% is from consumption of Halocarbons and SF6, 4.5% is from Other Product Manufacture and Use and the remaining 0.8% is from non-energy products from fuels and solvent use.

### 2.2.3. Agriculture

Emissions from Agriculture accounted for 6.6% of total emissions in 2015 (without LULUCF), compared to 9.4% in 1990. Emissions increased by 5.3% compared to 1990. The peak of Agriculture emissions was in 2002 (717 Gg CO2 eq.) when an increase of 35% compared to 1990 was observed. Since 2002 a reduction in emissions was observed, due to the reduction of $N_2O$ emissions from agricultural soils, because of the reduction in the use of synthetic nitrogen fertilisers. The reduction of the use of fertilisers was caused by the drought that was taking place during the same period that had an extreme in 2008. Further reduction was caused by the recent changes in manure management. Agriculture is responsible for mainly methane and nitrous oxide emissions. In 2015 agriculture has contributed 41% to the total methane emissions and 59% to the total nitrous oxide emissions. The contribution of the main agricultural sources of emissions to the total agriculture emissions in 2015 is presented in Figure 2.3.

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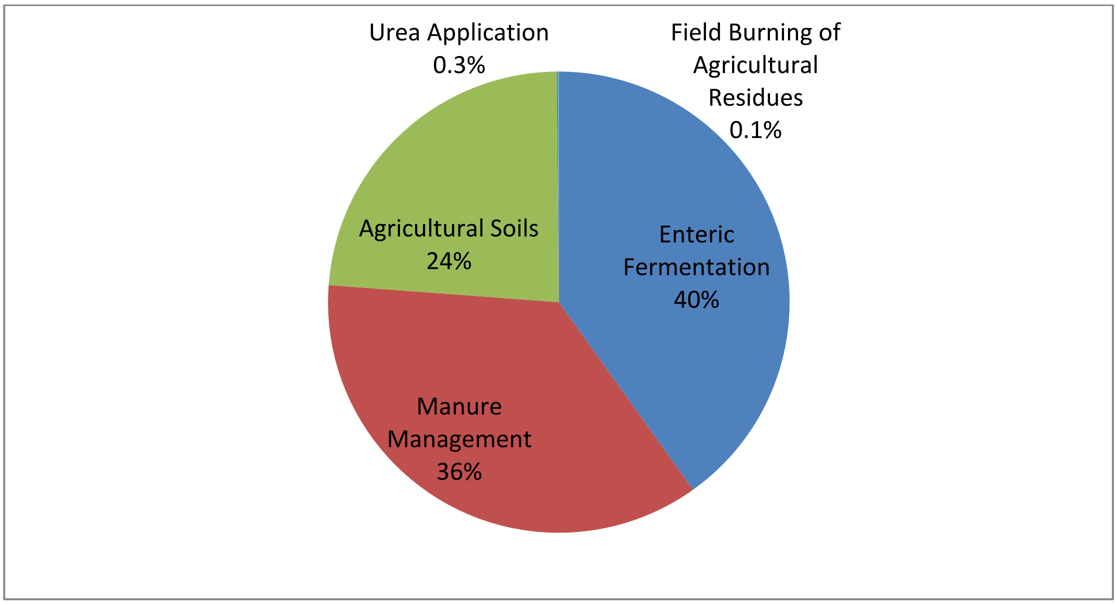


**Figure 2.3. Contribution of the main agricultural sources of emissions to the total agriculture emissions in 2015**

### 2.2.4. Land use, land use change and forestry

The emissions from LULUCF changed from about -100 Gg CO2 eq. in 1990 to -168 Gg CO2 in 2015. Overall the trend is one of increased removals from the LULUCF sector, with the exception of peaks in emissions in years with increased wildfires.

### 2.2.5. Waste

Emissions from the Waste Sector in 2015 contributed 6% of the total emissions without LULUCF. In 2015, 89% of the emissions is from solid waste disposal, 1.5% from biological treatment of solid waste and 9.5% from waste water treatment and discharge. 57% of the total methane emissions and 6.2% of the nitrous oxide emissions of the country are from the sector of waste. The emissions from waste have changed considerably between 1990 and 2015 due to changes that are taking place in the waste and wastewater management practices of the country.

## 2.3. Description and interpretation of emission trends by gas

GHG emissions trends by gas for the period 1990 - 2015 are presented in Figure 2.4 and Table 2.3.

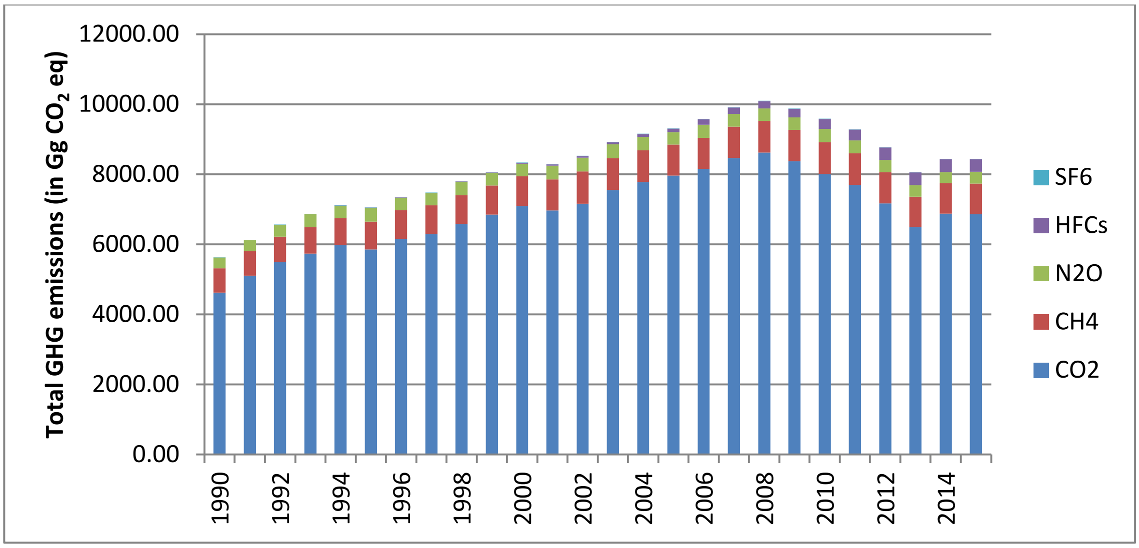


**Figure 2.4. Total national GHG emissions by gas 1990-2015 (excluding LULUCF)**

**Table 2.3. Total national GHG emissions by gas 1990-2015**

| **Gg CO2 eq.** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** |
|---|---|---|---|---|---|---|---|
| CO2 w/o LULUCF | 4620.99 | 5107.07 | 5482.96 | 5733.67 | 5977.25 | 5848.04 | 6156.12 |
| CO2 w/ LULUCF | 4520.60 | 4987.71 | 5356.50 | 5622.70 | 5862.16 | 5721.42 | 6028.78 |
| CH4 w/o LULUCF | 691.71 | 702.45 | 731.61 | 759.54 | 771.05 | 794.92 | 815.41 |
| CH4 w LULUCF | 691.75 | 702.57 | 731.65 | 759.87 | 771.88 | 795.25 | 815.95 |
| N2O w/o LULUCF | 308.92 | 308.89 | 341.48 | 362.00 | 350.72 | 397.41 | 363.43 |
| N2O w LULUCF | 308.95 | 308.98 | 341.51 | 362.21 | 351.28 | 397.62 | 363.73 |
| HFCs | NO,NE | 0.00 | 0.00 | 0.01 | 0.28 | 1.64 | 2.70 |
| PFCs | | | | | | | |
| SF6 | 0.03 | 0.03 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 |
| NF3 | | | | | | | |
| **Total (w/o LULUCF)** | **5621.64** | **6118.43** | **6556.09** | **6855.26** | **7099.35** | **7042.07** | **7337.71** |
| **Total (w/ LULUCF)** | **5521.32** | **5999.29** | **6429.70** | **6744.82** | **6985.64** | **6915.99** | **7211.28** |

| **Gg CO2 eq.** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** |
|---|---|---|---|---|---|---|---|
| CO2 w/o LULUCF | 6287.01 | 6580.28 | 6847.63 | 7095.92 | 6969.45 | 7160.37 | 7550.07 |
| CO2 w/ LULUCF | 6155.11 | 6466.22 | 6699.94 | 7012.79 | 6831.41 | 6992.45 | 7378.30 |
| CH4 w/o LULUCF | 822.65 | 825.96 | 826.57 | 842.54 | 882.07 | 914.83 | 909.51 |
| CH4 w LULUCF | 823.43 | 828.62 | 826.58 | 848.24 | 883.98 | 914.88 | 909.74 |
| N2O w/o LULUCF | 352.06 | 378.33 | 364.93 | 361.82 | 393.33 | 394.89 | 392.97 |
| N2O w LULUCF | 352.58 | 380.08 | 364.94 | 365.59 | 394.59 | 394.93 | 393.13 |
| HFCs | 5.21 | 10.62 | 16.97 | 25.20 | 36.55 | 47.77 | 59.40 |
| PFCs | | | | | | | |
| SF6 | 0.07 | 0.07 | 0.07 | 0.08 | 0.08 | 0.08 | 0.09 |
| NF3 | | | | | | | |
| **Total (w/o LULUCF)** | **7467.01** | **7795.25** | **8056.16** | **8325.55** | **8281.49** | **8517.95** | **8912.04** |
| **Total (w/ LULUCF)** | **7336.41** | **7685.60** | **7908.49** | **8251.89** | **8146.61** | **8350.11** | **8740.66** |

| **Gg CO2 eq.** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
|---|---|---|---|---|---|---|---|
| CO2 w/o LULUCF | 7776.89 | 7961.97 | 8152.48 | 8458.66 | 8620.39 | 8372.39 | 8004.90 |
| CO2 w/ LULUCF | 7604.53 | 7782.49 | 7972.28 | 8341.17 | 8459.66 | 8194.33 | 7837.64 |
| CH4 w/o LULUCF | 904.43 | 883.32 | 887.44 | 899.69 | 897.28 | 895.15 | 914.44 |
| CH4 w LULUCF | 904.89 | 883.47 | 887.81 | 903.16 | 897.40 | 895.35 | 915.18 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| N2O w/o LULUCF | 384.25 | 357.80 | 374.89 | 367.87 | 357.09 | 355.26 | 374.24 |
| N2O w LULUCF | 384.55 | 357.91 | 375.14 | 370.16 | 357.17 | 355.39 | 374.73 |
| HFCs | 77.60 | 103.28 | 156.10 | 182.93 | 216.65 | 249.22 | 280.66 |
| PFCs | | | | | | | |
| SF6 | 0.10 | 0.12 | 0.12 | 0.14 | 0.15 | 0.16 | 0.15 |
| NF3 | | | | | | | |
| **Total (w/o LULUCF)** | **9143.28** | **9306.49** | **9571.04** | **9909.29** | **10091.56** | **9872.18** | **9574.40** |
| **Total (w/ LULUCF)** | **8971.67** | **9127.27** | **9391.46** | **9797.57** | **9931.03** | **9694.45** | **9408.37** |

| **Gg CO2 eq.** | **2011** | **2012** | **2013** | **2014** | **2015** | | |
|---|---|---|---|---|---|---|---|
| CO2 w/o LULUCF | 7696.66 | 7164.09 | 6487.25 | 6878.37 | 6859.65 | | |
| CO2 w/ LULUCF | 7526.79 | 7000.08 | 6314.71 | 6704.74 | 6691.40 | | |
| CH4 w/o LULUCF | 906.54 | 895.93 | 873.33 | 868.01 | 876.72 | | |
| CH4 w LULUCF | 907.15 | 896.58 | 873.55 | 868.25 | 876.81 | | |
| N2O w/o LULUCF | 358.67 | 351.32 | 324.04 | 317.69 | 334.76 | | |
| N2O w LULUCF | 359.07 | 351.76 | 324.19 | 317.85 | 334.82 | | |
| HFCs | 313.24 | 356.67 | 363.98 | 359.31 | 359.31 | | |
| PFCs | | | | | | | |
| SF6 | 0.15 | 0.16 | 0.15 | 0.15 | 0.15 | | |
| NF3 | | | | | | | |
| **Total (w/o LULUCF)** | **9275.27** | **8768.17** | **8048.74** | **8423.53** | **8430.58** | | |
| **Total (w/ LULUCF)** | **9106.40** | **8605.24** | **7876.57** | **8250.30** | **8262.48** | | |

### 2.3.1. Carbon dioxide

Carbon dioxide emissions from 1990 to 2015 by source category are presented in Table 2.5. Total CO2 emissions without LULUCF increased from 4,621 Gg in 1990 to 6,860 Gg in 2015. The increase of 48% from 1990 to 2015 is mainly attributed to the increased electricity production as well as to the increased energy consumption in the residential and transport sectors. The decrease of 20% from 2008 to 2015 is mainly attributed to economic crisis and the increasing share of renewable energy technologies.

CO2 emissions from Energy increase from 3,896 Gg in 1990 to 5,962 Gg in 2015, presenting a total increase of 53% from 1990 to 2015. Carbon dioxide emissions from Industrial processes in 2015 increased by 24% compared to 1990 (from 724 to 897 Gg CO2).

### 2.3.2. Methane

The methane emissions from 1990 to 2015 by source category are presented in Table 2.6. Total methane emissions without LULUCF in 2015 increased by 27% from 1990. Methane emissions from Agriculture in 2015 accounted for 41% of total methane emissions (without LULUCF). Methane emissions from Waste sector in 2015 account for 57% of the total CH4 emissions (excl. LULUCF). The energy sector accounts for the remaining 2% of the total methane emissions (without LULUCF).

### 2.3.3. Nitrous Oxide

Nitrous oxide emissions from 1990 to 2015 by source category are presented in Table 2.7. Total nitrous oxide emissions without LULUCF in 2015 increased by 8% from 1990. Agriculture represents the largest anthropogenic source of nitrous oxide emissions in Cyprus with 59% of the total nitrous oxide emissions in 2015, without LULUCF. N2O emissions from industrial processes account for 18% of the national total N2O without LULUCF. N2O emissions from Waste in 2015 contributed 6% to the total emissions without LULUCF and increased by 58% compared to 1990 levels. $N_2O$ emissions from Energy in 2015 account for 18%.

### 2.3.4. Halocarbons and sulphur hexafluoride

HFC and PFC are chemical substances, the production of which aims mainly to the substitution of ozone depleting substances (see Montreal Protocol – 1987). HFC and PFC are not harmful to the stratospheric ozone layer and thus their emissions are not controlled by the above-mentioned Protocol. However, many of these substances, as well as $SF_6$, are powerful greenhouse gases. Apart from being characterized by a high Global Warming Potential (GWP), these gases have extremely long atmospheric lifetimes, resulting in their essentially irreversible accumulation in the atmosphere. Especially sulphur hexafluoride is the most potent greenhouse gas according to the IPCC evaluation.

HFC emissions increased significantly since 1990, mainly due to the increase of air conditioning equipment in the residential sector, the increasing trend of emissions from the commercial refrigeration and the introduction of new passenger cars with air-conditioning systems, but also due to the implementation of the Montreal Protocol, leading to an increase in the number of equipment operating with f-gases.

**Table 2.4. Halocarbons and sulphur hexafluoride emissions for the period 1990-2015 in Gg $CO_2$ eq.**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| HFC-134a | NE,NO | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 |
| HFC-227ea | NE,NO | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unspecified mix of HFCs | NE,NO | 1.62 | 23.72 | 98.35 | 300.13 | 349.51 | 345.03 | 345.03 |
| **Emissions of HFCs** | **NE,NO** | **1.64** | **25.20** | **103.28** | **280.66** | **363.98** | **359.31** | **359.31** |
| | | | | | | | | |
| **Emissions of SF6** | **0.026** | **0.06** | **0.08** | **0.12** | **0.15** | **0.15** | **0.15** | **0.00** |

**Table 2.5. CO2 emissions 1990-2015, Gg**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2014 | 2015 | | *change 1990-2015* |
|---|---|---|---|---|---|---|---|---|---|
| **1. Energy** | **3896** | **5039** | **6280** | **7049** | **7402** | **5883** | **5962** | | ***53%*** |
| A. Fuel combustion (sectoral approach) | 3896 | 5039 | 6280 | 7049 | 7402 | 5883 | 5962 | | *53%* |
| 1. Energy industries | 1761 | 2166 | 2955 | 3472 | 3868 | 2940 | 3023 | | *72%* |
| 2. Manufacturing industries and construction | 512 | 771 | 819 | 908 | 697 | 690 | 546 | | *7%* |
| 3. Transport | 1181 | 1482 | 1760 | 2045 | 2253 | 1761 | 1830 | | *55%* |
| 4. Other sectors | 430 | 603 | 725 | 605 | 563 | 456 | 541 | | *26%* |
| 5. Other | 11.0 | 17.2 | 21.4 | 19.0 | 20.3 | 35.0 | 22.2 | | *103%* |
| **2. Industrial processes** | **724** | **808** | **814** | **912** | **602** | **995** | **897** | | ***24%*** |
| A. Mineral industry | 717 | 795 | 803 | 894 | 585 | 986 | 887 | | *24%* |
| D. Non-energy products from fuels and solvent use | 6.30 | 13.14 | 10.96 | 17.60 | 17.19 | 9.16 | 10.70 | | *70%* |
| G. Other product manufacture and use | 0.06 | 0.02 | 0.16 | 0.04 | 0.03 | 0.01 | 0.01 | | *-64%* |
| **3. Agriculture** | **1.82** | **1.54** | **1.67** | **0.97** | **0.74** | **0.41** | **0.40** | | ***-78%*** |
| H. Urea application | 1.82 | 1.54 | 1.67 | 0.97 | 0.74 | 0.41 | 0.40 | | *-78%* |
| **4. Land use, land-use change and forestry** | **-100.39** | **-127** | **-83** | **-179** | **-167** | **-174** | **-168** | | ***68%*** |
| A. Forest land | -100.39 | -127 | -83 | -179 | -167 | -174 | -168 | | *68%* |
| | | | | | | | | | |
| **Memo items:** | | | | | | | | | |
| **International bunkers** | **916** | **1024** | **1439** | **1763** | **1424** | **1510** | **1519** | | ***66%*** |
| Aviation | 733 | 808 | 833 | 846 | 836 | 776 | 752 | | *3%* |
| Navigation | 183 | 217 | 606 | 917 | 588 | 733 | 767 | | *320%* |
| **$CO_2$ emissions from biomass** | **18.0** | **33.3** | **29.2** | **44.1** | **143** | **125** | **134** | | ***648%*** |
| | | | | | | | | | |
| **Total $CO_2$ w/o LULUCF** | **4621** | **5848** | **7096** | **7962** | **8005** | **6878** | **6860** | | ***48%*** |
| **Total $CO_2$ w/ LULUCF** | **4521** | **5721** | **7013** | **7782** | **7838** | **6705** | **6691** | | ***48%*** |

**Table 2.6. CH4 emissions 1990-2015, Gg**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2014 | 2015 | change 1990-2015 |
|---|---|---|---|---|---|---|---|---|
| 1. Energy | 0.422 | 0.512 | 0.589 | 0.736 | 0.857 | 0.728 | 0.768 | 82% |
| A. Fuel combustion (sectoral approach) | 0.422 | 0.512 | 0.589 | 0.736 | 0.857 | 0.728 | 0.768 | 82% |
| 1. Energy industries | 0.068 | 0.084 | 0.115 | 0.136 | 0.149 | 0.113 | 0.117 | 72% |
| 2. Manufacturing industries and construction | 0.035 | 0.032 | 0.040 | 0.049 | 0.047 | 0.040 | 0.025 | -29% |
| 3. Transport | 0.216 | 0.251 | 0.287 | 0.394 | 0.490 | 0.417 | 0.424 | 97% |
| 4. Other sectors | 0.101 | 0.144 | 0.145 | 0.152 | 0.166 | 0.154 | 0.198 | 96% |
| 5. Other | 0.001 | 0.002 | 0.003 | 0.006 | 0.006 | 0.005 | 0.003 | 104% |
| B. Fugitive emissions from fuels | 0.000002 | 0.000003 | 0.000005 | NO,NE | NO,NE | NE,NO | NE,NO | 0 |
| 2. Oil and natural gas and other emissions from energy production | 0.000002 | 0.000003 | 0.000005 | NO,NE | NO,NE | NE,NO | NE,NO | |
| 3. Agriculture | 12.34 | 14.79 | 15.29 | 15.74 | 16.40 | 14.22 | 14.48 | 17% |
| A. Enteric fermentation | 7.88 | 8.88 | 8.97 | 9.14 | 9.41 | 8.91 | 8.98 | 14% |
| B. Manure management | 4.44 | 5.91 | 6.32 | 6.59 | 6.98 | 5.31 | 5.49 | 24% |
| F. Field burning of agricultural residues | 0.01 | 0.001 | 0.01 | 0.01 | 0.01 | 0.01 | 0.013 | -7% |
| 4. Land use, land-use change and forestry | 0.002 | 0.013 | 0.228 | 0.006 | 0.030 | 0.010 | 0.003 | 104% |
| A. Forest land | 0.002 | 0.013 | 0.228 | 0.006 | 0.030 | 0.010 | 0.003 | 104% |
| 5. Waste | 14.91 | 16.49 | 17.82 | 18.86 | 19.32 | 19.77 | 19.82 | 33% |
| A. Solid waste disposal | 10.33 | 11.38 | 12.78 | 14.40 | 16.30 | 18.01 | 18.33 | 77% |
| B. Biological treatment of solid waste | NO | NO | NO | NO | 0.03 | 0.12 | 0.18 | 100 |
| D. Waste water treatment and discharge | 4.58 | 5.12 | 5.04 | 4.46 | 2.99 | 1.64 | 1.31 | -71% |
| | | | | | | | | |
| Memo items: | | | | | | | | |
| International bunkers | 0.019 | 0.023 | 0.055 | 0.081 | 0.053 | 0.062 | 0.066 | 250% |
| Aviation | 0.005 | 0.006 | 0.006 | 0.006 | 0.006 | 0.005 | 0.005 | 3% |
| Navigation | 0.014 | 0.018 | 0.049 | 0.075 | 0.047 | 0.057 | 0.060 | 343% |
| | | | | | | | | |
| Total CH4 emissions without CH4 from LULUCF | 27.743 | 31.901 | 33.898 | 35.770 | 37.663 | 36.448 | 36.932 | 33% |
| Total CH4 emissions with CH4 from LULUCF | 27.744 | 31.914 | 34.126 | 35.776 | 37.693 | 36.457 | 36.935 | 33% |

**Table 2.7. N2O emissions 1990-2015, Gg**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2014 | 2015 | | change 1990-2015 |
|---|---|---|---|---|---|---|---|---|---|
| **1. Energy** | **0.116** | **0.140** | **0.167** | **0.206** | **0.240** | **0.194** | **0.197** | | **70%** |
| A. Fuel combustion (sectoral approach) | 0.116 | 0.140 | 0.167 | 0.206 | 0.240 | 0.194 | 0.197 | | 70% |
| 1. Energy industries | 0.013 | 0.016 | 0.022 | 0.027 | 0.030 | 0.023 | 0.023 | | 72% |
| 2. Manufacturing industries and construction | 0.006 | 0.006 | 0.007 | 0.009 | 0.008 | 0.007 | 0.005 | | -22% |
| 3. Transport | 0.093 | 0.113 | 0.132 | 0.166 | 0.197 | 0.161 | 0.165 | | 77% |
| 4. Other sectors | 0.003 | 0.005 | 0.006 | 0.005 | 0.004 | 0.004 | 0.005 | | 39% |
| 5. Other | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | 102% |
| **2. Industrial processes** | **0.139** | **0.155** | **0.165** | **0.176** | **0.198** | **0.200** | **0.200** | | **44%** |
| G. Other product manufacture and use | 0.139 | 0.155 | 0.165 | 0.176 | 0.198 | 0.200 | 0.200 | | 44% |
| **3. Agriculture** | **0.74** | **0.99** | **0.83** | **0.77** | **0.76** | **0.61** | **0.66** | | **-11%** |
| B. Manure management | 0.24 | 0.28 | 0.31 | 0.29 | 0.27 | 0.22 | 0.22 | | -10% |
| D. Agricultural soils | 0.50 | 0.71 | 0.52 | 0.48 | 0.49 | 0.39 | 0.44 | | -11% |
| F. Field burning of agricultural residues | 0.00036 | 0.00020 | 0.00029 | 0.00018 | 0.00021 | 0.00017 | 0.0034 | | -6% |
| **4. Land use, land-use change and forestry** | **9.23809E-05** | **0.00072** | **0.01263** | **0.00034** | **0.00164** | **0.00054** | **0.0002** | | **116%** |
| A. Forest land | 9.23809E-05 | 0.00072 | 0.01263 | 0.00034 | 0.00164 | 0.00054 | 0.0002 | | 116% |
| **5. Waste** | **0.04** | **0.048** | **0.049** | **0.049** | **0.057** | **0.062** | **0.065** | | **58%** |
| B. Biological treatment of solid waste | NO | NO | NO | NO | 0.002 | 0.007 | 0.011 | | 100% |
| D. Waste water treatment and discharge | 0.04 | 0.05 | 0.049 | 0.049 | 0.055 | 0.055 | 0.055 | | 32% |
| | | | | | | | | | |
| **Memo items:** | | | | | | | | | |
| **International bunkers** | **0.028** | **0.029** | **0.043** | **0.053** | **0.046** | **0.048** | **0.047** | | **68%** |
| Aviation | 0.021 | 0.023 | 0.023 | 0.024 | 0.023 | 0.022 | 0.021 | | 3% |
| Navigation | 0.008 | 0.007 | 0.020 | 0.029 | 0.023 | 0.026 | 0.026 | | 245% |
| | | | | | | | | | |
| **Total direct N2O emissions without N2O from LULUCF** | **1.04** | **1.33** | **1.21** | **1.20** | **1.26** | **1.07** | **1.12** | | **8%** |
| **Total direct N2O emissions with N2O from LULUCF** | **1.04** | **1.33** | **1.23** | **1.20** | **1.26** | **1.07** | **1.12** | | **8%** |

## 2.4. Description and interpretation of emission trends for indirect greenhouse gases and SO2

The role of carbon monoxide (CO), nitrogen oxides (NOx) and non-methane organic volatile compounds (NMVOC) is important for climate change as these gases act as precursors of tropospheric ozone. In this way, they contribute to ozone formation and alter the atmospheric lifetimes of other greenhouse gases. For example, CO interacts with the hydroxyl radical (OH), the major atmospheric sink for methane, to form carbon dioxide. Therefore, increased atmospheric concentration of CO limits the number of OH compounds available to destroy methane, thus increasing the atmospheric lifetime of methane.

These gases are generated through a variety of anthropogenic activities. Emissions for indirect greenhouse gases and SO2 are presented in Table 2.8. The emissions (except LULUCF) have been estimated by the Department of Labour Inspection that is the competent authority for the preparation of air pollutants inventories under Directive 2001/81/EC.

## 2.5. Description and interpretation of emission trends for KP-LULUCF inventory in aggregate and by activity, and by gas

Please refer to Chapter 9.

**Table 2.8. Indirect greenhouse gases and SO2 emissions for the period 1990-2015 in Gg**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Energy | | | | | | | | | | | | | | |
| NOx | 15.13 | 15.34 | 17.18 | 17.64 | 18.84 | 18.22 | 18.29 | 18.68 | 19.17 | 21.34 | 22.71 | 20.16 | 20.33 | 20.76 |
| CO | 40.41 | 37.81 | 38.42 | 37.57 | 37.37 | 35.59 | 34.61 | 33.20 | 31.14 | 29.73 | 28.47 | 27.59 | 27.09 | 27.51 |
| NMVOC | 6.83 | 6.64 | 6.86 | 6.82 | 6.93 | 6.75 | 6.60 | 6.68 | 6.47 | 6.37 | 6.17 | 6.06 | 5.82 | 6.01 |
| SO2 | 31.30 | 32.58 | 37.42 | 39.59 | 42.11 | 41.81 | 41.15 | 43.30 | 46.58 | 48.88 | 47.95 | 44.99 | 45.29 | 46.77 |
| Industrial processes | | | | | | | | | | | | | | |
| NOx | 0.007 | 0.007 | 0.008 | 0.002 | 0.002 | 0.002 | 0.006 | 0.007 | 0.007 | 0.010 | 0.019 | 0.006 | 0.006 | 0.004 |
| CO | 0.21 | 0.21 | 0.23 | 0.07 | 0.07 | 0.19 | 0.20 | 0.22 | 0.23 | 032 | 0.59 | 0.18 | 0.17 | 0.12 |
| NMVOC | 2.57 | 2.06 | 2.36 | 2.35 | 2.55 | 2.56 | 2.28 | 2.43 | 2.32 | 2.37 | 2.55 | 2.42 | 3.16 | 3.72 |
| SO2 | 0.00001318 | 0.00001318 | 0.00001318 | 0.00001318 | 0.00001318 | 0.00001318 | 0.00001318 | 0.00001318 | 0.00001318 | 0.00001318 | 0.00001318 | 0.00001318 | 0.00001318 | 0.00001318 |
| Agriculture | | | | | | | | | | | | | | |
| NOx | 0.65 | 0.65 | 0.80 | 0.68 | 0.66 | 0.66 | 0.64 | 0.52 | 0.45 | 0.47 | 0.46 | 0.50 | 0.41 | 0.33 |
| CO | 2.30 | 2.24 | 2.35 | 2.35 | 2.03 | 1.83 | 1.65 | 1.51 | 1.42 | 1.30 | 1.03 | 1.01 | 0.95 | 1.02 |
| NMVOC | 1.54 | 1.52 | 1.60 | 1.75 | 1.77 | 1.84 | 1.90 | 1.85 | 1.80 | 1.77 | 1.77 | 1.82 | 1.92 | 1.93 |
| SO2 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| LULUCF | | | | | | | | | | | | | | |
| NOx | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO |
| CO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO |
| NMVOC | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO |
| SO2 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Waste | | | | | | | | | | | | | | |
| NOx | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.002 |
| CO | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| NMVOC | 0.53 | 0.54 | 0.56 | 0.58 | 0.60 | 0.60 | 0.61 | 0.62 | 0.63 | 0.66 | 0.66 | 0.69 | 0.70 | 0.73 |
| SO2 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0001 |
| **Total including LULUCF** | | | | | | | | | | | | | | |
| **NOx** | **15.79** | **15.99** | **17.98** | **18.33** | **19.50** | **18.89** | **18.98** | **19.21** | **19.62** | **21.82** | **23.19** | **20.67** | **20.74** | **21.10** |
| **CO** | **42.95** | **40.28** | **41.03** | **40.02** | **39.49** | **37.64** | **36.49** | **34.96** | **32.82** | **31.38** | **30.12** | **28.82** | **28.24** | **28.68** |
| **NMVOC** | **11.47** | **10.76** | **11.38** | **11.50** | **11.85** | **11.75** | **11.38** | **11.58** | **11.23** | **11.16** | **11.16** | **11.16** | **10.98** | **11.60** |
| **SO2** | **31.3** | **32.58** | **37.42** | **39.59** | **42.10** | **41.81** | **41.15** | **43.30** | **46.58** | **48.88** | **47.95** | **45.00** | **45.29** | **46.77** |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Energy | | | | | | | | | | | | | | |
| NOx | 20.37 | 20.39 | 20.30 | 20.51 | 19.19 | 19.07 | 17.59 | 20.56 | 20.63 | 15.47 | 16.62 | 14.27 | | |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | 26.36 | 25.37 | 23.80 | 23.08 | 21.20 | 19.05 | 17.82 | 16.35 | 14.83 | 13.89 | 13.99 | 13.75 | | |
| NMVOC | 5.22 | 4.84 | 4.01 | 4.11 | 4.00 | 3.69 | 3.50 | 3.33 | 3.15 | 2.59 | 2.45 | 2.46 | | |
| SO2 | 40.06 | 37.81 | 31.41 | 29.37 | 22.37 | 17.68 | 21.86 | 20.86 | 16.17 | 13.70 | 16.88 | 13.10 | | |
| Industrial processes | | | | | | | | | | | | | | |
| NOx | 0.006 | 0.005 | 0.003 | 0.003 | 0.003 | 0.004 | 0.004 | 0.003 | 0.003 | 0.003 | 0.001 | 0.002 | | |
| CO | 0.18 | 0.16 | 0.10 | 0.11 | 0.10 | 0.11 | 0.12 | 0.10 | 0.11 | 0.08 | 0.034 | 0.077 | | |
| NMVOC | 4.99 | 4.72 | 5.39 | 5.04 | 4.07 | 3.77 | 4.17 | 2.32 | 2.28 | 1.93 | 1.79 | 2.20 | | |
| SO2 | 0.00001318 | 0.00001318 | 0.0000132 | 0.0000132 | 0.0000132 | 0.0000132 | 0.0000132 | 0.0000021 | 0.00001 | 0.0000005 | 0.0000085 | 0.000006 | | |
| Agriculture | | | | | | | | | | | | | | |
| NOx | 0.36 | 0.38 | 0.34 | 0.31 | 0.24 | 0.20 | 0.25 | 0.18 | 0.20 | 0.19 | 0.16 | 0.17 | | |
| CO | 0.8 | 0.62 | 0.47 | 0.26 | 0.15 | 0.12 | 0.13 | 0.14 | 0.15 | 0.12 | 0.10 | 0.13 | | |
| NMVOC | 1.87 | 1.77 | 1.68 | 1.66 | 1.65 | 0.94 | 0.94 | 0.92 | 0.89 | 0.84 | 0.88 | 0.84 | | |
| SO2 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | | |
| LULUCF | | | LULUCF | | | | | | | | | | | |
| NOx | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | | |
| CO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | | |
| NMVOC | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | NE,NO | | |
| SO2 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | | |
| Waste | | | | | | | | | | | | | | |
| NOx | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | | |
| CO | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | | |
| NMVOC | 0.75 | 0.76 | 0.78 | 0.80 | 0.83 | 0.84 | 0.77 | 0.72 | 0.71 | 0.66 | 0.62 | 0.63 | | |
| SO2 | 0.000065 | 0.000066 | 0.000067 | 0.000069 | 0.000071 | 0.000073 | 0.000074 | 0.000076 | 0.000077 | 0.000076 | 0.000075 | 0.000075 | | |
| **Total including LULUCF** | | | | | | | | | | | | | | |
| **NOx** | **20.74** | **20.77** | **20.64** | **20.83** | **19.44** | **19.28** | **17.85** | **20.75** | **20.84** | **15.67** | **16.78** | **14.45** | | |
| **CO** | **27.38** | **26.19** | **24.41** | **23.48** | **21.49** | **19.32** | **18.11** | **16.63** | **15.13** | **14.14** | **14.17** | **14.00** | | |
| **NMVOC** | **12.34** | **12.10** | **11.86** | **11.61** | **10.55** | **9.24** | **9.38** | **7.29** | **7.02** | **6.02** | **5.74** | **6.13** | | |
| **SO2** | **40.06** | **37.80** | **31.41** | **29.37** | **22.37** | **17.69** | **21.86** | **20.86** | **16.17** | **13.70** | **16.88** | **13.10** | | |

# Chapter 3: Energy (CRF source category sector 1)

## 3.1. Overview of sector

Carbon dioxide ($CO_2$) emissions from stationary combustion result from the release of the carbon in fuel during combustion. $CO_2$ emissions depend on the carbon content of the fuel. During the combustion process, most carbon is emitted as $CO_2$ immediately. However, some carbon is released as carbon monoxide (CO), methane ($CH_4$) or non-methane volatile organic compounds (NMVOCs), all of which oxidise to $CO_2$ in the atmosphere within a period of a few days to about 12 years. The 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines) account for all the released carbon as $CO_2$ emissions. Unoxidised carbon, in the form of particulate matter, soot or ash, is excluded from greenhouse gas emissions totals.

### 3.1.1. Emissions trends

The energy sector in Cyprus relies on fossil fuel combustion for meeting the bulk of energy requirements. Final consumption in 2015 amounted to approximately 80 PJ compared to 78 PJ in 2014 (2.6% increase). 97.77% of the consumption in 2015 was from liquid fuels, 0.19% from solid fuels, 0.04% from other fossil fuels and 2% from biomass. In comparison to 1990, total fuel consumption in 2015 including biomass increased by 54%. Natural gas is not available in Cyprus.

After robust growth rates in the 1980s (average annual growth was 6.1%), economic performance in the 1990s was mixed: real GDP growth was 9.7% in 1992, 1.7% in 1993, 6.0% in 1994, 6.0% in 1995, 1.9% in 1996 and 2.3% in 1997. This pattern underlined the economy's vulnerability to swings in tourist arrivals (i.e. to economic and political conditions in Cyprus, Western Europe, and the Middle East) and the need to diversify the economy. Declining competitiveness in tourism and especially in manufacturing are acting as a drag on growth until structural changes are in effect. This is greatly affecting the energy sector.

The emissions from the energy sector in Cyprus increased by 53% during the period 1990-2015. The greatest increase in emissions was between 1990 and 2008 (98%), the emissions reached their peak (7799 Gg CO2 eq.). All the emissions in 2015 are from fuel combustion. The contribution of the emissions from the energy sector to the total without LULUCF in 2015 was 72% compared to 70% in 1990.

Energy is mainly responsible for carbon dioxide emissions, while it contributes also to methane and nitrous oxide emissions. In 2015, 98.7% of the emissions from the energy sector were carbon dioxide, 0.3% methane and 1% nitrous oxide. Fugitive emissions from fuels have not been estimated since 2004 when the refining activities stopped in Cyprus. The contribution of each source and gas to the total emissions of the energy sector over the period 1990 to 2015 are presented in Table 3.1.

**Table 3.1. Emissions from the energy sector 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| 1. Energy industries | 1767 | 2173 | 2964 | 3483 | 3881 | 2839 | 2950 | 3033 |
| 2. Manufacturing industries & construction | 515 | 774 | 822 | 912 | 701 | 539 | 693 | 548 |
| 3. Transport | 1214 | 1522 | 1807 | 2104 | 2324 | 1869 | 1819 | 1889 |
| a. Domestic aviation | 11 | 12 | 12 | 12 | 8 | 1 | 1 | 1 |
| b. Road transportation | 1200 | 1506 | 1792 | 2091 | 2314 | 1866 | 1817 | 1887 |
| d. Domestic navigation | 2 | 3 | 2 | 2 | 3 | 2 | 1 | 1 |
| 4. Other sectors | 434 | 608 | 731 | 610 | 569 | 518 | 461 | 547 |
| a. Commercial/institutional | 76 | 105 | 117 | 99 | 120 | 104 | 88 | 107 |
| b. Residential | 302 | 415 | 506 | 420 | 371 | 337 | 306 | 357 |
| c. Agriculture/forestry/fishing | 56 | 85 | 106 | 89 | 77 | 77 | 67 | 83 |
| 5. Other | 11 | 17 | 22 | 19 | 20 | 24 | 35 | 22 |
| **TOTAL** | **3941** | **5093** | **6345** | **7129** | **7495** | **5789** | **5959** | **6040** |
| | | | | | | | | |
| CO2 | 3896 | 5039 | 6280 | 7049 | 7402 | 5712 | 5883 | 5962 |
| CH4 | 11 | 13 | 15 | 18 | 21 | 18 | 18 | 19 |
| N2O | 35 | 42 | 50 | 61 | 71 | 59 | 58 | 59 |

### 3.1.2. Methodology

There are three methods provided in the IPCC Guidelines: two Tier 1 approaches (the ‘Reference Approach’ and the ‘Sectoral Approach’) and the Tier 2/Tier 3 approach (a detailed technology-based method, also called ‘bottom-up’ approach). For the Tier 1 Sectoral Approach, total $CO_2$ is summed across all fuels (excluding biomass) and all sectors. For Tiers 2 and 3, the Detailed Technology-Based Approach, total $CO_2$ is summed across all fuels and sectors, plus combustion technologies (e.g. stationary and mobile sources). Both approaches provide more disaggregated emission estimates, but also require more data. For the estimation of emissions for Cyprus, the two Tier 1 approaches i.e. the ‘Reference Approach’ and the ‘Sectoral Approach’. The sectoral approach is presented in this chapter. The reference approach is presented in details in Section 3.2.8. A comparison of the results of the two approaches is presented in Section 3.2.9.

The calculation of GHG emissions from energy is based on the IPCC 2006 Guidelines. Where data is available for installations included in the Emissions Trading System of the EU, emission factors have been reported as country or plant specific. The methodologies applied for the calculation of emissions by source category is presented in Table 3.2.

**Table 3.2. Methodology for the estimation of emissions from energy**

| | $CO_2$ | | $CH_4$ | | $N_2O$ | |
|---|---|---|---|---|---|---|
| | **Method** | **EF** | **Method** | **EF** | **Method** | **EF** |
| 1AA FUEL COMBUSTION | | | | | | |
| 1A1Energy industries | | | | | | |
| 1A1a Public electricity | CS | CS | T1 | D | T1 | D |
| 1A1b Petroleum refining | T1 | D | T1 | D | T1 | D |
| 1A2 Manufacturing Industries and Construction | | | | | | |
| 1A2b Non - ferrous metals | T1 | D | T1 | D | T1 | D |
| 1A2c Chemicals | T1 | D | T1 | D | T1 | D |
| 1A2d Pulp, Paper and Print | T1 | D | T1 | D | T1 | D |
| 1A2e Food processing, beverages and tobacco | T1 | D | T1 | D | T1 | D |

| | $CO_2$ | | $CH_4$ | | $N_2O$ | |
|---|---|---|---|---|---|---|
| | **Method** | **EF** | **Method** | **EF** | **Method** | **EF** |
| 1A2f Non-metallic Minerals – Liquid fuels | CS | CS | T1 | D | T1 | D |
| 1A2f Non-metallic Minerals – Solid fuels | CS | CS | T1 | D | T1 | D |
| 1A2f Non-metallic Minerals – Other fossil fuels | T1 | D | T1 | D | T1 | D |
| 1A2f Non-metallic Minerals – Biomass | T1 | D | T1 | D | T1 | D |
| 1A2i Mining (excluding fuels) and Quarrying | T1 | D | T1 | D | T1 | D |
| 1A2k Construction | T1 | D | T1 | D | T1 | D |
| 1A2m Non-specified Industry | T1 | D | T1 | D | T1 | D |
| 1A3 Transport | | | | | | |
| 1A3aiiDomestic aviation | T1 | D | T1 | D | T1 | D |
| 1A3b Road Transportation | T1 | D | T1 | D | T1 | D |
| 1A3d ii Domestic water-borne navigation | T1 | D | T1 | D | T1 | D |
| 1A4 Other Sectors | | | | | | |
| 1A4a Commercial/ Institutional – stationary combustion | T1 | D | T1 | D | T1 | D |
| 1A4b Residential | T1 | D | T1 | D | T1 | D |
| 1A4ci Agriculture/ Forestry/ Fisheries - stationary | T1 | D | T1 | D | T1 | D |
| 1A4ciii Agriculture/ Forestry/ Fisheries - Fishing (mobile combustion) | T1 | D | T1 | D | T1 | D |
| 1A5 Other | | | | | | |
| 1A5a Stationary - Other | T1 | D | T1 | D | T1 | D |
| 1B FUGITIVE EMISSIONS FROM FUELS | | | | | | |
| 1B2 Oil and Natural Gas and Other Emissions from Energy Production | NA | NA | T1 | D | NA | NA |

T1: IPCC methodology Tier 1; D: IPCC default methodology and emission factor; CS: Country specific emission factor; PS: Plant specific emission factor; OTH: Other; NA: not available

**Key categories**

The results of the key categories assessment are presented in Section 1.5.

**Uncertainty**

The uncertainty analysis is presented in Section 1.7.

### 3.1.3. Completeness

The emissions from energy are complete.

## 3.2. Fuel combustion (CRF source category 1A)

### 3.2.1. Source category description

The emissions from the fuel combustion in Cyprus increased by 53.2% during the period 1990-2015. The greatest increase in emissions was between 1990 and 2008 (98%), the emissions reached their peak (7799 Gg CO2 eq.). The majority of energy related GHG emissions (50.2%) in 2015 was derived from energy industries, while transport contributed 31.2%, manufacturing industries and construction 9%, other sectors 9.1% and other 0.4% respectively.

The substantial increase of GHG emissions from road transport (56% between 1990 and 2015) is directly linked to the increase of vehicles fleet but also to the increase of transportation activity. The renewal of the passenger car fleet and the implied improvement of energy efficiency, limit the increase of GHG emissions. The implemented, adopted and planned measures for the improvement of public transport are expected to moderate the high use of passenger cars.

Energy is mainly responsible for carbon dioxide emissions, while it contributes also to methane and nitrous oxide emissions. In 2015, 98.70% of the emissions from the energy sector were carbon dioxide, 0.32% methane and 0.97% nitrous oxide (Table 3.3). The contribution of each source to the total of the sector is presented in Table 3.3. The trend of the emissions from fuel consumption (1A) is presented in Figure 3.1.

**Table 3.3. Emissions from the energy sector 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| CO2 (Gg) | 3,896 | 5,039 | 6,280 | 7,049 | 7,402 | 5712 | 5,883 | 5,962 |
| CH4 (Gg) | 0.42 | 0.51 | 0.59 | 0.74 | 0.86 | 0.74 | 0.74 | 0.77 |
| N2O (Gg) | 0.12 | 0.14 | 0.17 | 0.21 | 0.24 | 0.20 | 0.19 | 0.20 |
| Total (Gg CO2 eq.) | 3,941 | 5,093 | 6,345 | 7,129 | 7,495 | 5,789 | 5,959 | 6,040 |
| Gg CO2 eq. | | | | | | | | |
| 1A1. Energy industries | 1767 | 2173 | 2964 | 3483 | 3881 | 2839 | 2950 | 3033 |
| 1A2. Manufacturing and construction | 515 | 774 | 822 | 912 | 701 | 539 | 693 | 548 |
| 1A3. Transport | 1214 | 1522 | 1807 | 2104 | 2324 | 1869 | 1819 | 1889 |
| 1A4. Other sectors | 434 | 608 | 731 | 610 | 569 | 518 | 461 | 547 |
| 1A5. Other (not elsewhere specified) | 11.06 | 17.27 | 21.55 | 19.23 | 20.49 | 23.66 | 35.19 | 22.40 |

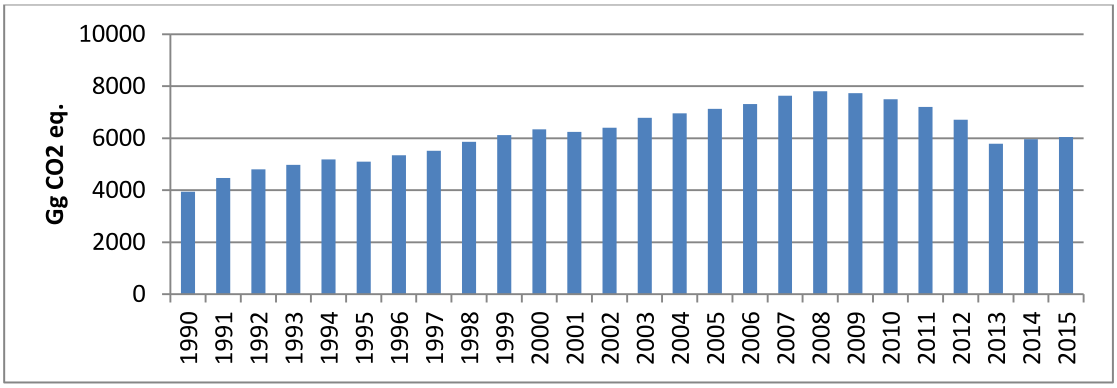


**Figure 3.1. Fuel combustion (1A) emissions 1990-2015**

### 3.2.2. Methodological issues

**Emission factors**

The emission factors used are predominately the defaults proposed by the IPCC guidelines. Further details on the emission factor are provided in the methodological issues Section of each source.

### Activity data

The fuel consumption data published by the National Statistical Service in 2016 for the period 1990-2015 are presented in Table 3.4. In green are sectors/consumers that have been added for the first time in 2014 and in red are the revisions.

**Table 3.4. Fuel consumption according to the National Energy balance 2015in kt (1990-2015)**

**(a) 1990-1996**

| **CYSTAT: ENERGY BALANCE 2015** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** |
|---|---|---|---|---|---|---|---|
| **Refinery gas** | | | | | | | |
| Refinery fuel | 18 | 17 | 17 | 13 | 24 | 13 | 12 |
| **LPG** | | | | | | | |
| Non-ferrous metals | | | | | | | |
| Non-metallic minerals | | | | | | | |
| Food, beverages and tobacco | | | | | | | |
| Not elsewhere specified (Industry) | | | | | | | |
| Commercial and public services | | | | | | | |
| Residential | 49 | 49 | 55 | 51 | 50 | 51 | 51 |
| Agriculture/forestry | | | | | | | |
| **Non-biogasoline = GASOLINE** | | | | | | | |
| Road | 163 | 170 | 172 | 169 | 180 | 183 | 186 |
| **Non-bio jet kerosene = JET-KEROSENE** | | | | | | | |
| International aviation | 236 | 280 | 272 | 231 | 237 | 260 | 249 |
| Not elsewhere specified (Other) | | | | | | | |
| **Other kerosene** | | | | | | | |
| Residential | 12 | 12 | 17 | 16 | 17 | 17 | 18 |
| Oil and gas extraction | | | | | | | |
| Not elsewhere specified (Industry) | | | | | | | |
| **Biodiesels** | | | | | | | |
| Road | | | | | | | |
| **Non-bio gas/diesel oil = DIESEL** | | | | | | | |
| International marine bunkers | 24 | 20 | 21 | 14 | 12 | 15 | 25 |
| Main activity producer electricity plants | | | 11 | 3 | 2 | 8 | 6 |
| Autoproducer electricity plants | | | | | | | |
| Road | 210 | 202 | 246 | 255 | 261 | 285 | 298 |
| Chemical and petrochemical | | | | | | | |
| Non-ferrous metals | | | | | | | |
| Non-metallic minerals | | | | | | | |
| Mining and Quarrying | | | | | | | |
| Food, beverages and tobacco | | | | | | | |
| Construction | | | | | | | |
| Not elsewhere specified (Industry) | 98 | 109 | 132 | 137 | 141 | 153 | 161 |
| Commercial and public services | | | | | | | |
| Residential | | | | | | | |
| Agriculture/forestry | | | | | | | |
| Fishing | | | | | | | |
| Not elsewhere specified (Other) | | | | | | | |
| **Total fuel oil** | | | | | | | |
| Chemical and petrochemical | | | | | | | |

| CYSTAT: ENERGY BALANCE 2015 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| **Refinery gas** | | | | | | | |
| Refinery fuel | 18 | 17 | 17 | 13 | 24 | 13 | 12 |
| **LPG** | | | | | | | |
| Non-ferrous metals | | | | | | | |
| Non-metallic minerals | | | | | | | |
| Food, beverages and tobacco | | | | | | | |
| Not elsewhere specified (Industry) | | | | | | | |
| Commercial and public services | | | | | | | |
| Residential | 49 | 49 | 55 | 51 | 50 | 51 | 51 |
| Agriculture/forestry | | | | | | | |
| **Non-biogasoline = GASOLINE** | | | | | | | |
| Road | 163 | 170 | 172 | 169 | 180 | 183 | 186 |
| **Non-bio jet kerosene = JET-KEROSENE** | | | | | | | |
| International aviation | 236 | 280 | 272 | 231 | 237 | 260 | 249 |
| Not elsewhere specified (Other) | | | | | | | |
| **Other kerosene** | | | | | | | |
| Recycled products | | | | | | | |
| International marine bunkers | 34 | 36 | 38 | 36 | 50 | 54 | 65 |
| Refinery fuel | 11 | 12 | 13 | 13 | 14 | 17 | 16 |
| Main activity producer electricity plants | 540 | 561 | 645 | 697 | 727 | 662 | 703 |
| Autoproducer electricity plants | | | | | | | |
| Autoproducer CHP Plants | | | | | | | |
| Non-metallic minerals | 37 | 124 | 118 | 100 | 110 | 97 | 111 |
| Food, beverages and tobacco | | | | | | | |
| Paper, pulp and printing | | | | | | | |
| Not elsewhere specified (Industry) | | | | | | | |
| Commercial and public services | | | | | | | |
| **White spirit and SPB** | | | | | | | |
| Not elsewhere specified (Industry) | | | | 1 | | 1 | 1 |
| **Lubricants** | | | | | | | |
| International marine bunkers | | | | | | | 1 |
| Non-energy use: Road | | | | 6 | 8 | 8 | 9 |
| Non-energy use: Not elsewhere specified (Industry) | | | | 2 | 3 | 3 | 3 |
| **Bitumen** | | | | | | | |
| Construction | | | | | | | |
| Non-energy use: Not elsewhere specified (Industry) | 33 | 23 | 50 | 59 | 57 | 54 | 57 |
| **Pet-coke** | | | | | | | |
| Non-metallic minerals | | 93 | 85 | 114 | 112 | 125 | 147 |
| **Other products (liquid)** | | | | | | | |
| Refinery fuel | | | | | | | |
| Not elsewhere specified (Industry) | 40 | 5 | | | | | |
| **Bituminous Coal** | | | | | | | |
| Non-metallic minerals | 97 | 97 | 26 | 31 | 27 | 20 | 18 |
| **Lignite** | | | | | | | |
| Not elsewhere specified (Other) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Industrial waste (non-renewable) (TJ)** | | | | | | | |
| Non-metallic minerals | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **RENEWABLES** | | | | | | | |
| **Solid biomass** | | | | | | | |
| Charcoal production plants (Transformation) | 112 | 112 | 112 | 112 | 405 | 388 | 328 |
| Chemical and petrochemical | | | | | | | |
| Non-metallic minerals | | | | | | | |
| Food, beverages and tobacco | | | | | | | |
| Commercial and public services | | | | | | | |
| Residential | | | | | | | |
| Agriculture/Forestry | | | | | | | |
| Not elsewhere specified (Other) | 145 | 120 | 118 | 117 | 85 | 91 | 136 |

| CYSTAT: ENERGY BALANCE 2015 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| **Refinery gas** | | | | | | | |
| Refinery fuel | 18 | 17 | 17 | 13 | 24 | 13 | 12 |
| **LPG** | | | | | | | |
| Non-ferrous metals | | | | | | | |
| Non-metallic minerals | | | | | | | |
| Food, beverages and tobacco | | | | | | | |
| Not elsewhere specified (Industry) | | | | | | | |
| Commercial and public services | | | | | | | |
| Residential | 49 | 49 | 55 | 51 | 50 | 51 | 51 |
| Agriculture/forestry | | | | | | | |
| **Non-biogasoline = GASOLINE** | | | | | | | |
| Road | 163 | 170 | 172 | 169 | 180 | 183 | 186 |
| **Non-bio jet kerosene = JET-KEROSENE** | | | | | | | |
| International aviation | 236 | 280 | 272 | 231 | 237 | 260 | 249 |
| Not elsewhere specified (Other) | | | | | | | |
| **Other kerosene** | | | | | | | |
| **Charcoal (kt)** | | | | | | | |
| Commercial and public services | | | | | | | |
| Residential | | | | | | | |
| Not elsewhere specified (Other) | 1 | 1 | 1 | 1 | 2 | 7 | 7 |
| **Biogases (TJ)** | | | | | | | |
| Main activity producer CHP plants | | | | | | | |
| Autoproducer CHP plants | | | | | | | |
| Commercial and public services | | | | | | | |
| Agriculture/Forestry | | | | | | | |

**(b) 1997-2003**

| CYSTAT: ENERGY BALANCE 2015 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| **Refinery gas** | | | | | | | |
| Refinery fuel | 16 | 16 | 20 | 19 | 19 | 21 | 21 |
| **LPG** | | | | | | | |
| Non-ferrous metals | | | | | | | |
| Non-metallic minerals | | | | | | | |
| Food, beverages and tobacco | | | | | | | |
| Not elsewhere specified (Industry) | | | | | | | |
| Commercial and public services | | | | | | | |
| Residential | 52 | 50 | 49 | 53 | 53 | 54 | 58 |
| Agriculture/forestry | | | | | | | |
| **Non-biogasoline = GASOLINE** | | | | | | | |
| Road | 191 | 195 | 203 | 206 | 219 | 228 | 252 |
| **Non-bio jet kerosene = JET-KEROSENE** | | | | | | | |
| International aviation | 245 | 258 | 264 | 268 | 314 | 302 | 323 |
| Not elsewhere specified (Other) | | | | | | | |
| **Other kerosene** | | | | | | | |
| Residential | 20 | 21 | 20 | 24 | 24 | 31 | 31 |
| Oil and gas extraction | | | | | | | |
| Not elsewhere specified (Industry) | | | | | | | |
| **Biodiesels** | | | | | | | |
| Road | | | | | | | |
| **Non-bio gas/diesel oil = DIESEL** | | | | | | | |
| International marine bunkers | 27 | 35 | 46 | 50 | 47 | 33 | 36 |
| Main activity producer electricity plants | 6 | 12 | 21 | 19 | 4 | 2 | 5 |
| Autoproducer electricity plants | | | | | | | |
| Road | 314 | 334 | 340 | 350 | 355 | 341 | 351 |
| Chemical and petrochemical | | | | | | | |
| Non-ferrous metals | | | | | | | |

| CYSTAT: ENERGY BALANCE 2015 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| Non-metallic minerals | | | | | | | |
| Mining and Quarrying | | | | | | | |
| Food, beverages and tobacco | | | | | | | |
| Construction | | | | | | | |
| Not elsewhere specified (Industry) | 169 | 180 | 185 | 191 | 193 | 185 | 190 |
| Commercial and public services | | | | | | | |
| Residential | | | | | | | |
| Agriculture/forestry | | | | | | | |
| Fishing | | | | | | | |
| Not elsewhere specified (Other) | | | | | | | |
| **Total fuel oil** | | | | | | | |
| Chemical and petrochemical | | | | | | | |
| Recycled products | | | | | | | |
| International marine bunkers | 71 | 63 | 108 | 143 | 145 | 105 | 88 |
| Refinery fuel | 14 | 15 | 16 | 16 | | | |
| Main activity producer electricity plants | 743 | 811 | 856 | 902 | 897 | 932 | 1095 |
| Autoproducer electricity plants | | | | | | | |
| Autoproducer CHP Plants | | | | | | | 2 |
| Non-metallic minerals | 70 | 68 | 68 | 70 | 54 | 55 | 62 |
| Food, beverages and tobacco | | | | | | | |
| Paper, pulp and printing | | | | | | | |
| Not elsewhere specified (Industry) | | | | | | | |
| Commercial and public services | | | | | | | |
| **White spirit and SPB** | | | | | | | |
| Not elsewhere specified (Industry) | 1 | | 1 | | 1 | | |
| **Lubricants** | | | | | | | |
| International marine bunkers | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Non-energy use: Road | 8 | 5 | 5 | 5 | 5 | 6 | 6 |
| Non-energy use: Not elsewhere specified (Industry) | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| **Bitumen** | | | | | | | |
| Construction | | | | | | | |
| Non-energy use: Not elsewhere specified (Industry) | 62 | 75 | 86 | 83 | 81 | 84 | 70 |
| **Pet-coke** | | | | | | | |
| Non-metallic minerals | 152 | 150 | 154 | 141 | 133 | 139 | 137 |
| **Other products (liquid)** | | | | | | | |
| Refinery fuel | | | | | | 16 | 16 |
| Not elsewhere specified (Industry) | 1 | | | | | | |
| **Bituminous Coal** | | | | | | | |
| Non-metallic minerals | 19 | 26 | 30 | 49 | 53 | 53 | 53 |
| **Lignite** | | | | | | | |
| Not elsewhere specified (Other) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Industrial waste (non-renewable) (TJ)** | | | | | | | |
| Non-metallic minerals | 0 | 0 | 0 | 0 | 18 | 0 | 15 |
| **RENEWABLES** | | | | | | | |
| **Solid biomass** | | | | | | | |
| Charcoal production plants (Transformation) | 288 | 314 | 281 | 248 | 253 | 235 | 209 |
| Chemical and petrochemical | | | | | | | |
| Non-metallic minerals | | | | 41 | 70 | 90 | 211 |
| Food, beverages and tobacco | | | | | | | |
| Commercial and public services | | | | | | | |
| Residential | | | | | | | |
| Agriculture/Forestry | | | | | | | |
| Not elsewhere specified (Other) | 70 | 64 | 88 | 78 | 80 | 74 | 67 |
| **Charcoal (kt)** | | | | | | | |
| Commercial and public services | | | | | | | |
| Residential | | | | | | | |
| Not elsewhere specified (Other) | 7 | 8 | 7 | 5 | 5 | 7 | 7 |

| CYSTAT: ENERGY BALANCE 2015 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| **Biogases (TJ)** | | | | | | | |
| Main activity producer CHP plants | | | | | | | |
| Autoproducer CHP plants | | | | | | | |
| Commercial and public services | | | | | | | |
| Agriculture/Forestry | | | | | | | |

**(c) 2004-2010**

| CYSTAT: ENERGY BALANCE 2015 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| **Refinery gas** | | | | | | | |
| Refinery fuel | 9 | | | | | | |
| **LPG** | | | | | | | |
| Non-ferrous metals | | | 1 | 1 | | 1 | 1 |
| Non-metallic minerals | | | | | | | 1 |
| Food, beverages and tobacco | | | 3 | 3 | 3 | 3 | 3 |
| Not elsewhere specified (Industry) | | | 1 | 1 | 1 | 1 | |
| Commercial and public services | | | 13 | 13 | 14 | 13 | 13 |
| Residential | 56 | 53 | 35 | 36 | 34 | 36 | 34 |
| Agriculture/forestry | | | 1 | 1 | 1 | 1 | 1 |
| **Non-biogasoline = GASOLINE** | | | | | | | |
| Road | 282 | 303 | 323 | 352 | 373 | 383 | 390 |
| **Non-bio jet kerosene = JET-KEROSENE** | | | | | | | |
| International aviation | 295 | 291 | 300 | 287 | 286 | 265 | 270 |
| Not elsewhere specified (Other) | | | | | | 1 | 1 |
| **Other kerosene** | | | | | | | |
| Residential | 24 | 13 | 16 | 16 | 14 | 19 | 14 |
| Oil and gas extraction | | | | | | | |
| Not elsewhere specified (Industry) | | 3 | | | | | |
| **Biodiesels** | | | | | | | |
| Road | | | | 1 | 16 | 17 | 17 |
| **Non-bio gas/diesel oil = DIESEL** | | | | | | | |
| International marine bunkers | 27 | 67 | 106 | 104 | 88 | 73 | 53 |
| Main activity producer electricity plants | 8 | 16 | 7 | 16 | 23 | 92 | 158 |
| Autoproducer electricity plants | | | | 1 | | | |
| Road | 354 | 346 | 323 | 337 | 330 | 321 | 329 |
| Chemical and petrochemical | | | | | | | |
| Non-ferrous metals | | | | | | | |
| Non-metallic minerals | | | | | | | |
| Mining and Quarrying | | | | | | | |
| Food, beverages and tobacco | | | | | | | |
| Construction | | | | | | | |
| Not elsewhere specified (Industry) | 171 | 47 | 24 | 20 | 18 | 18 | 14 |
| Commercial and public services | | | 19 | 18 | 20 | 19 | 23 |
| Residential | | 83 | 98 | 89 | 78 | 83 | 70 |
| Agriculture/forestry | | 27 | 28 | 28 | 23 | 20 | 19 |
| Fishing | | | | | 3 | 4 | 4 |
| Not elsewhere specified (Other) | | | 4 | 6 | 13 | 5 | 5 |
| **Total fuel oil** | | | | | | | |
| Chemical and petrochemical | | | | | | | |
| Recycled products | | | | | | | |
| International marine bunkers | 27 | 225 | 190 | 171 | 165 | 146 | 134 |
| Refinery fuel | | | | | | | |
| Main activity producer electricity plants | 1046 | 1104 | 1137 | 1174 | 1219 | 1163 | 1053 |
| Autoproducer electricity plants | | | | 4 | 3 | 2 | 2 |

| **CYSTAT: ENERGY BALANCE 2015** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
|---|---|---|---|---|---|---|---|
| Autoproducer CHP Plants | 5 | 6 | 7 | 14 | 12 | 11 | 8 |
| Non-metallic minerals | 68 | 37 | 35 | 38 | 38 | 30 | 25 |
| Food, beverages and tobacco | | | | | | | |
| Paper, pulp and printing | | | | | | | |
| Not elsewhere specified (Industry) | | 28 | 19 | 27 | 25 | 17 | 20 |
| Commercial and public services | | 1 | 2 | 2 | 2 | 2 | 2 |
| **White spirit and SPB** | | | | | | | |
| Not elsewhere specified (Industry) | | 1 | 1 | 1 | | | |
| **Lubricants** | | | | | | | |
| International marine bunkers | 1 | 1 | 1 | 1 | 1 | | |
| Non-energy use: Road | 7 | 2 | 2 | 2 | 2 | 2 | 2 |
| Non-energy use: Not elsewhere specified (Industry) | 3 | 4 | 4 | 4 | 4 | 4 | 4 |
| **Bitumen** | | | | | | | |
| Construction | | 69 | 69 | 57 | 66 | 74 | 83 |
| Non-energy use: Not elsewhere specified (Industry) | 65 | | | | | | |
| **Pet-coke** | | | | | | | |
| Non-metallic minerals | 146 | 154 | 146 | 143 | 152 | 144 | 116 |
| **Other products (liquid)** | | | | | | | |
| Refinery fuel | | | | | | | |
| Not elsewhere specified (Industry) | 6 | | | | | | |
| **Bituminous Coal** | | | | | | | |
| Non-metallic minerals | 57 | 52 | 54 | 49 | 40 | 21 | 26 |
| **Lignite** | | | | | | | |
| Not elsewhere specified (Other) | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Industrial waste (non-renewable) (TJ)** | | | | | | | |
| Non-metallic minerals | 71 | 138 | 73 | 288 | 239 | 276 | 299 |
| **RENEWABLES** | | | | | | | |
| **Solid biomass** | | | | | | | |
| Charcoal production plants (Transformation) | 184 | 174 | 135 | 274 | 211 | 47 | 48 |
| Chemical and petrochemical | | | | | | | |
| Non-metallic minerals | 127 | 38 | 61 | 133 | 281 | 304 | 347 |
| Food, beverages and tobacco | | | | | | | |
| Commercial and public services | | | | 14 | 15 | 15 | 15 |
| Residential | | | 74 | 95 | 123 | 222 | 84 |
| Agriculture/Forestry | | | 5 | | | | |
| Not elsewhere specified (Other) | 61 | 58 | | | | | |
| **Charcoal (kt)** | | | | | | | |
| Commercial and public services | | | 5 | 7 | 7 | 6 | 6 |
| Residential | | | 5 | 6 | 6 | 5 | 5 |
| Not elsewhere specified (Other) | 8 | 10 | | | | | |
| **Biogases (TJ)** | | | | | | | |
| Main activity producer CHP plants | | | | | | 13 | 21 |
| Autoproducer CHP plants | | | | 9 | 78 | 131 | 148 |
| Commercial and public services | | | | | | 11 | 12 |
| Agriculture/Forestry | | | | 6 | | 54 | 93 |

**(d) 2011-2015**

| **CYSTAT: ENERGY BALANCE 2015** | **2011** | **2012** | **2013** | **2014** | **2015** | |
|---|---|---|---|---|---|---|
| **Refinery gas** | | | | | | |
| Refinery fuel | | | | | | |
| **LPG** | | | | | | |
| Non-ferrous metals | 1 | 1 | | 0 | 1 | |
| Non-metallic minerals | 1 | 1 | 1 | 0 | 1 | |
| Food, beverages and tobacco | 4 | 5 | 4 | 3 | 2 | |
| Not elsewhere specified (Industry) | | | 0 | 2 | 1 | |
| Commercial and public services | 14 | 14 | 12 | 11 | 12 | |

| CYSTAT: ENERGY BALANCE 2015 | 2011 | 2012 | 2013 | 2014 | 2015 | |
|---|---|---|---|---|---|---|
| Residential | 38 | 37 | 33 | 31 | 34 | |
| Agriculture/forestry | 1 | 1 | 1 | | 2 | |
| **Non-biogasoline = GASOLINE** | | | | | | |
| Road | 385 | 372 | 349 | 341 | 345 | |
| **Non-bio jet kerosene = JET-KEROSENE** | | | | | | |
| International aviation | 294 | 264 | 235 | 231 | 233 | |
| Not elsewhere specified (Other) | 2 | 1 | 2 | 2 | 1 | |
| **Other kerosene** | | | | | | |
| Residential | 16 | 17 | 12 | 9 | 14 | |
| Oil and gas extraction | | | | 2 | | |
| Not elsewhere specified (Industry) | | | | | | |
| **Biodiesels** | | | | | | |
| Road | 18 | 18 | 17 | 11 | 11 | |
| **Non-bio gas/diesel oil = DIESEL** | | | | | | |
| International marine bunkers | 58 | 69 | 83 | 80 | 75 | |
| Main activity producer electricity plants | 112 | 214 | 236 | 124 | 89 | |
| Autoproducer electricity plants | 2 | 2 | 2 | 1 | 2 | |
| Road | 313 | 272 | 231 | 224 | 241 | |
| Chemical and petrochemical | | 1 | 0 | 1 | 1 | |
| Non-ferrous metals | | 1 | | | | |
| Non-metallic minerals | | 3 | 1 | 1 | 1 | |
| Mining and Quarrying | | 5 | 2 | 1 | 2 | |
| Food, beverages and tobacco | | 3 | 2 | 1 | 3 | |
| Construction | | 5 | 5 | 5 | 3 | |
| Not elsewhere specified (Industry) | 16 | 3 | 1 | 1 | | |
| Commercial and public services | 20 | 16 | 17 | 15 | 19 | |
| Residential | 80 | 76 | 62 | 57 | 65 | |
| Agriculture/forestry | 22 | 21 | 21 | 19 | 22 | |
| Fishing | 3 | 3 | 2 | 2 | 2 | |
| Not elsewhere specified (Other) | 6 | 5 | 5 | 9 | 6 | |
| **Total fuel oil** | | | | | | |
| Chemical and petrochemical | | | | | 1 | |
| Recycled products | | 2 | 3 | 5 | 5 | |
| International marine bunkers | 141 | 128 | 157 | 153 | 169 | |
| Refinery fuel | | | | | | |
| Main activity producer electricity plants | 1058 | 896 | 649 | 793 | 858 | |
| Autoproducer electricity plants | 2 | | 2 | 4 | | |
| Autoproducer CHP Plants | 2 | 2 | 2 | 0 | | |
| Non-metallic minerals | 15 | 13 | 8 | 7 | 8 | |
| Food, beverages and tobacco | | 9 | 8 | 13 | 9 | |
| Paper, pulp and printing | | | | 1 | 1 | |
| Not elsewhere specified (Industry) | 34 | 2 | 2 | 1 | 1 | |
| Commercial and public services | 2 | 4 | 4 | 2 | 3 | |
| **White spirit and SPB** | | | | | | |
| Not elsewhere specified (Industry) | | | | | | |
| **Lubricants** | | | | | | |
| International marine bunkers | | | | | | |
| Non-energy use: Road | 2 | 1 | 1 | 1 | 1 | |
| Non-energy use: Not elsewhere specified (Industry) | 4 | 4 | 3 | 3 | 3 | |
| **Bitumen** | | | | | | |
| Construction | 64 | 36 | 24 | 21 | 21 | |
| Non-energy use: Not elsewhere specified (Industry) | | | | | | |
| **Pet-coke** | | | | | | |
| Non-metallic minerals | 100 | 94 | 135 | 162 | 128 | |
| **Other products (liquid)** | | | | | | |
| Refinery fuel | | | | | | |
| Not elsewhere specified (Industry) | | | | | | |

| CYSTAT: ENERGY BALANCE 2015 | 2011 | 2012 | 2013 | 2014 | 2015 | |
|---|---|---|---|---|---|---|
| **Bituminous Coal** | | | | | | |
| Non-metallic minerals | 12 | 20 | 20 | 4.152 | 6.029 | |
| **Lignite** | | | | | | |
| Not elsewhere specified (Other) | 1 | 1 | 1 | 0 | 0 | |
| **Industrial waste (non-renewable) (TJ)** | | | | | | |
| Non-metallic minerals | 4 | 0 | 0 | 279 | 221 | |
| **RENEWABLES** | | | | | | |
| **Solid biomass** | | | | | | |
| Charcoal production plants (Transformation) | 45 | 82 | 71 | 58 | 94 | |
| Chemical and petrochemical | | | | 42 | 52 | |
| Non-metallic minerals | 306 | 29 | 28 | 116 | 95 | |
| Food, beverages and tobacco | | | | 44 | 7 | |
| Commercial and public services | 13 | 16 | 16 | 16 | 15 | |
| Residential | 123 | 143 | 112 | 71 | 146 | |
| Agriculture/Forestry | | | | | | |
| Not elsewhere specified (Other) | | | | | | |
| **Charcoal (kt)** | | | | | | |
| Commercial and public services | 6 | 6 | 6 | 6 | 7 | |
| Residential | 6 | 6 | 6 | 6 | 6 | |
| Not elsewhere specified (Other) | | | | | | |
| **Biogases (TJ)** | | | | | | |
| Main activity producer CHP plants | 92 | 91 | 118 | 116 | 130 | |
| Autoproducer CHP plants | 180 | 192 | 171 | 176 | 179 | |
| Commercial and public services | 11 | 11 | 11 | 12 | 12 | |
| Agriculture/Forestry | 165 | 182 | 166 | 172 | 151 | |

Due to the unavailability of consumption data for several years, using the data as is would create issues of inconsistence and incomparability. Therefore it was decided to complete the period using the following assumptions. The resulting data used for the estimation of the emissions will be presented at the methodological issues Section of the appropriate sector. The following pages present the assumptions made to allocate consumption to activities where data was not available.

LPG

(a) 2006-2009 consumption from Not elsewhere specified (Industry) has been moved to Non-metallic minerals.

(b) There is available data for all the consumers of LPG during the period 2006-2015. Since there is no particular trend during this period, it was decided to use the same ratio as 2006 to distribute the consumption that was allocated to residential to all sectors for the period 1990-2005 (Table 3.5).

**Table 3.5. Contribution of different activities to LPG consumption (2006) used to allocate consumption to different sectors for 1990-2005**

| Activity | Consumption |
|---|---|
| Non-ferrous metals | 1.9% |
| Non-metallic minerals | 1.9% |
| Food, beverages and tobacco | 5.6% |
| Commercial and public services | 24.1% |
| Residential | 64.8% |
| Agriculture/forestry | 1.9% |

Jet kerosene

Information on fuel consumption for domestic flights is not available from national statistics. To estimate the emissions from aviation, the available information on fuel consumption from EUROCONTROL was used (Table 3.19) for 2005-2015. To complete the time series back to 1990, it was assumed that domestic flights during the period 1990-2004 had the same contribution to the total consumption as 2005 (1.48%).

Other kerosene

(a) Other kerosene consumption was recorded for non-elsewhere specified (industry) only for 2005. For the same year the consumption of residential sector was much lower than other years. The consumption from non-elsewhere specified (industry) of 2005 was moved to residential.

(b) Oil and gas extraction consumption (NEW CONSUMER) was moved to Not elsewhere specified (Industry).

Diesel

According to the energy balance of 2014, the consumers of gas-diesel oil are Main activity producer electricity plants, Road, Chemical and petrochemical, Non-ferrous metals, Non-metallic minerals, Mining and Quarrying, Food, beverages and tobacco, Construction, Not elsewhere specified (Industry), Commercial and public services, Residential, Agriculture/ Forestry and Not elsewhere specified (Other). Consumption data for Chemical and petrochemical, Non-ferrous metals, Non-metallic minerals, Mining and Quarrying, Food, beverages and tobacco, Construction is only available for 2012 to 2015.

(a) For the years 2006-2011 all consumption from industrial activities (incl. autoproducers) was included in Not elsewhere specified (Industry). The consumption was allocated to the industrial sectors according to the ratio of 2012 (Table 3.6).

**Table 3.6. Contribution of different activities to gas-diesel oil consumption (2012) used to allocate consumption to Chemical and petrochemical, Non-ferrous metals, Non-metallic minerals, Mining and Quarrying, Food, beverages and tobacco, Construction, Not elsewhere specified (Industry) for 2006-2011**

| Activity | Consumption |
|---|---|
| Chemical and petrochemical | 5% |
| Non-ferrous metals | 5% |
| Non-metallic minerals | 14% |
| Mining and Quarrying | 24% |
| Food, beverages and tobacco | 14% |
| Construction | 24% |
| Not elsewhere specified (Industry) | 14% |

(b) The contribution of fishing consumption to the total for the years 2005-2007 is assumed the same as 2008.

(c) For 2005, consumption is available for Main activity producer electricity plants, road, Residential and Agriculture/forestry. Due to the large increase of the Not elsewhere specified (Industry) compare to 2006-2011, it is assumed that consumption by Commercial and public services, and Not elsewhere specified (Other) is included in the Not elsewhere specified

(Industry). The assumed contribution of each sector to the consumption allocated to Not elsewhere specified (Industry) is based on the 2012 consumption ratio for these sectors (Table 3.7).

**Table 3.7. Contribution of different activities to gas-diesel oil consumption (2012) used to allocate consumption to Chemical and petrochemical, Non-ferrous metals, Non-metallic minerals, Mining and Quarrying, Food, beverages and tobacco, Construction, Not elsewhere specified (Industry), Commercial and public services, Not elsewhere specified (Other) from Not elsewhere specified (Industry) for 2005**

| Activity | Consumption |
|---|---|
| Chemical and petrochemical | 2% |
| Non-ferrous metals | 2% |
| Non-metallic minerals | 7% |
| Mining and Quarrying | 12% |
| Food, beverages and tobacco | 7% |
| Construction | 12% |
| Not elsewhere specified (Industry) | 7% |
| Commercial and public services | 38% |
| Not elsewhere specified (Other) | 12% |

(d) To estimate the consumption for the years 1990-2004, the consumption ratio compared to Not elsewhere specified (Industry) is assumed to be the same as 2012 (Table 3.8).

**Table 3.8. Contribution of different activities to gas-diesel oil consumption (2012) used to allocate consumption to from Not elsewhere specified (Industry) for 1990-2004**

| Activity | Consumption |
|---|---|
| Chemical and petrochemical | 0.7% |
| Non-ferrous metals | 0.7% |
| Non-metallic minerals | 2.11% |
| Mining and Quarrying | 3.52% |
| Food, beverages and tobacco | 2.11% |
| Construction | 3.52% |
| Not elsewhere specified (Industry) | 2.11% |
| Commercial and public services | 11.27% |
| Residential | 53.52% |
| Agriculture/ forestry | 14.79% |
| Fishing | 2.11% |
| Not elsewhere specified (Other) | 3.52% |

(e) Consumption for Water-borne navigation activities is available for the years 1998-2014[14] (Table 3.9). The consumption for the period 1990-1997 was estimated assuming that the contribution of the activity to road transport consumption is the same as 1998; the consumption for 2015 was estimated assuming that the contribution of the activity to road transport consumption is the same as 2014.

[14] Mr. George Ioannou, Statistical Service, Estimation based on fuel expenses assuming that all fuel is road diesel

**Table 3.9. Consumption diesel for Water-borne navigation activities**

| **Year** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** |
|---|---|---|---|---|---|---|---|---|---|
| t | 1097.05 | 1236.84 | 531.915 | 430.208 | 561.862 | 430.478 | 596.723 | 730.847 | 558.887 |
| kt | 1.10 | 1.24 | 0.53 | 0.43 | 0.56 | 0.43 | 0.60 | 0.73 | 0.56 |
| % of road | 0.33% | 0.36% | 0.15% | 0.12% | 0.16% | 0.12% | 0.17% | 0.21% | 0.17% |

| **Year** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|---|
| t | 626.709 | 757.997 | 1491.21 | 946.597 | 886.776 | 625.631 | 472.399 | 558.96 | 558.96 |
| kt | 0.63 | 0.76 | 1.49 | 0.95 | 0.89 | 0.63 | 0.47 | 0.56 | 0.56 |
| % of road | 0.19% | 0.23% | 0.46% | 0.29% | 0.28% | 0.23% | 0.20% | 0.25% | 0.23% |

(f) The consumption for Water-borne navigation activities was subtracted from Road transport. Therefore road transport consumption was revised for the whole reporting period.

RFO

(a) All consumption allocated to Autoproducer electricity, Food, beverages and tobacco plants and Autoproducer CHP Plants was moved to Not elsewhere specified (Industry).

(b) The consumption food, beverages and tobacco, is only available for 2012-2015. For 2005-2012 consumption is also reported for non – metallic minerals and commercial and public services.

(c) All consumption during 1990-2004 except Refinery fuel and Main activity producer electricity plants was allocated to non-metallic minerals, food, beverages and tobacco, not elsewhere specified (industry) and commercial and public services.

(d) Consumption for Paper, pulp and printing is only available for 2014 and 2015. It is known however that activities in the particular sector did take place in previous years.

Bitumen

All bitumen consumption allocated to Non-energy use: Not elsewhere specified (Industry) during 1990-2004 has been moved to construction.

Pet-coke

Pet-coke in Cyprus is consumed only for cement production. According to the information received from the cement installations, pet-coke was consumed in 1990. The energy balance shows that pet-coke was not imported in 1990. To reduce the inconsistency and the impact on the times series, it was decided to move the “other liquid fuels” consumption of 1990 to cement as pet-coke.

Solid biofuels

(a) All consumption of solid biofuels for the period 1990-1999 is reported as non-elsewhere specified (other).

(b) For 2001-2005 consumption is reported as non-elsewhere specified (other) and non-metallic minerals.

(c) Consumption in agriculture is reported only for 2006.

The consumption of agriculture of 2006 was moved to commercial and public services for which consumption is reported for 2007-2015. All the consumption reported as non-elsewhere specified (other) for 1990-2005 was distributed to commercial and public services, and residential sector according to the consumption ratio the two sectors had in 2007 (Table 3.10).

**Table 3.10. Contribution of different activities to solid biofuels consumption (2007) used to allocate consumption to commercial and public services, and residential for 1990-2005**

| Activity | Consumption |
|---|---|
| Commercial and public services | 12.8% |
| Residential | 87.2% |

Charcoal

All charcoal consumption for the period 1990-2005 was reported as non-elsewhere specified (other). For the period 2006-2015, the charcoal consumption is allocated to commercial and public services, and residential sectors using the ratio of 50:50. This ratio was used to allocate charcoal consumption to the two sectors for the period 1990-2005.

Biogases

Biogas consumption is available in Cyprus after 2006, when the first anaerobic digester of the country started it operation. The biogas in Cyprus is consumed onsite to produce electricity and heat through a combined heat power (CHP) generator. Therefore, the biogas consumed by “Main activity producer CHP plants” (2009-2012) and “Autoproducer CHP plants” (2007-2015) was moved to agriculture.

## 3.2.3. Energy industries (CRF 1A1)

### 3.2.3.1. Source category description

Prior to the introduction of electricity production from renewable energy sources, the Electricity Authority of Cyprus (EAC) was the solely provider of electrical energy in Cyprus. EAC remains the single electricity producer for the public. Heat production (included in 1A1a) and manufacture of solid fuels and other energy industries (1A1c) do not occur in Cyprus. Refining activities in the country stopped in 2004 following a government decision not to upgrade it to EU standards, instead turning it into a fuel import and storage terminal. Consequently emissions from petroleum refinery (1A1b) are reported for the years 1990-2004 only.

The consumption of fossil fuels by energy industries in 2015 (38.9 PJ) increased by 61.6% compared to 1990 (23.2 PJ). Since 2005, when the refinery stopped its operations, the emissions from energy industries are entirely caused by the production of electricity (1A1a). Emissions from energy industries account for 36.4% of total national emissions without LULUCF for 2015, while in 1990 the contribution was 31.1%. The total GHG emissions from energy industries in 2015 (3.0 Tg CO2 eq.) increased by 66.6% compared to 1990 (1.8 Tg CO2 eq). The emissions from energy industries are presented in Table 3.11. Since 2009, a decreasing trend of emissions has been observed. This decreasing trend is attributed to the penetration of renewable energy technologies to the energy mix, and to the economic recession that the country is facing since 2010. The emissions from energy industries (1A1) for the period 1990-2015 are presented in Figure 3.2.

**Table 3.11. Emissions from energy industries 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| CO2 (Gg) | 1761 | 2166 | 2955 | 3472 | 3868 | 2830 | 2940 | 3023 |
| CH4 (Gg) | 0.07 | 0.08 | 0.11 | 0.14 | 0.15 | 0.11 | 0.11 | 0.12 |
| N2O (Gg) | 0.01 | 0.02 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 |
| Total (Gg CO2 eq.) | 1767 | 2173 | 2964 | 3483 | 3881 | 2839 | 2950 | 3033 |
| Gg CO2 eq. | | | | | | | | |
| 1A1ai Electricity generation | 1680.5 | 2083.9 | 2859.1 | 3483 | 3868 | 2839 | 2950 | 3033 |
| 1A1b Petroleum Refining | 85.9 | 90.43 | 104.4 | NO | NO | NO | NO | NO |

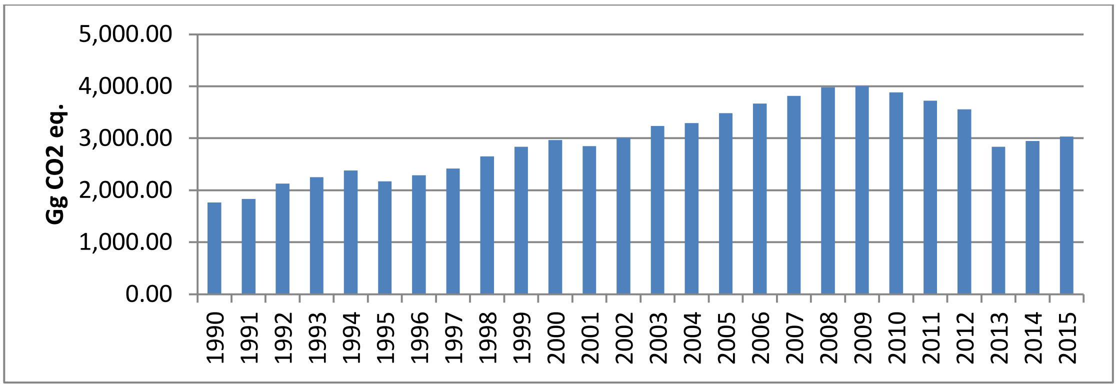


**Figure 3.2. Energy industries emissions (1A1) 1990-2015**

### 3.2.3.2. Methodological issues

**Carbon dioxide emissions**

Public electricity and heat production

The IPCC approach to the calculation of emission inventories encourages the use of fuel statistics collected by an officially recognised national body, as this is usually the most appropriate and accessible activity data. As already mentioned, there is only one electricity producing company in Cyprus (EAC), therefore the fuel consumption for public electricity and heat production was obtained from this one company. The fuel consumption data for all the years was obtained in kt. The fuel consumption data used for the years 1990-2004 is presented in Table 3.12.

**Table 3.12. Fuel consumption data obtained from the electricity production company in Cyprus (1990-2004)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|
| Fuel consumption (kt) | | | | | | | | |
| HFO | 540.4 | 560.5 | 644.6 | 694.8 | 726.4 | 661.2 | 702.5 | 742.9 |
| Diesel | 0.0 | 0.0 | 10.5 | 3.5 | 2.0 | 8.2 | 5.9 | 5.8 |
| Net calorific value (TJ/kt)* | | | | | | | | |
| HFO | 40.446 | 40.446 | 40.446 | 40.446 | 40.446 | 40.446 | 40.446 | 40.446 |
| Diesel | 42.815 | 42.815 | 42.815 | 42.815 | 42.815 | 42.815 | 42.815 | 42.815 |
| CO2 emissions (Gg) | | | | | | | | |
| HFO | 1675.8 | 1738.0 | 1999.0 | 2154.5 | 2252.6 | 2050.5 | 2178.5 | 2303.7 |
| Diesel | 0.0 | 0.0 | 32.62 | 10.79 | 6.09 | 25.45 | 18.39 | 17.83 |

| | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|
| Fuel consumption (kt) | | | | | | | |
| HFO | 810.9 | 856.1 | 900.5 | 893.8 | 930.8 | 1000.3 | 1042.1 |
| Diesel | 11.6 | 21.0 | 18.7 | 3.7 | 1.6 | 5.1 | 8.4 |
| Net calorific value (TJ/kt)* | | | | | | | |
| HFO | 40.446 | 40.446 | 40.446 | 40.446 | 40.446 | 40.446 | 40.446 |
| Diesel | 42.815 | 42.815 | 42.815 | 42.815 | 42.815 | 42.815 | 42.815 |
| CO2 emissions (Gg) | | | | | | | |
| HFO | 2514.8 | 2654.9 | 2792.5 | 2771.6 | 2886.5 | 3102.2 | 3231.6 |
| Diesel | 35.91 | 64.97 | 57.89 | 11.48 | 4.91 | 15.73 | 26.14 |

Detailed data on fuel consumption and other parameters are submitted annually by the installation since 2005 in compliance to the Emissions Trading System law (110(I)/2011). The data collected through the ETS for the period 2005-2014 and used for the estimation of the emissions is presented in Table 3.13.

**Table 3.13. Data collected through the ETS for electricity production in Cyprus (2005-2015)**

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fuel consumption (kt) | | | | | | | | | | | |
| HFO | 1103.2 | 1137.3 | 1174.7 | 1218.5 | 1163.1 | 1053.0 | 1057.8 | 895.5 | 649.3 | 793.3 | 857.9 |
| Diesel | 16.3 | 6.9 | 16.0 | 22.9 | 91.9 | 157.5 | 111.7 | 213.9 | 237.5 | 123.6 | 89.4 |
| Net calorific value (TJ/kt)* | | | | | | | | | | | |
| HFO | 40.446 | 40.460 | 40.463 | 40.690 | 40.795 | 40.641 | 40.741 | 40.791 | 40.613 | 40.691 | 40.880 |
| Diesel | 42.815 | 42.821 | 42.806 | 42.598 | 42.660 | 42.938 | 42.714 | 42.715 | 42.580 | 42.354 | 42.709 |
| CO2 emissions (Gg) | | | | | | | | | | | |
| HFO | 3421.2 | 3632.1 | 3751.9 | 3896.3 | 3707.6 | 3377.5 | 3373.4 | 2869.8 | 2085.9 | 2553.1 | 2742.3 |
| Diesel | 50.60 | 21.28 | 49.72 | 70.98 | 284.84 | 490.53 | 336.65 | 676.13 | 743.85 | 387.23 | 280.73 |

* weighted average based on consumption

The emissions for 1990-2004 were estimated using the implied emission factors derived from the annual report of the company for 2005 in compliance with the ETS law which are 76.67 t CO2/TJ HFO and 72.43 t CO2/TJ diesel. For the years 2005-2015, the CO2 emissions as reported by the company in compliance with the ETS law have been used (Table 3.13).

The emission factor was multiplied with the fuel consumption of the respective fuel. This method has been considered as a country specific method, since it does not follow the methodologies proposed by the IPCC guidelines.

<u>Petroleum refining</u>

Data for the consumption of fuel for petroleum refining was obtained from the National Statistical Service in kt (Table 3.14). No information is available on the characteristics of the consumption reported as other oil products. The fuel consumption was converted to TJ using the default NCVs of 40.4 TJ/kt RFO, 40.2 TJ/kt other oil product and 49.5 TJ/kt refinery gas. CO2 emission factors are also the defaults proposed by the revised IPCC 2006 guidelines (volume 2, pg. 2.16); i.e. 77.4 t CO2/TJ RFO, 73.3 t CO2/TJ other oil product and 57.6 t CO2/TJ refinery gas.

**Table 3.14. Fuel consumed for petroleum refining in Cyprus (1990-2004)**

| Fuel consumption (kt) | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|
| RFO | 11 | 12 | 13 | 13 | 14 | 17 | 16 | 14 |
| Other products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Refinery gas | 18 | 17 | 17 | 13 | 24 | 13 | 12 | 16 |

| | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|
| RFO | 15 | 16 | 16 | 0 | 0 | 0 | 0 |
| Other products | 0 | 0 | 0 | 0 | 16 | 16 | 0 |
| Refinery gas | 16 | 20 | 19 | 19 | 21 | 21 | 9 |

**Non-Carbon dioxide emissions**

Non-CO2 emissions were estimated using the default emission factors proposed by the IPCC2006 methodology for energy industries (volume 2, pg. 2.16); i.e. 3 kg CH4/TJ and 0.6 kg N2O/TJ for RFO and other oil products and 1 kg CH4/TJ and 0.1 kg N2O/TJ for Refinery gas.

#### 3.2.3.3. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

#### 3.2.3.4. Source-specific QA / QC and verification

QA/QC and verification activities are presented in Section 1.6.

#### 3.2.3.5. Source-specific recalculations

No recalculations have been performed.

#### 3.2.3.6. Source-specific planned improvements

There are no planned improvements for Public electricity and Heat production.

### 3.2.4. Manufacturing industries and construction (CRF 1A2)

#### 3.2.4.1. Source category description

Emissions from energy consumption for the production of steam and process heat are mainly reported under Manufacturing industry and construction.

Even though the shock inflicted on the manufacturing sector by the Turkish invasion of 1974 was severe, recovery during the period 1975-1983 was remarkable. By 2002 the sector accounted for about 10% of GDP and 12% of employment. However, during the past decade, the manufacturing industry of Cyprus has been going through difficult times, experiencing a fall in the growth of production, exports and employment. This development has been the result of erosion in competitiveness, both abroad and in the local market, at a time of increasingly intensified, international competition. At the root of these problems lie the structural weaknesses of the sector, the drastic reduction of tariff protection due to the participation of Cyprus in the World Trade Organization, the rising labour costs and low productivity. As a result the share of the manufacturing sector in the Gross Domestic Product and in employment remained stagnant. International competition is increasingly intensified mainly from two directions: on the one hand, the high-wage producers, who have combined design, quality and new forms of flexible production to cut working and capital costs and improve response times and on the other, the low-wage mass producers of South-East Asia.

The main industrial activities that take place in Cyprus are food and beverage processing, cement and gypsum production, light chemicals (predominately pharmaceuticals), metal and wood products. The industrial sector in 2012 registered a negative growth rate in real terms for a second year in a row.

The GHG emissions caused by energy consumption in manufacturing industries and construction in 2015 were 545 Gg CO2 eq. The total GHG emissions from manufacturing industries and construction in 2015 increased by 5.9% compared to 1990, while the corresponding increase in fuel consumption was 5.6%. There is no available information to explain the large change in emissions between 1990 and 1991. The emissions from manufacturing industries and construction 1990-2015 are presented in Figure 3.3.

**Table 3.15. Emissions from manufacturing industries and construction 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| CO2 (Gg | 512.2 | 770.9 | 818.7 | 908.3 | 697.3 | 537.5 | 690.5 | 546.18 |
| CH4 (Gg) | 0.04 | 0.03 | 0.04 | 0.05 | 0.05 | 0.02 | 0.04 | 0.02 |
| N2O (Gg) | 0.006 | 0.006 | 0.007 | 0.009 | 0.008 | 0.004 | 0.007 | 0.005 |
| Total (Gg CO2 eq.) | 514.8 | 773.5 | 821.9 | 912 | 700.7 | 539.1 | 693.4 | 548.1 |
| | | | | | | | | |
| Gg CO2 eq. | | | | | | | | |
| 1A2b. Non-ferrous metals | 4.9 | 6.3 | 7.2 | 6.5 | 5.8 | 0.0 | 0.0 | 3.0 |
| 1A2c. Chemicals | 2.3 | 3.4 | 4.3 | 3.6 | 2.1 | 0.0 | 3.2 | 6.4 |
| 1A2d. Pulp, paper and print | 4.3 | 12.7 | 9.2 | 5.2 | 3.7 | 3.0 | 3.1 | 3.1 |
| 1A2e. Food Processing etc. | 72.8 | 170.9 | 131.5 | 81.5 | 59.6 | 43.3 | 52.8 | 75.2 |
| 1A2f. Non-metallic minerals | 382 | 481.7 | 577.2 | 726.2 | 555.6 | 445 | 586.6 | 435 |
| 1A2giii. Mining | 11 | 17.2 | 21.5 | 17.9 | 10.7 | 6.4 | 3.2 | 6.4 |
| 1A2gv. Construction | 11 | 17.2 | 21.5 | 17.9 | 10.7 | 15.9 | 15.9 | 9.8 |
| 1A2gviii. Other non-specified industry | 26 | 63.9 | 49.5 | 53.2 | 52.5 | 25.3 | 28.4 | 9.5 |

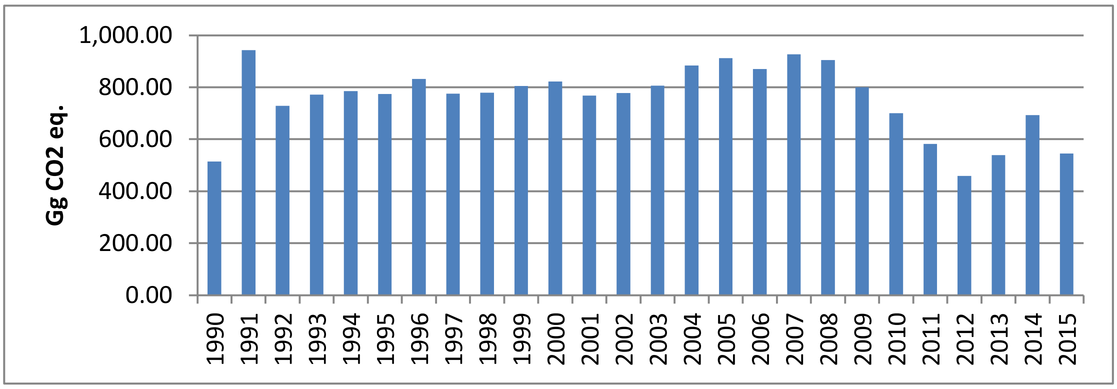


**Figure 3.3. Emissions from energy use in manufacturing industries and construction (1A2) 1990-2015**

### 3.2.4.2. Methodological issues

**Data**

The data used to estimate the emissions for the industrial activities from energy consumption in manufacturing industries and construction 1990-2015 is presented in Table 3.16. Consumption for Iron and steel (1A2a) is included in Non-ferrous metals (1A2b). Consumption for Transport equipment (1A2g), Machinery (1A2h) and Autoproducer electricity plants is included in Non-specified Industry (1A2m). RFO in Chemical and petrochemical (1A2c) is introduced for the first time (in green colour). Additionally, the consumption of Diesel, RFO, LPG, biomass for years 2012 - 2014 is revised for some industrial sectors where it is consumed (with red colour).

**Table 3.16. Fuel consumption in manufacturing industries and construction 1990-2015**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| **1A2b Non-ferrous metals** | | | | | | | |
| LPG (kt) | 0.91 | 0.91 | 1.02 | 0.94 | 0.93 | 0.94 | 0.94 |
| Diesel/gasoil (kt) | 0.69 | 0.77 | 0.93 | 0.96 | 0.99 | 1.08 | 1.13 |
| **1A2c Chemical and petrochemical** | | | | | | | |
| RFO (kt) | | | | | | | |
| Diesel/gasoil (kt) | 0.69 | 0.77 | 0.93 | 0.96 | 0.99 | 1.08 | 1.13 |
| Solid biofuels (TJ) | | | | | | | |
| **1A2d Paper, pulp and printing** | | | | | | | |
| RFO (kt) | 1.54 | 5.17 | 4.92 | 4.17 | 4.58 | 4.04 | 4.63 |
| **1A2e Food, beverages and tobacco** | | | | | | | |
| Diesel/gasoil (kt) | 2.07 | 2.30 | 2.79 | 2.89 | 2.98 | 3.23 | 3.40 |
| RFO (kt) | 18.50 | 62.00 | 59.00 | 50.00 | 55.00 | 48.50 | 55.50 |
| LPG (kt) | 2.72 | 2.72 | 3.06 | 2.83 | 2.78 | 2.83 | 2.83 |
| Solid biofuels (TJ) | | | | | | | |
| **1A2f Non-Metallic Minerals** | | | | | | | |
| Pet-coke (kt) | 40.00 | 93.00 | 85.00 | 114.00 | 112.00 | 125.00 | 147.00 |
| RFO (kt) | 9.25 | 31.00 | 29.50 | 25.00 | 27.50 | 24.25 | 27.75 |
| diesel (kt) | 2.07 | 2.30 | 2.79 | 2.89 | 2.98 | 3.23 | 3.40 |
| LPG (kt) | 0.91 | 0.91 | 1.02 | 0.94 | 0.93 | 0.94 | 0.94 |
| Other bituminous coal (kt) | 97.00 | 97.00 | 26.00 | 31.00 | 27.00 | 20.00 | 18.00 |
| Solid biomass (TJ) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Industrial waste* (TJ) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **1A2i Mining** | | | | | | | |
| Diesel (kt) | 3.45 | 3.84 | 4.65 | 4.82 | 4.96 | 5.39 | 5.67 |
| **1A2k Construction** | | | | | | | |
| Diesel (kt) | 3.45 | 3.84 | 4.65 | 4.82 | 4.96 | 5.39 | 5.67 |
| **1A2m Non-specified Industry** | | | | | | | |
| Diesel (kt) | 2.07 | 2.30 | 2.79 | 2.89 | 2.98 | 3.23 | 3.40 |
| RFO (kt) | 6.17 | 20.67 | 19.67 | 16.67 | 18.33 | 16.17 | 18.50 |
| Other oil products (kt) | 0.00 | 5.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| White spirit (kt) | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 1.00 | 1.00 |
| Other kerosene (kt) | | | | | | | |

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| **1A2b Non-ferrous metals** | | | | | | | |
| LPG (kt) | 0.96 | 0.93 | 0.91 | 0.98 | 0.98 | 1.00 | 1.07 |
| Diesel/gasoil (kt) | 1.19 | 1.27 | 1.30 | 1.35 | 1.36 | 1.30 | 1.34 |
| **1A2c Chemical and petrochemical** | | | | | | | |
| RFO (kt) | | | | | | | |
| Diesel/gasoil (kt) | 1.19 | 1.27 | 1.30 | 1.35 | 1.36 | 1.30 | 1.34 |

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| Solid biofuels (TJ) | | | | | | | |
| **1A2d Paper, pulp and printing** | | | | | | | |
| RFO (kt) | 2.92 | 2.83 | 2.83 | 2.92 | 2.25 | 2.29 | 2.58 |
| **1A2e Food, beverages and tobacco** | | | | | | | |
| Diesel/gasoil (kt) | 3.57 | 3.80 | 3.91 | 4.04 | 4.08 | 3.91 | 4.01 |
| RFO (kt) | 35.00 | 34.00 | 34.00 | 35.00 | 27.00 | 27.50 | 31.00 |
| LPG (kt) | 2.89 | 2.78 | 2.72 | 2.94 | 2.94 | 3.00 | 3.22 |
| Solid biofuels (TJ) | | | | | | | |
| **1A2f Non-Metallic Minerals** | | | | | | | |
| Pet-coke (kt) | 152.00 | 150.00 | 154.00 | 141.00 | 133.00 | 139.00 | 137.00 |
| RFO (kt) | 17.50 | 17.00 | 17.00 | 17.50 | 13.50 | 13.75 | 15.50 |
| diesel (kt) | 3.57 | 3.80 | 3.91 | 4.04 | 4.08 | 3.91 | 4.01 |
| LPG (kt) | 0.96 | 0.93 | 0.91 | 0.98 | 0.98 | 1.00 | 1.07 |
| Other bituminous coal (kt) | 19.00 | 26.00 | 30.00 | 49.00 | 53.00 | 53.00 | 53.00 |
| Solid biomass (TJ) | 0.00 | 0.00 | 0.00 | 41.00 | 70.00 | 90.00 | 211.00 |
| Industrial waste* (TJ) | 0.00 | 0.00 | 0.00 | 0.00 | 18.00 | 0.00 | 15.00 |
| **1A2i Mining** | | | | | | | |
| Diesel (kt) | 5.95 | 6.34 | 6.51 | 6.73 | 6.80 | 6.51 | 6.69 |
| **1A2k Construction** | | | | | | | |
| Diesel (kt) | 5.95 | 6.34 | 6.51 | 6.73 | 6.80 | 6.51 | 6.69 |
| **1A2m Non-specified Industry** | | | | | | | |
| Diesel (kt) | 3.57 | 3.80 | 3.91 | 4.04 | 4.08 | 3.91 | 4.01 |
| RFO (kt) | 11.67 | 11.33 | 11.33 | 11.67 | 9.00 | 9.17 | 12.33 |
| Other oil products (kt) | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| White spirit (kt) | 1.00 | 0.00 | 1.00 | 0.00 | 1.00 | 0.00 | 0.00 |
| Other kerosene (kt) | | | | | | | |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| **1A2b Non-ferrous metals** | | | | | | | |
| LPG (kt) | 1.04 | 0.98 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 |
| Diesel/gasoil (kt) | 1.20 | 1.12 | 1.14 | 0.95 | 0.86 | 0.86 | 0.67 |
| **1A2c Chemical and petrochemical** | | | | | | | |
| RFO (kt) | | | | | | | |
| Diesel/gasoil (kt) | 1.20 | 1.12 | 1.14 | 0.95 | 0.86 | 0.86 | 0.67 |
| Solid biofuels (TJ) | | | | | | | |
| **1A2d Paper, pulp and printing** | | | | | | | |
| RFO (kt) | 2.83 | 1.65 | 1.12 | 1.59 | 1.47 | 1.00 | 1.18 |
| **1A2e Food, beverages and tobacco** | | | | | | | |
| Diesel/gasoil (kt) | 3.61 | 3.36 | 3.43 | 2.86 | 2.57 | 2.57 | 2.00 |
| RFO (kt) | 34.00 | 19.76 | 13.41 | 19.06 | 17.65 | 12.00 | 14.12 |
| LPG (kt) | 3.11 | 2.94 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Solid biofuels (TJ) | | | | | | | |
| **1A2f Non-Metallic Minerals** | | | | | | | |
| Pet-coke (kt) | 146.00 | 154.00 | 146.00 | 143.00 | 152.00 | 144.00 | 116.00 |
| RFO (kt) | 17.00 | 37.00 | 35.00 | 38.00 | 38.00 | 30.00 | 25.00 |
| diesel (kt) | 3.61 | 3.36 | 3.43 | 2.86 | 2.57 | 2.57 | 2.00 |
| LPG (kt) | 1.04 | 0.98 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Other bituminous coal (kt) | 57.00 | 54.72 | 54.33 | 49.46 | 44.60 | 23.49 | 27.44 |
| Solid biomass (TJ) | 127.00 | 38.00 | 61.00 | 133.00 | 281.00 | 304.00 | 347.00 |
| Industrial waste* (TJ) | 71.00 | 138.00 | 73.00 | 288.00 | 239.00 | 276.00 | 299.00 |
| **1A2i Mining** | | | | | | | |
| Diesel (kt) | 6.02 | 5.60 | 5.71 | 4.76 | 4.29 | 4.29 | 3.33 |
| **1A2k Construction** | | | | | | | |
| Diesel (kt) | 6.02 | 5.60 | 5.71 | 4.76 | 4.29 | 4.29 | 3.33 |
| **1A2m Non-specified Industry** | | | | | | | |
| Diesel (kt) | 3.61 | 3.36 | 3.43 | 3.86 | 2.57 | 2.57 | 2.00 |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| RFO (kt) | 16.33 | 12.59 | 11.47 | 24.35 | 20.88 | 17.00 | 14.71 |
| Other oil products (kt) | 6.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| White spirit (kt) | 0.00 | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 |
| Other kerosene (kt) | 1.04 | 0.98 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 |

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| **1A2b Non-ferrous metals** | | | | | |
| LPG (kt) | 1.00 | 1.00 | 0.00 | 0.00 | 1.00 |
| Diesel/gasoil (kt) | 0.76 | 1.00 | 0.00 | 0.00 | 0.00 |
| **1A2c Chemical and petrochemical** | | | | | |
| RFO (kt) | | | | | 1.00 |
| Diesel/gasoil (kt) | 0.76 | 1.00 | 1.00 | 1.00 | 1.00 |
| Solid biofuels (TJ) | | | | 42.00 | 52.00 |
| **1A2d Paper, pulp and printing** | | | | | |
| RFO (kt) | 2.00 | 1.1 | 1.00 | 1.00 | 1.00 |
| **1A2e Food, beverages and tobacco** | | | | | |
| Diesel/gasoil (kt) | 2.29 | 3.00 | 2.00 | 1.00 | 3.00 |
| RFO (kt) | 24.00 | 9.00 | 8.00 | 13.00 | 19.00 |
| LPG (kt) | 4.00 | 5.00 | 4.00 | 3.00 | 2.00 |
| Solid biofuels (TJ) | | | | 44.00 | 7.00 |
| **1A2f Non-Metallic Minerals** | | | | | |
| Pet-coke (kt) | 100.00 | 94.00 | 135.00 | 162.00 | 128 |
| RFO (kt) | 15.00 | 13.00 | 8.00 | 7.00 | 8.00 |
| diesel (kt) | 2.29 | 3.00 | 1.00 | 1.00 | 1.00 |
| LPG (kt) | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 |
| Other bituminous coal (kt) | 12.25 | 0.00 | 0.00 | 4.15 | 6.03 |
| Solid biomass (TJ) | 306.00 | 29.00 | 28.00 | 116.00 | 95.00 |
| Industrial waste* (TJ) | 56.23 | 23.06 | 45.08 | 390.53 | 31.76 |
| **1A2i Mining** | | | | | |
| Diesel (kt) | 3.81 | 5.00 | 2.00 | 1.00 | 2.00 |
| **1A2k Construction** | | | | | |
| Diesel (kt) | 3.81 | 5.00 | 5.00 | 5.00 | 3.00 |
| **1A2m Non-specified Industry** | | | | | |
| Diesel (kt) | 4.29 | 5.00 | 3.00 | 2.00 | 2.00 |
| RFO (kt) | 12.00 | 3.00 | 5.00 | 5.00 | 1.00 |
| Other oil products (kt) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| White spirit (kt) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other kerosene (kt) | | | | 2.00 | 0.00 |

* non-renewable

### Methodology

The emissions from energy use in manufacturing industries and construction were estimated using predominately the IPCC 2006 guidelines. Details for each industrial activity are presented below.

<u>Non-ferrous metals</u>

The liquid fuels are consumed by non-ferrous metals, namely LPG and Gas-Diesel oil (Table 3.16). Fuel consumption was converted to TJ using the default NCV proposed by the IPCC 2006 guidelines (Table 3.17). The CO2, CH4 and N2O emissions were estimated using the default emission factors proposed by the IPCC 2006 guidelines (volume 2, pg. 2.18); i.e. 63100 kg CO2/TJ, 1 kg CH4/TJ and 0.1 kg N2O/TJ for LPG and 74100 kg CO2/TJ, 3 kg CH4/TJ and 0.6 kg N2O/TJ for Gas-Diesel oil.

Chemicals

According the energy balance gas-diesel oil and solid biomass are consumed by chemical industries (Table 3.16). Fuel consumption was converted to TJ using the default NCV proposed by the IPCC 2006 guidelines (Table 3.17). The CO2, CH4 and N2O emissions from gas-diesel oil were estimated using the default emission factors proposed by the IPCC 2006 guidelines (volume 2, pg. 2.18); i.e. 74100 kg CO2/TJ, 3 kg CH4/TJ and 0.6 kg N2O/TJ. Consumption of solid biomass is reported for the first time in 2014. The CO2, CH4 and N2O emissions from solid biomass were estimated using the default emission factors proposed by the IPCC 2006 guidelines (volume 2, pg. 2.19); i.e. 100000 kg CO2/TJ, 30 kg CH4/TJ and 4 kg N2O/TJ.

Pulp, Paper and Print

Fuel consumption for this category has been reported for the first time in the 2014 energy balance. However, the activity did take place in previous years. Therefore assumptions have been made to estimate the fuel consumption of the category (see previous Section) of the complete period. Consumption of RFO was converted to TJ using the default NCV proposed by the IPCC 2006 guidelines (Table 3.17).The CO2, CH4 and N2O emissions from RFO were estimated using the default emission factors proposed by the IPCC 2006 guidelines (volume 2, pg. 2.18); i.e. 77400 kg CO2/TJ, 3 kg CH4/TJ and 0.6 kg N2O/TJ.

Food processing, beverages and tobacco

According the energy balance the fuels consumed by food processing, beverages and tobacco industries are LPG, gas-diesel oil and RFO (Table 3.16). Fuel consumption was converted to TJ using the default NCV proposed by the IPCC 2006 guidelines (Table 3.17). The CO2, CH4 and N2O emissions were estimated using the default emission factors proposed by the IPCC2006 guidelines (volume 2, pg. 2.18); i.e. 63100 kg CO2/TJ, 1 kg CH4/TJ and 0.1 kg N2O/TJ for LPG, 74100 kg CO2/TJ, 3 kg CH4/TJ, 0.6 kg N2O/TJ for Gas-Diesel oil and 77400 kg CO2/TJ, 3 kg CH4/TJ, 0.6 kg N2O/TJ for RFO. Consumption of solid biomass is reported for the first time in 2014.The CO2, CH4 and N2O emissions from solid biomass were estimated using the default emission factors proposed by the IPCC 2006 guidelines (volume 2, pg. 2.19); i.e. 100000 kg CO2/TJ, 30 kg CH4/TJ and 4 kg N2O/TJ.

Non-metallic minerals

According the energy balance the non-metallic minerals industries consume LPG, gas-diesel oil, RFO, pet-coke, other bituminous coal, solid biomass and industrial waste non-renewable (Table 3.16). RFO consumption for 1990-2004 has been revised due to the addition of Pulp, Paper and Print industries.

All liquid fuel consumption (LPG, gas-diesel oil, RFO and pet-coke) was converted to TJ using the default NCV proposed by the IPCC 2006 guidelines (Table 3.17). Pet-coke is consumed only by two cement producing installations during 1990-2011, which merged into one in 2011. These installations have been submitting annual emissions' report according to the requirements of the ETS law 110(I)/2011, since 2005. The CO2 emissions from pet-coke for the period 2005- 2015 were used as reported for the ETS. CO2 emissions for the period

1990-2004 were estimated using the IEF of 2005, resulting from the division of CO2 emissions by the TJ fuel consumed (84.51 t CO2/TJ). CH4 and N2O emissions for fuels were estimated using the default emission factors proposed by the IPCC2006 guidelines (volume 2, pg. 2.18); i.e. 3 kg CH4/TJ and 0.6 kg N2O/TJ for gas-diesel oil, RFO and pet-coke and 1 kg CH4/TJ and 0.1 kg N2O/TJ for LPG.

Other bituminous coal was consumed during the period 1990-2011 by only one cement-producing installation, which has been submitting annual emissions' report according to the requirements of the ETS law 110(I)/2011, since 2005. The new installation (after 2011) consumed other bituminous coal in 2014 and 2015. Fuel consumption for the period 2005-2015 was obtained in TJ from the annual ETS reports. Fuel consumption for the period 1990-2004 was converted to TJ with the NCV of the first ETS report submitted (i.e. 2005), which was 29.824 TJ/kt. The CO2 emissions from other bituminous coal for the period 2005-2013 were used as reported for the ETS. CO2 emissions for the period 1990-2004 were estimated using the IEF of 2005, resulting from the division of CO2 emissions by the TJ fuel consumed (92.60 t CO2/TJ). CH4 and N2O emissions for other bituminous coal were estimated using the default emission factors proposed by the IPCC2006 guidelines (volume 2, pg. 2.18); i.e. 10 kg CH4/TJ and 1.5 kg N2O/TJ.

Solid biomass data was available in TJ. Solid biomass is consumed by only one cement-producing installation, which has been submitting annual emissions' report according to the requirements of the ETS law 110(I)/2011, since 2005. The CO2 emissions from solid biomass for the period 2005-2015 were used as reported for the ETS. CO2, CH4 and N2O emissions for solid biomass were estimated using the default emission factors proposed by the IPCC 2006 guidelines for "other primary solid biomass" (volume 2, pg. 2.19); i.e. 100000 kg CO2/TJ, 30 kg CH4/TJ and 4 kg N2O/TJ.

Non-renewable waste data was available in TJ. Non-renewable waste is consumed by only one cement-producing installation, which has been submitting annual emissions' report according to the requirements of the ETS law 110(I)/2011, since 2005. The CO2, CH4 and N2O emissions for non-renewable industrial waste were estimated using the default emission factors proposed by the IPCC2006 guidelines (volume 2, pg. 2.19); i.e. 143000 kg CO2/TJ, 30 kg CH4/TJ and 4 kg N2O/TJ.

1A2i Mining (excluding fuels) and Quarrying

According the energy balance mining and quarrying industries consume only diesel (Table 3.16). Fuel consumption was converted to TJ using the default NCV proposed by the IPCC 2006 guidelines (Table 3.17.). CO2, CH4 and N2O emissions were estimated using the default emission factors proposed by the IPCC2006 guidelines (volume 2, pg. 2.18); i.e. 74100kg CO2/TJ, 3 kg CH4/TJ and 0.6 kg N2O/TJ for gas – diesel oil.

1A2k Construction

According the energy balance construction industries consume only diesel (Table 3.16). Fuel consumption was converted to TJ using the default NCV proposed by the IPCC 2006 guidelines (Table 3.17). CO2, CH4 and N2O emissions were estimated using the default emission factors proposed by the IPCC2006 guidelines (volume 2, pg. 2.18); i.e. 74100kg CO2/TJ, 3 kg CH4/TJ and 0.6 kg N2O/TJ for gas – diesel oil.

1A2m Non-specified Industry

According the energy balance the fuels consumed by Non-specified industries are gas-diesel oil, RFO, other oil products and white spirit (Table 3.16). Other kerosene has been consumed in 2014 by the gas exploration platforms. RFO consumption for 1990-2014 has been revised due to the addition of Pulp, Paper and Print industries. Fuel consumption was converted to TJ using the default NCV proposed by the IPCC 2006 guidelines (Table 3.17). The CO2, CH4 and N2O emissions were estimated using the default emission factors proposed by the IPCC2006 guidelines (volume 2, pg. 2.18); i.e. 74100 kg CO2/TJ for Gas-Diesel oil, 77400 kg CO2/TJ for RFO, 71900 kg CO2/TJ for other kerosene, 73300 kg CO2/TJ for white spirit and other oil products. The emission factors for CH4 and N2O are 3 kg CH4/TJ, 0.6 kg N2O/TJ for all fuels.

**Table 3.17. Parameters used for the estimation of emissions**

| | NCV (TJ/kt) | IEF (tCO2/TJ)* |
|---|---|---|
| Gas-diesel oil | 43.0 | |
| RFO | 40.4 | |
| Other oil products | 40.2 | |
| White spirit | 40.2 | |
| Pet-coke | 32.5 | 84.505 |
| LPG | 47.3 | |
| Other kerosene | 43.8 | |
| Other bituminous coal | 25.8 | 92.600 |

* based on the ETS 2005 report; used for the years 1990-2004

### 3.2.4.3. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

### 3.2.4.4. Source-specific QA / QC and verification

QA/QC and verification activities are presented in Section 1.6.

### 3.2.4.5. Source-specific recalculations

Non-ferrous metals: a mistake has been identified in the emission factors used for LPG. The emissions' estimates for the complete period have been affected.

Pulp, Paper and Print: fuel consumption for this category has been reported for the first time in the 2014 energy balance. However, the activity did take place in previous years. Therefore assumptions have been made to estimate the fuel consumption of the category (see previous Section) of the complete period.

Food processing, beverages and tobacco: RFO consumption has been revised due to the addition of Pulp, Paper and Print industries. The emissions' estimates for the complete period have been affected.

Non-metallic minerals: RFO consumption for the period 1990-2004 has been revised due to the addition of Pulp, Paper and Print industries. The emissions' estimates for the complete period have been affected.

1A2m Non-specified Industry: RFO consumption has been revised due to the addition of Pulp, Paper and Print industries. The emissions' estimates for the complete period have been affected. Source 1A2m includes consumption from Autoproducer electricity plants and Autoproducer CHP plants.

#### 3.2.4.6. Source-specific planned improvements

Efforts are made in collaboration with the Statistical Service to further improve data on fuel consumption per industrial activity.

### 3.2.5. Transport (CRF 1A3)

#### 3.2.5.1. Source category description

Internal aviation, road transportation, railways and internal navigation should be included in the transport sector (1A3). Emissions from international marine and aviation bunkers are not included in national totals, but are calculated and reported separately as Memo items (CRF 1D) (see Section 3.5). In Cyprus, the sources of emissions reported in Transport are domestic aviation (1A3a), road transport (1A3b) and Domestic water-borne navigation (1A3d(ii) - NEW). No other transport mean is used in Cyprus; i.e. there is no railway activity in Cyprus.

All fuel consumption and respective emissions for road transport are reported under 1A3b(i) Cars. The reason for this is the unavailability of fuel consumption breakdown to different means of road transport.

Between 1990 and 2015 the emissions from transport have increased by 56% (Table 3.18). During the same period the emissions from domestic aviation decreased by 94.5%, while emissions from road transport increased by 57%. The emissions for the period are presented in Table 3.18. Transport contributes 22.7% to the total emissions of the country in 2015 without LULUCF and 31.3% to the emissions from the energy sector. Transport (1A3) emissions are also presented in Figure 3.4.

**Table 3.18. Transport emissions 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| CO2 (Gg) | 1181 | 1482 | 1760 | 2045 | 2253 | 1808 | 1761 | 1830 |
| CH4 (Gg) | 0.22 | 0.25 | 0.29 | 0.39 | 0.49 | 0.43 | 0.42 | 0.42 |
| N2O (Gg) | 0.09 | 0.11 | 0.13 | 0.17 | 0.20 | 0.17 | 0.16 | 0.17 |
| Total (Gg CO2 eq.) | 1214 | 1522 | 1807 | 2104 | 2324 | 1869 | 1820 | 1889 |
| Gg CO2 eq. | | | | | | | | |
| 1A3a. Domestic aviation | 11.08 | 12.20 | 12.58 | 12.59 | 7.72 | 0.97 | 0.61 | 0.61 |
| 1A3b. Road transport | 1200 | 1506 | 1792 | 2089 | 2313 | 1866 | 1817 | 1887 |
| 1A3d. Domestic Navigation | 2.24 | 3.03 | 1.72 | 2.37 | 3.07 | 1.53 | 1.49 | 1.59 |

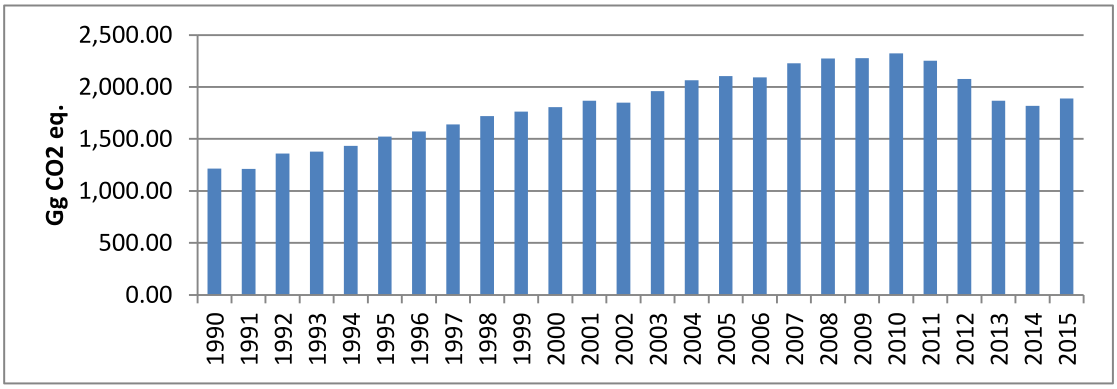


**Figure 3.4. Transport (1A3) emissions 1990-2015**

### 3.2.5.2. Methodological issues

**Domestic aviation**

The emissions from domestic aviation were estimated using the Tier 1 method proposed by 2006 IPCC guidelines. Information on fuel consumption for domestic flights is not available from national statistics. To estimate the emissions from aviation, the available information on fuel consumption from EUROCONTROL was used (Table 3.19) for 2005-2015. To complete the time series back to 1990, it was assumed that domestic flights during the period 1990-2004 had the same contribution to the total aviation consumption as 2005 (1.48%). Total consumption for 1990-2004 was obtained from the National Statistics.

NCV and emission factors are the defaults proposed by the IPCC 2006 guidelines; i.e. 44.1 TJ/kt, 71.5 t CO2/TJ, 0.5 kg CH4/TJ and 2 kg N2O/TJ.

This is the second time this method is used. In previous submissions emissions were estimated using LTOs.

**Table 3.19. Fuel consumption for domestic and international flights 1990-2015 (kt)**

| kt | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| Domestic | 3.5 | 4.1 | 4.0 | 3.4 | 3.5 | 3.8 | 3.7 | 3.6 | 3.8 | 3.9 |
| International | 232.5 | 275.9 | 268.0 | 227.6 | 233.5 | 256.2 | 245.3 | 241.4 | 254.2 | 260.1 |
| TOTAL | 236 | 280 | 272 | 231 | 237 | 260 | 249 | 245 | 258 | 264 |

| kt | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|
| Domestic | 4.0 | 4.6 | 4.5 | 4.8 | 4.4 | 4.0 | 3.3 | 3.0 | 2.8 | 2.3 |
| International | 264.0 | 309.4 | 297.5 | 318.2 | 290.6 | 264.2 | 266.4 | 262.4 | 272.3 | 257.4 |
| TOTAL | 268 | 314 | 302 | 323 | 295 | 268.2 | 269.7 | 265.3 | 275.1 | 259.7 |

| kt | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Domestic | 2.4 | 0.7 | 0.5 | 0.3 | 0.2 | 0.3 | | | | |
| International | 262.6 | 272.5 | 263.4 | 245.7 | 246.0 | 238.1 | | | | |
| TOTAL | 265.1 | 273.2 | 263.9 | 246.1 | 246.2 | 238.4 | | | | |

### Road transport

GHG emissions from road transport were estimated according to the IPCC2006 guidelines. Fuel consumption data was obtained from the energy balance prepared by the statistical service and is presented in Table 3.20. Consumption of Diesel for 2014 has been revised due to revision of the energy balance. Carbon dioxide emission factors are according to the IPCC 2006 guidelines (volume 2, pg. 3.16, table 3.2.1 and pg. 1.23, table 1.4). Methane and nitrous oxide emission factor are according to the IPCC 2006 guidelines (volume 2, pg. 3.21, table 3.2.2).

All fuel consumption and respective emissions for road transport are reported under 1A3b(i) Cars. The reason for this is the unavailability of fuel consumption breakdown to different means of road transport.

**Table 3.20. Fuel consumed by road transport (kt) during 1990-2015**

| kt | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| Gasoline | 163 | 170 | 172 | 169 | 180 | 183 | 186 | 191 | 195 | 203 |
| Diesel | 209 | 201 | 245 | 254 | 260 | 284 | 297 | 313 | 333 | 339 |
| Biodiesel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| kt | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|
| Gasoline | 206 | 219 | 228 | 252 | 282 | 303 | 323 | 352 | 373 | 383 |
| Diesel | 349 | 355 | 340 | 351 | 353 | 345 | 322 | 336 | 329 | 320 |
| Biodiesel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 16 | 17 |

| kt | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| Gasoline | 390 | 385 | 372 | 349 | 341 | 345 |
| Diesel | 328 | 312 | 271 | 231 | 223 | 241 |
| Biodiesel | 17 | 18 | 18 | 17 | 11 | 11 |

Calorific values and emission factors for the estimation of emissions from road transport are presented in Table 3.21. The CH4 emission factor for gasoline has been revised compared to 2015 submission due to the recommendation by the TERT to use the factors for “motor gasoline - oxidation catalyst” instead of “low mileage light duty vehicle vintage 1995 or later” that was used in NIR2015. NCV and CO2 emission factor for biodiesel has been obtained from table 1.4 (volume 2, pg. 1.23). CH4 and N2O emission factors for biodiesel have been assumed to be the same as diesel (IPCC2006 default, volume 2, pg. 3.21).

**Table 3.21. Parameters used for the estimation of emissions from road transport (IPCC 2006 guidelines)**

| Fuel | NCV (TJ/kt) | CO2 (kg/TJ) | $CH_4$ EF (kg/TJ) | $N_2O$ EF (kg/TJ) |
|---|---|---|---|---|
| Diesel | 43.0 | 74100 | 3.9 | 3.9 |
| Gasoline | 44.3 | 69300 | 25 | 8 |
| Biodiesel | 37.0* | 70800 | 3.8 | 5.7 |

* NCV based on the energy balance prepared by the National Statistical Service and not the IPCC guidelines

### Domestic water-borne navigation

Estimation of emission from domestic water-borne navigation activities has been made possible due to data obtained from the Statistical Service on fuel consumption for the years 1998-2014 (Table 3.22). The consumption for remaining years has been estimated assuming the following: (a) for the years 1990-1997 the contribution of domestic water-borne navigation activities to road transport was assumed the same as 1998 (0.33%), (b) for 2015 the contribution of domestic water-borne navigation activities to road transport was assumed the same as 2014 (0.25%).

**Table 3.22. Diesel consumption by domestic water-borne navigation activities**

| | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Activity (kt) | 0.69 | 0.66 | 0.81 | 0.84 | 0.86 | 0.94 | 0.98 | 1.03 | 1.10 | 1.24 | 0.53 |
| | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** |
| Activity (kt) | 0.43 | 0.56 | 0.43 | 0.60 | 0.73 | 0.56 | 0.63 | 0.76 | 1.49 | 0.95 | 0.89 |
| | **2012** | **2013** | **2014** | **2015** | | | | | | | |
| Activity (kt) | 0.63 | 0.47 | 0.56 | 0.49 | | | | | | | |

Calorific values and emission factors of road diesel for the estimation of emissions from domestic water-borne navigation are according to IPCC2006: NCV 43 TJ/kt (volume 2, pg. 1.18), 74100 kg CO2/TJ (volume 2, pg. 3.50), 3.9 kg CH4/TJ and 3.9 kg N2O/TJ (assumed same as road - default, volume 2, pg. 3.21).

#### 3.2.5.3. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

#### 3.2.5.4. Source-specific QA / QC and verification

QA/QC and verification activities are presented in Section 1.6.

#### 3.2.5.5. Source-specific recalculations

No recalculations.

#### 3.2.5.6. Source-specific planned improvements

Obtain COBERT estimates for emissions from road transport for the whole reporting period by next NIR submission.

The improvement of the estimation of emissions from domestic aviation is planned. However, because it is not considered a priority or urgent to complete it, due to the very small contribution to the total emissions, it is not foreseen to be completed for the next submission.

### 3.2.6. Other sectors (CRF 1A4)

#### 3.2.6.1. Source category description

Emissions from other sectors (1A4) include the emissions caused by the sectors commercial/ institutional (1A4A), residential (1A4B) and agriculture/ forestry/ fishery (1A4C). The source of emissions is the energy consumption for heat in order to cover the needs for the space heating, water heating etc. Thermal needs in these sectors are covered mainly by liquid fossil fuels, while the contribution of biomass (fuel wood), especially in the residential sector, is also significant (mainly in mountainous areas).

Due to the unavailability of consumption data for several years and sectors, using the fuel consumption data as published by the Statistical Service, would create issues of consistence and comparability. Therefore it was decided to complete the period using assumptions.

GHG emissions from other sectors in 2015 increased by 26% compared to 1990 emissions (from 434 Gg $CO_2$ eq in 1990 to 547 Gg $CO_2$ eq in 2015). Table 3.23 presents the trend between 1990 and 2015. Other sectors contribute 6.4% to the total emissions of the country in 2015 without LULUCF and 9.1% to the emissions from the energy sector. The emissions from Other sources (1A4) are presented in Figure 3.5.

**Table 3.23. GHG emissions from Other sectors 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| CO2 (Gg) | 430.4 | 602.5 | 725.4 | 604.6 | 563.2 | 512.6 | 456.3 | 540.9 |
| CH4 (Gg) | 0.10 | 0.14 | 0.14 | 0.15 | 0.17 | 0.17 | 0.15 | 0.20 |
| N2O (Gg) | 0.003 | 0.005 | 0.005 | 0.005 | 0.004 | 0.004 | 0.004 | 0.005 |
| Total (Gg CO2 eq.) | 434 | 608 | 731 | 610 | 569 | 518 | 461 | 547 |
| Gg CO2 eq. | | | | | | | | |
| 1A4a. Commercial / Institutional | 75.8 | 105.3 | 116.8 | 99.5 | 120.0 | 104.0 | 88.3 | 107.5 |
| 1A4b. Residential | 302 | 416.4 | 507.4 | 420.7 | 371.9 | 337.3 | 305.5 | 356.8 |
| 1A4ci. Agriculture/Forestry/Fisheries-stationary | 49.2 | 75.4 | 93.5 | 79.7 | 64.0 | 70.4 | 70.0 | 76.6 |
| 1A4ciii. Agriculture/Forestry/Fisheries-Fishing | 6.6 | 10.4 | 12.9 | 9.8 | 12.8 | 6.4 | 6.4 | 6.4 |

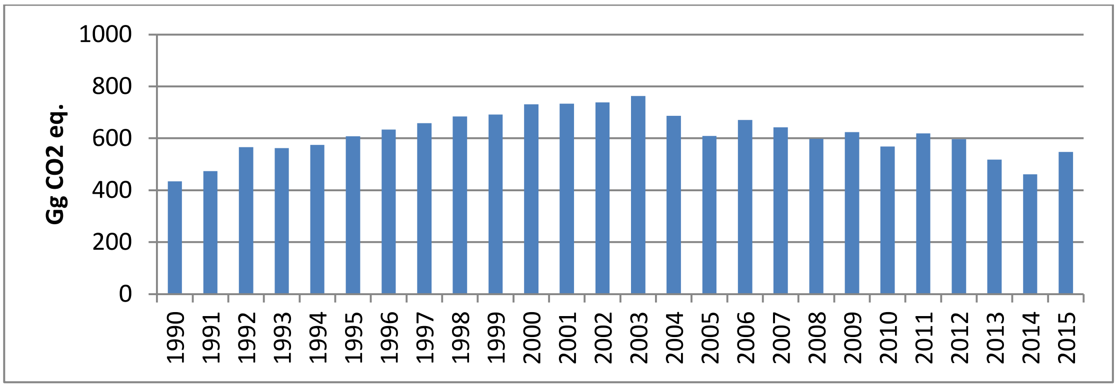


**Figure 3.5. Other sectors (1A4) emissions 1990-2015**

### 3.2.6.2. Methodological issues

Due to the unavailability of consumption data for several years and sectors, using the fuel consumption data as published by the Statistical Service, would create issues of consistence and comparability. Therefore it was decided to complete the period using assumptions. The activity data used for the estimation of GHG emissions of other sectors is presented in Table 3.25.

Gas biomass consumed by agriculture includes all biogas consumption. Diesel consumption by agriculture was revised to exclude diesel consumed for fishing (in red). Fuel consumption for fishing is added. Moreover RFO consumption by the commercial sector has been revised and Off-road Vehicles and Other Machinery (1A4c ii) consumption is included in road transport (1A3b). Consumption of some fuels for years 2012 - 2014 has been revised due to revision of the energy balance.

**Table 3.25. Fuel consumption for other sectors 1990-2015**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| **1A4a Commercial / Institutional** | | | | | | | | | |
| Gas-diesel oil (kt) | 11 | 12 | 15 | 15 | 16 | 17 | 18 | 19 | 20 |
| RFO (kt) | 2 | 5 | 5 | 4 | 5 | 4 | 5 | 3 | 3 |
| LPG (kt) | 12 | 12 | 13 | 12 | 12 | 12 | 12 | 13 | 12 |
| Solid biofuels (TJ) | 19 | 15 | 15 | 15 | 11 | 12 | 17 | 9 | 8 |
| Biogas (TJ) | | | | | | | | | |
| Charcoal (kt) | 1 | 1 | 1 | 1 | 1 | 4 | 4 | 4 | 4 |
| **1A4b Residential** | | | | | | | | | |
| Other kerosene (kt) | 12 | 12 | 17 | 16 | 17 | 17 | 18 | 20 | 21 |
| Gas-diesel oil (kt) | 52 | 58 | 71 | 73 | 75 | 82 | 86 | 90 | 96 |
| LPG (kt) | 32 | 32 | 36 | 33 | 32 | 33 | 33 | 34 | 32 |
| Solid biofuels (TJ) | 126 | 105 | 103 | 102 | 74 | 79 | 119 | 61 | 56 |
| Charcoal (kt) | 1 | 1 | 1 | 1 | 1 | 4 | 4 | 4 | 4 |
| **1A4c Agriculture / Forestry / Fishing / Fish farms** | | | | | | | | | |
| ***1A4c i Stationary*** | | | | | | | | | |
| Gas-diesel oil (kt) | 14 | 16 | 20 | 20 | 21 | 23 | 24 | 25 | 27 |
| LPG (kt) | 0.9 | 0.9 | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 0.9 |
| Biogas (TJ) | | | | | | | | | |
| Solid Biomass (TJ) | | | | | | | | | |
| ***1A4c iii Fishing*** | | | | | | | | | |
| Gas-diesel oil (kt) | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 4 | 4 |

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| **1A4a Commercial / Institutional** | | | | | | | | | |
| Gas-diesel oil (kt) | 21 | 22 | 22 | 21 | 21 | 19 | 18 | 19 | 18 |
| RFO (kt) | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 2 | 2 |
| LPG (kt) | 12 | 13 | 13 | 13 | 14 | 13 | 13 | 13 | 13 |
| Solid biofuels (TJ) | 11 | 10 | 10 | 10 | 9 | 8 | 7 | 5 | 14 |
| Biogas (TJ) | | | | | | | | | |
| Charcoal (kt) | 4 | 3 | 3 | 4 | 4 | 4 | 5 | 5 | 7 |
| **1A4b Residential** | | | | | | | | | |
| Other kerosene (kt) | 20 | 24 | 24 | 31 | 31 | 24 | 16 | 16 | 16 |
| Gas-diesel oil (kt) | 99 | 102 | 103 | 99 | 102 | 92 | 83 | 98 | 89 |
| LPG (kt) | 32 | 34 | 34 | 35 | 38 | 36 | 34 | 35 | 36 |
| Solid biofuels (TJ) | 77 | 68 | 70 | 64 | 58 | 53 | 51 | 74 | 95 |
| Charcoal (kt) | 4 | 3 | 3 | 4 | 4 | 4 | 5 | 5 | 6 |
| **1A4c Agriculture / Forestry / Fishing / Fish farms** | | | | | | | | | |
| ***1A4c i Stationary*** | | | | | | | | | |
| Gas-diesel oil (kt) | 27 | 28 | 29 | 27 | 28 | 25 | 24 | 25 | 25 |
| LPG (kt) | 0.9 | 1.0 | 1.0 | 1.0 | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 |
| Biogas (TJ) | | | | | | | | 0 | 15 |
| Solid Biomass (TJ) | | | | | | | | 5 | |
| ***1A4c iii Fishing*** | | | | | | | | | |
| Gas-diesel oil (kt) | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 |

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| **1A4a Commercial / Institutional** | | | | | | | | |
| Gas-diesel oil (kt) | 20 | 19 | 23 | 20 | 16 | 17 | 15 | 19 |
| RFO (kt) | 2 | 2 | 2 | 2 | 4 | 4 | 2 | 3 |
| LPG (kt) | 14 | 13 | 13 | 14 | 14 | 12 | 11 | 12 |
| Solid biofuels (TJ) | 15 | 15 | 15 | 13 | 16 | 16 | 16 | 15 |

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Biogas (TJ) | | 11 | 12 | 11 | 11 | 11 | 11 | 11 |
| Charcoal (kt) | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 7 |
| **1A4b Residential** | | | | | | | | |
| Other kerosene (kt) | 14 | 19 | 14 | 16 | 17 | 12 | 9 | 14 |
| Gas-diesel oil (kt) | 78 | 83 | 70 | 80 | 76 | 62 | 57 | 65 |
| LPG (kt) | 34 | 36 | 34 | 38 | 37 | 33 | 31 | 34 |
| Solid biofuels (TJ) | 123 | 222 | 84 | 123 | 143 | 112 | 71 | 146 |
| Charcoal (kt) | 6 | 5 | 5 | 6 | 6 | 6 | 6 | 7 |
| **1A4c Agriculture / Forestry / Fishing / Fish farms** | | | | | | | | |
| ***1A4c i Stationary*** | | | | | | | | |
| Gas-diesel oil (kt) | 23 | 20 | 19 | 22 | 21 | 21 | 19 | 22 |
| LPG (kt) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1 | 0.0 | 2.0 |
| Biogas (TJ) | 78 | 209 | 274 | 448 | 476 | 466 | 464 | 460 |
| Solid Biomass (TJ) | | | | | | | | |
| ***1A4c iii Fishing*** | | | | | | | | |
| Gas-diesel oil (kt) | 3 | 4 | 4 | 3 | 3 | 2 | 2 | 2 |

The GHG emissions from other sectors were estimated according to the IPCC2006 guidelines. Fuel consumption was converted to TJ using the default NCV proposed by the IPCC 2006 guidelines (Table 3.26). The oxidation factor used is 1, as proposed by the IPCC 2006 guidelines (pg. 1.20).The CO2, CH4 and N2O emissions were estimated using the default emission factors proposed by the IPCC2006 guidelines (IPCC2006, pg. 2.20-2.22, oil) as presented in Table 3.26.

**Table 3.26. Parameters used for the estimation of emissions from other sectors**

| Fuel | NCV (TJ/kt) | kg $CO_2$ /TJ | kg $CH_4$ /TJ | kg $N_2O$ /TJ |
|---|---|---|---|---|
| Diesel | 43.0 | 74100 | 10 | 0.6 |
| Other Kerosene | 43.8 | 71900 | 10 | 0.6 |
| LPG | 47.3 | 63100 | 5 | 0.1 |
| RFO | 40.4 | 77400 | 10 | 0.6 |
| Solid Biomass | | 100000 | 300 | 4 |
| Charcoal | 29.5 | 112000 | 200 | 1 |
| Gas biomass | | 54600 | 5 | 0.1 |

#### 3.2.6.3. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

#### 3.2.6.4. Source-specific QA / QC and verification

QA/QC and verification activities are presented in Section 1.6.

#### 3.2.6.5. Source-specific recalculations

RFO consumption by commerce has been revised due to the addition of Pulp, Paper and Print industries. Diesel consumption by agriculture has been revised to exclude the consumption for fishing, which is now reported separately.

#### 3.2.6.6. Source-specific planned improvements

Improve collaboration between involved authorities of the government, to increase the accuracy in data collection.

### 3.2.7. Other (CRF 1A5)

#### 3.2.7.1. Source category description

Fuel consumption not elsewhere specified, has been allocated to an additional category CRF 1A5. The emissions during the period 1990-2015 are presented in Table 3.27 and Figure 3.6.

**Table 3.27. GHG emissions from Other (Not elsewhere specified-Stationary) 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| CO2 (Gg) | 11.00 | 17.17 | 21.43 | 19.03 | 20.29 | 23.44 | 34.98 | 22.27 |
| CH4 (Gg) | 0.0015 | 0.0023 | 0.0029 | 0.0060 | 0.0062 | 0.0066 | 0.0048 | 0.0030 |
| N2O (Gg) | 0.00009 | 0.00014 | 0.00017 | 0.00016 | 0.00018 | 0.00020 | 0.00029 | 0.00018 |
| Total (Gg CO2 eq.) | 11.06 | 17.27 | 21.55 | 19.23 | 20.49 | 23.66 | 35.19 | 22.40 |

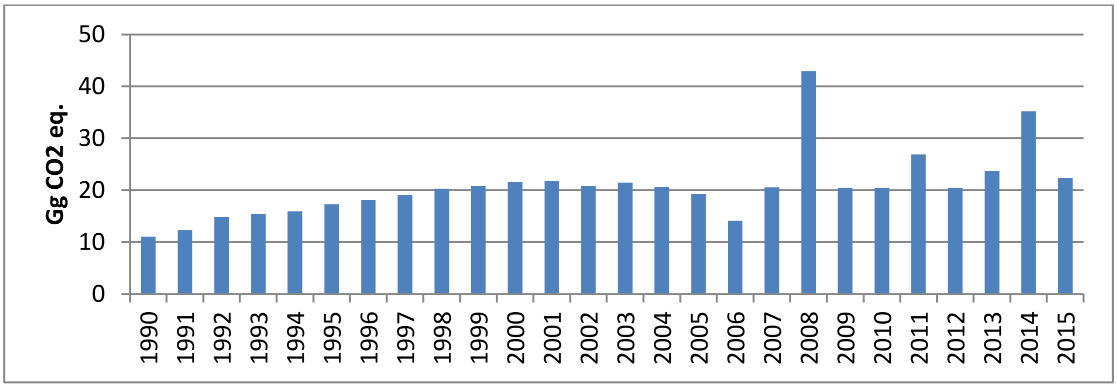


**Figure 3.6. GHG emissions from Other (Not elsewhere specified-Stationary) (1A5) 1990-2015**

#### 3.2.7.2. Methodological issues

**Data**

Due to the unavailability of consumption data for several years and sectors, using the fuel consumption data as published by the Statistical Service, would create issues of consistence and comparability. Therefore it was decided to complete the period using assumptions. The activity data used for the estimation of GHG emissions of other sectors is presented in Table 3.28.

All fuel consumption is allocated to stationary consumption.

**Table 3.28. Other non-specified fuel consumption 1990-2015**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| Gas-diesel oil (kt) | 3 | 4 | 5 | 5 | 5 | 5 | 6 | 6 | 6 |
| Lignite (kt) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jet kerosene (kt) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| Gas-diesel oil (kt) | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 4 | 6 |
| Lignite (kt) | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| Jet kerosene (kt) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Gas-diesel oil (kt) | 13 | 5 | 5 | 6 | 5 | 5 | 9 | 6 |
| Lignite (kt) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| Jet kerosene (kt) | 0 | 1 | 1 | 2 | 1 | 2 | 2 | 1 |

**Methodology**

The GHG emissions were estimated according to the IPCC2006 guidelines. Fuel consumption was converted to TJ using the default NCV proposed by the IPCC 2006 guidelines (Table 1.23). The CO2, CH4 and N2O emissions were estimated using the default emission factors proposed by the IPCC2006 guidelines (volume 2, pg. 2.22) as presented in Table 3.29.

**Table 3.29. Parameters used for the estimation of other emissions**

| Fuel | NCV (TJ/kt) | kg $CO_2$ /TJ | kg $CH_4$ /TJ | kg $N_2O$ /TJ |
|---|---|---|---|---|
| Diesel | 43.0 | 74100 | 10 | 0.6 |
| Jet kerosene | 44.1 | 71500 | 10 | 0.6 |
| Lignite | 11.9 | 101000 | 300 | 1.5 |
| Solid Biomass | 11.6 | 100000 | 300 | 4.0 |

#### 3.2.7.3. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section1.7.

#### 3.2.7.4. Source-specific QA / QC and verification

QA/QC and verification activities are presented in Section1.6.

#### 3.2.7.5. Source-specific recalculations

Recalculations have been caused by the revision of lignite consumption due to the correction of a mistake identified in the transfer of the data.

#### 3.2.7.6. Source-specific planned improvements

Improve collaboration between involved authorities of the government, to increase the accuracy in data collection.

### 3.2.8. Reference approach (CRF 1AB)

The Reference Approach requires statistics for production of fuels and their external trade as well as changes in their stocks. It also needs a limited number of figures for the consumption of fuels used for non-energy purposes where carbon may be stored. It uses a simple assumption: once carbon is brought into a national economy in fuel, it is either saved in some way (e.g., in increases of fuel stocks, stored in products, left unoxidised in ash) or it must be released to the atmosphere. The estimation process is divided in six steps that are described below.

Step 1: Estimation of apparent consumption

This step concerns the estimation of apparent consumption in natural units or in the units commonly used for the recording of the relative fuel amounts. For secondary fuels production data are not included in the apparent consumption calculation, since they are already accounted for in the primary fuel consumption, from which they derive. Therefore, the apparent consumption of primary fuels is estimated by the following equation:

Apparent consumption =Primary production + Imports - Exports - International bunkers + Stock change

The apparent consumption of secondary fuels is estimated by the following equation:

Apparent consumption = Imports - Exports - International bunkers + Stock change

Step 2: Conversion of fuel data to a common energy unit

The values were multiplied by the net calorific values listed in Table 3.30 to provide the energy consumed in TJ. The NCV values used were the defaults proposed by the IPCC 2006 guidelines (volume 2, pg. 1.18) except for pet-coke and other bituminous coal. Pet-coke and other bituminous coal are consumed only from one cement producing installation. Therefore the NCV implied by the annual reports submitted according to national ETS legislation (law no. 110(I)/2011), instead of the default proposed by the IPCC were used, which is available for the years 2000-2014; for the years 1990-1999 the NCV was assumed the same as 2000.

Step 3: Estimation of carbon content

Total carbon included in each fuel is calculated by multiplying energy consumption by an emission factor (Table 3.30a and Table 3.30b) that reflects the amount of carbon per energy unit for each fuel. The result gives the maximum amount of carbon that could be potentially released if all carbon in the fuels were converted to $CO_2$. The carbon emission factor of fuels used in the reference approach, are based predominately on the 2006 IPCC guidelines. The exceptions are pet-coke and other bituminous coal. These fuels are consumed only from one cement producing installation. Therefore it was preferred to use the carbon emission factor implied by the annual reports submitted according to national ETS legislation (law no. 110(I)/2011), instead of the default proposed by the IPCC.

Step 4: Estimation of carbon stored in products

Depending on the end use, non-energy uses of fuels can result in the storage of some or all of the carbon contained in the fuel to the non-energy product. The non-energy consumption of fuels is multiplied by an emission factor that reflects the amount of the carbon content of the fuel stored in non-energy product. The result is the maximum amount of carbon that could potentially be sequestered if that amount of carbon were stored in the non-energy product. By subtracting this amount from the total carbon calculated in step 3, the amount of carbon that could be theoretically converted in $CO_2$ is calculated.

Step 5: Estimation of carbon unoxidised during fuel use

The amount of carbon that was previously calculated is reduced by a fraction of 1%, in order to take account of the fact that a small part of the fuel carbon entering combustion escapes oxidation. It is assumed that the carbon that remains unoxidised is stored indefinitely.

Step 6: Estimation of $CO_2$ emissions

Carbon emissions from all fuels are multiplied by 44/12 to be converted to $CO_2$ emissions and are summed giving the total amount of $CO_2$ released in the atmosphere. The emissions estimated with the reference approach are presented in Table 3.31. Detailed presentation of the results is available in Annex III.

**Table 3.30. Net calorific value (TJ/kt) and carbon emission factors (t CO2/kt) of fuels consumed in Cyprus used for the reference approach**

**(a) Net calorific value (TJ/kt) and carbon emission factors (t CO2/kt) that remain constant for the period 1990-2015**

| | Conversion factor (TJ/kt) | Carbon emission factor (tC/TJ) |
|---|---|---|
| Crude oil | 42.3 | 20.0 |
| Gasoline | 44.3 | 18.9 |
| Jet kerosene | 44.1 | 19.5 |
| Other kerosene | 43.8 | 19.6 |
| Gas-diesel oil | 43.0 | 20.2 |
| Residual fuel oil | 40.4 | 21.1 |
| LPG | 47.3 | 17.2 |
| Bitumen | 40.2 | 22.0 |
| Lubricants | 40.2 | 20.0 |
| Pet-coke | 32.5 | table (b) |
| Other oil-refinery gas | 49.5 | 15.7 |
| Other oil-White spirit & SBP | 40.2 | 20.0 |
| Other bituminous coal | table (b) | table (b) |
| Lignite | 11.9 | 27.6 |
| Waste (non-biomass fraction) | 10 | 25.0 |
| Industrial waste | NA | 39.0 |

**(b) Net calorific value (TJ/kt) and carbon emission factors (t CO2/kt) that are not constant for the period 1990-2015**

| | 1990-2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|
| **NCV (TJ/kt)** | | | | | | |
| Other bituminous coal | 25.8 | 29.824 | 29.824 | 28.360 | 25.950 | 26.080 |
| **Implied CEF (tC/TJ)** | | | | | | |
| Pet-coke | 23.047 | 23.047 | 24.160 | 24.659 | 24.486 | 25.578 |
| Other bituminous coal | 25.254 | 25.254 | 25.156 | 22.815 | 25.788 | 25.661 |

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| **NCV (TJ/kt)** | | | | | | |
| Other bituminous coal | 26.819 | 25.517 | NO | NO | 23.21 | 25.675 |
| **Implied CEF (tC/TJ)** | | | | | | |
| Pet-coke | 25.515 | 25.301 | 24.795 | 25.238 | 25.583 | 25.150 |
| Other bituminous coal | 25.794 | 25.620 | NO | NO | 25.890 | 25.876 |

**Table 3.31. Apparent consumption (TJ) and CO2 emissions (Gg) estimates according to the reference approach**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| **Liquid Fuels** | | | | | | | |
| Apparent consumption | 54,413 | 56,077 | 65,228 | 69,960 | 79,824 | 69,164 | 77,171 |
| CO2 | 4,049 | 4,193 | 4,794 | 5,140 | 5,853 | 5,090 | 5,670 |
| **Solid Fuels** | | | | | | | |
| Apparent consumption | 2,682 | 2,682 | 719 | 857 | 747 | 553 | 498 |
| CO2 | 248 | 248 | 67 | 79 | 69 | 51 | 46 |
| **Biomass** | | | | | | | |

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| Apparent consumption | 287 | 262 | 260 | 259 | 726 | 686 | 671 |
| CO2 | 29 | 27 | 26 | 26 | 75 | 71 | 70 |
| **Waste (non-biomass fraction)** | | | | | | | |
| Apparent consumption | NO | NO | NO | NO | NO | NO | NO |
| CO2 | NO | NO | NO | NO | NO | NO | NO |

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| **Liquid Fuels** | | | | | | | |
| Apparent consumption | 75,396 | 80,331 | 80,895 | 86,793 | 85,796 | 86,919 | 95,075 |
| CO2 | 5,535 | 5,880 | 6,038 | 6,317 | 6,252 | 6,339 | 6,983 |
| **Solid Fuels** | | | | | | | |
| Apparent consumption | 525 | 719 | 830 | 1,355 | 1,423 | 1,399 | 1,447 |
| CO2 | 49 | 67 | 77 | 125 | 132 | 130 | 134 |
| **Biomass** | | | | | | | |
| Apparent consumption | 565 | 614 | 487 | 515 | 551 | 606 | 694 |
| CO2 | 59 | 64 | 51 | 53 | 57 | 63 | 72 |
| **Waste (non-biomass fraction)** | | | | | | | |
| Apparent consumption | NO | NO | NO | NO | 18.00 | NO | 15.00 |
| CO2 | NO | NO | NO | NO | 2.57 | NO | 2.15 |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| **Liquid Fuels** | | | | | | | |
| Apparent consumption | 88,710 | 90,431 | 94,032 | 98,797 | 104,335 | 102,219 | 98,350 |
| CO2 | 6,450 | 6,546 | 6,873 | 7,249 | 7,636 | 7,518 | 7,143 |
| **Solid Fuels** | | | | | | | |
| Apparent consumption | 1,643 | 1,500 | 1,632 | 1,402 | 1,182 | 616 | 709 |
| CO2 | 152 | 139 | 151 | 117 | 112 | 58 | 67 |
| **Biomass** | | | | | | | |
| Apparent consumption | 608 | 565 | 570 | 915 | 1,684 | 1,751 | 1,722 |
| CO2 | 64 | 60 | 61 | 95 | 152 | 151 | 145 |
| **Waste (non-biomass fraction)** | | | | | | | |
| Apparent consumption | 71.00 | 138.00 | 73.00 | 288.00 | 239.00 | 276.00 | 299.00 |
| CO2 | 10.15 | 19.73 | 10.44 | 41.18 | 34.18 | 39.47 | 42.76 |

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| **Liquid Fuels** | | | | | |
| Apparent consumption | 95,237 | 89,107 | 76,342 | 77,846 | 78,755 |
| CO2 | 6,931 | 6,536 | 5,626 | 5,795 | 5,834 |
| **Solid Fuels** | | | | | |
| Apparent consumption | 318 | 12 | 12 | 96 | 155 |
| CO2 | 30 | 1 | 1 | 9 | 15 |
| **Biomass** | | | | | |
| Apparent consumption | 1955 | 1840 | 1676 | 1582 | 1639 |
| CO2 | 160 | 145 | 132 | 129 | 135 |
| **Waste (non-biomass fraction)** | | | | | |
| Apparent consumption | 56.23 | 23.06 | 45.08 | 390.53 | 31.76 |
| CO2 | 8.04 | 3.30 | 6.45 | 55.85 | 4.54 |

### 3.2.9. Comparison of the sectoral approach with the reference approach (CRF 1AC)

The data used in the reference and the sectoral approach and the resulting emissions are presented in Annex III. The comparison of the fuel consumption and the emissions is summarised in Table 3.32.

The reason for the small differences that occur between the two approaches is the statistical difference that exists in the energy balance, between the Gross inland deliveries (Calculated) and the Gross inland deliveries (Observed). For some fuels and years the statistical difference is extremely large. The statistical difference of the energy balance is presented in detail in Annex III.

**Table 3.32. Difference between Reference and Sectoral Approach 1990-2015**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| **Fuel consumption (PJ)** | | | | | | | |
| Sectoral approach | 52.0 | 58.7 | 63.5 | 65.6 | 68.5 | 67.2 | 71.0 |
| Apparent energy consumption* | 57.1 | 58.6 | 64.9 | 69.5 | 79.2 | 68.7 | 76.2 |
| *Difference* | *9.9%* | *-0.1%* | *2.2%* | *6.0%* | *15.6%* | *2.2%* | *7.3%* |
| **CO2 (Gg)** | | | | | | | |
| Reference approach | 4,297.1 | 4,441.6 | 4,860.2 | 5,219.1 | 5,922.6 | 5,141.0 | 5,716.1 |
| Sectoral approach | 3,895.6 | 4,423.6 | 4,748.1 | 4,927.0 | 5,134.3 | 5,038.7 | 5,288.9 |
| *Difference* | *10.3%* | *0.41%* | *2.36%* | *5.93%* | *15.35%* | *2.03%* | *8.08%* |

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| **Fuel consumption (PJ)** | | | | | | | |
| Sectoral approach | 72.7 | 77.2 | 80.6 | 83.5 | 82.1 | 84.2 | 89.4 |
| Apparent energy consumption* | 74.6 | 79.4 | 79.6 | 85.9 | 85.3 | 85.9 | 94.4 |
| *Difference* | *2.5%* | *2.8%* | *-1.3%* | *2.9%* | *3.9%* | *2.0%* | *5.6%* |
| **CO2 (Gg)** | | | | | | | |
| Reference approach | 5,583.4 | 5,947.1 | 6,114.3 | 6,442.3 | 6,386.5 | 6.468.4 | 7,119.4 |
| Sectoral approach | 5,453.5 | 5,793.7 | 6,054.7 | 6,280.3 | 6,170.4 | 6,327.6 | 6,713.3 |
| *Difference* | *2.38%* | *2.65%* | *0.99%* | *2.58%* | *3.50%* | *2.22%* | *6.05%* |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| **Fuel consumption (PJ)** | | | | | | | |
| Sectoral approach | 91.3 | 93.4 | 94.3 | 98.5 | 100.8 | 100.2 | 97.2 |
| Apparent energy consumption* | 87.4 | 88.8 | 92.7 | 97.7 | 102.6 | 100.4 | 95.9 |
| *Difference* | *-4.2%* | *-4.9%* | *-1.8%* | *-0.9%* | *1.8%* | *0.2%* | *-1.3%* |
| **CO2 (Gg)** | | | | | | | |
| Reference approach | 6,612.0 | 6,704.9 | 7,034.0 | 7,407.6 | 7,781.9 | 7,615.9 | 7,253.2 |
| Sectoral approach | 6,872.9 | 7,048.9 | 7,228.9 | 7,544.8 | 7,707.4 | 7,631.3 | 7,402.0 |
| *Difference* | *-3.8%* | *-4.9%* | *-2.7%* | *-1.8%* | *1.0%* | *-0.2%* | *-2.0%* |

| | 2011 | 2012 | 2013 | 2014 | 2015 | | |
|---|---|---|---|---|---|---|---|
| **Fuel consumption (PJ)** | | | | | | | |
| Sectoral approach | 94.3 | 87.9 | 75.6 | 76.7 | 78.8 | | |
| Apparent energy consumption* | 92.6 | 87.4 | 75.1 | 77.2 | 77.8 | | |
| *Difference* | *-1.7%* | *-0.6%* | *-0.7%* | *0.6%* | -1.3% | | |
| **CO2 (Gg)** | | | | | | | |
| Reference approach | 6,969.1 | 6,540.4 | 5,633.4 | 5,861.5 | 5,853.5 | | |
| Sectoral approach | 7,111.3 | 6,624.2 | 5,711,7 | 5,883.0 | 5,958.7 | | |
| *Difference* | *-2.0%* | *-1.2%* | *-1.4%* | *-0.4%* | -1.8% | | |

* excluding non-energy use, reductants and feedstocks

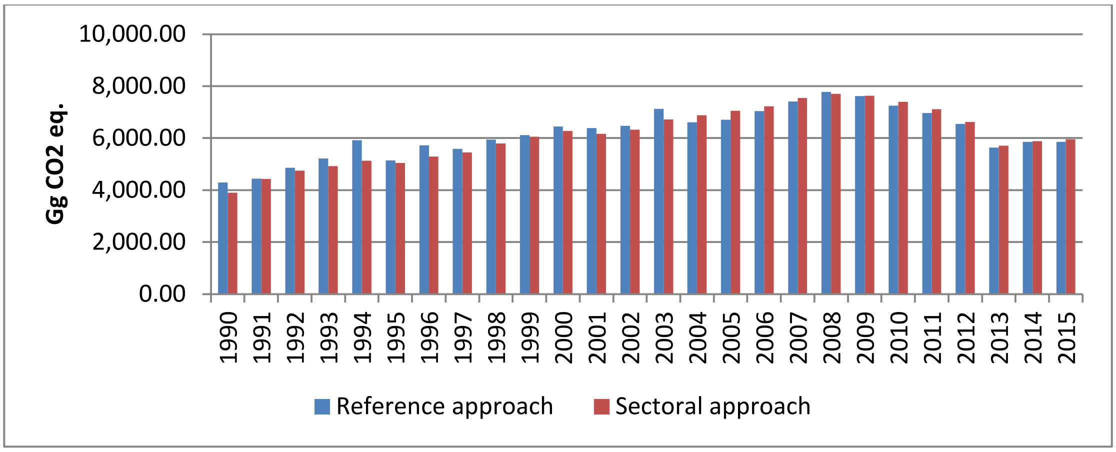


**Figure 3.7. Emissions from fuel combustion using sectoral and reference approach**

### 3.2.10. Feedstocks and non-energy use of fuels (CRF source 1AD)

Non-energy fuel use concerns the consumption of fuels as raw materials (e.g. in chemical industry, metal production) for the production of other products, or the use of fuels for non-energy purposes (e.g. bitumen). Part of the carbon content of fuels is stored in final products and is not oxidised into carbon dioxide for a certain time period. The fraction of the carbon contained in final products and the time period for which carbon is stored in them, depend on the type of fuel used and of the products produced.

The oxidation of the carbon stored in final products occurs either during the use of the product (e.g. solvents) or during their decomposition (e.g. through combustion). It should be noted that emissions from burning of products should be reported under the waste sector or energy sector (as long as energy exploitation takes place). In the case of Cyprus the products are used in the energy sector (it is assumed that 100% is collected and converted to fuel that is then consumed).

Non-energy use of fuels in Cyprus refers to the consumption of lubricants in transport and bitumen in construction. Data on the non-energy consumption of fuels was obtained from the national energy balance (Gross inland deliveries (Calculated)).

The calculation of carbon dioxide emissions from non-energy use of fuels is according to the methodology proposed by the IPCC2006 guidelines. NCVs, carbon emission factor and fraction of C stored are according to the guidelines (Table 3.33). Non-energy fuel use, carbon dioxide emissions and the amount of carbon stored in the final products are presented in Table 3.34.

The emissions are reported under 2D. The large difference that occurs for bitumen between the C stored estimated in Reference and 1AD between 1990-2004 is due to the production of bitumen by the refinery.

**Table 3.33. Parameters used for the calculation of emissions**

| | Lubricants | Bitumen |
|---|---|---|
| NCV (TJ/kt) | 40.2 | 40.2 |
| Carbon emission factor (t/TJ) | 20.00 | 22.00 |
| Oxidation factor | 1 | 1 |

**Table 3.34. Fuel consumption, carbon stored and CO2 emissions for Feedstocks and non-energy use of fuels**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| Lubricants | | | | | | | |
| Consumption (kt) | 0 | 0 | 0 | 6 | 11 | 11 | 12 |
| Carbon excluded (Gg) | 0 | 0 | 0 | 4.824 | 8.844 | 8.844 | 9.648 |
| $CO_2$ (Gg) | 0.00 | 0.00 | 0.00 | 17.69 | 32.43 | 32.43 | 35.38 |
| Bitumen | | | | | | | |
| Consumption (kt) | 33 | 19 | 50 | 59 | 58 | 51 | 55 |
| Carbon excluded (Gg) | 29.19 | 16.80 | 44.22 | 52.18 | 51.30 | 45.10 | 48.64 |
| $CO_2$ (Gg) | 107.01 | 61.61 | 162.14 | 191.33 | 188.08 | 165.38 | 178.35 |

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| Lubricants | | | | | | | |
| Consumption (kt) | 11 | 4 | 5 | 7 | 9 | 8 | 8 |
| Carbon excluded (Gg) | 8.844 | 3.216 | 4.02 | 5.628 | 7.236 | 6.432 | 6.432 |
| $CO_2$ (Gg) | 32.43 | 11.79 | 14.74 | 20.64 | 26.53 | 23.58 | 23.58 |
| Bitumen | | | | | | | |
| Consumption (kt) | 60 | 75 | 86 | 85 | 81 | 84 | 69 |
| Carbon excluded (Gg) | 53.06 | 66.33 | 76.06 | 75.17 | 71.64 | 74.29 | 61.02 |
| $CO_2$ (Gg) | 194.57 | 243.21 | 278.88 | 275.64 | 262.67 | 272.40 | 223.75 |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| Lubricants | | | | | | | |
| Consumption (kt) | 11 | 10 | 11 | 10 | 10 | 10 | 11 |
| Carbon excluded (Gg) | 8.844 | 8.04 | 8.844 | 8.04 | 8.04 | 8.04 | 8.844 |
| $CO_2$ (Gg) | 32.43 | 29.48 | 32.43 | 29.48 | 29.48 | 29.48 | 32.43 |
| Bitumen | | | | | | | |
| Consumption (kt) | 66 | 71 | 65 | 60 | 69 | 57 | 74 |
| Carbon excluded (Gg) | 58.37 | 62.79 | 57.49 | 53.06 | 61.02 | 50.41 | 65.45 |
| $CO_2$ (Gg) | 214.02 | 230.24 | 210.78 | 194.57 | 223.75 | 184.84 | 239.97 |

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| Lubricants | | | | | |
| Consumption (kt) | 10 | 9 | 7 | 7 | 8 |
| Carbon excluded (Gg) | 8.04 | 7.236 | 5.628 | 5.628 | 6.432 |
| $CO_2$ (Gg) | 29.48 | 26.53 | 20.64 | 20.64 | 23.58 |
| Bitumen | | | | | |
| Consumption (kt) | 64 | 35 | 26 | 22 | 21 |
| Carbon excluded (Gg) | 56.60 | 30.95 | 22.99 | 19.46 | 18.57 |
| $CO_2$ (Gg) | 207.54 | 113.50 | 84.31 | 71.34 | 68.10 |

### 3.2.11. $CO_2$ capture from flue gases and subsequent $CO_2$ storage

Not applicable.

### 3.2.12. Country-specific issues

Not applicable.

## 3.3. Fugitive emissions from solid fuels and oil and natural gas (CRF source 1B)

Activities related to primary production (extraction), processing, storage and transmission/ distribution of fossil fuels should be included in this sector. GHG released in the atmosphere during these operations is the direct result of leaks, disruptions and maintenance procedures. Moreover, the sector should also include emissions resulting from venting and flaring of gases that cannot be controlled by other means.

In Cyprus, there is no primary production of fuels or processing. There was one refinery in the country, which ceased its operation in 2004. Since then all fuels are imported. All transport of liquid fuels in Cyprus takes place by road transport. No central pipeline system is in place.

Based on the above, the fugitive emissions from oil for Cyprus are caused by refining. For refining, no emissions are reported after 2004 when the refinery stop operating (NO). Table 3.35 presents the emissions of the source. All emissions are methane emissions and are from refining activities (1B2A.4) and only occur during 1990-2004 when the refinery was operating. “NE” notation key for venting and flaring oil (1.B.2.c.1.i and 1.B.2.c.2.i CRF categories accordingly) has been used due to data unavailability for volume of oil transported by trucks and ships.

**Table 3.35. CH4 fugitive emissions from oil during 1990-2004, in tons**

| $CH_4$, t | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| Refining | 0.002 | 0.003 | 0.003 | 0.003 | 0.004 | 0.003 | 0.003 | 0.004 | 0.004 | 0.005 |

| $CH_4$, t | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|
| Refining | 0.005 | 0.005 | 0.004 | 0.004 | 0.001 |

**Methodological issues**

GHG emissions from oil until 2004 when the refinery was operating are estimated according to the Tier 1 methodology described in the IPCC 2006 guidelines. The activity data used in presented in Table 3.36.

**Table 3.36. Oil refined during 1990-2004, kt**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| Oil refined, kt | 743 | 891 | 849 | 912 | 1058 | 967 | 888 | 1218 | 1264 | 1379 |

| | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|
| Oil refined, kt | 1370 | 1350 | 1269 | 1134 | 326 |

The activity data is from the energy balance of the National Statistical Service. The emission factor 0.00335[15] CH4 t/m3 for oil refined is according to the IPCC 2006 guidelines, Table 4.2.4, pg. 4.53.

**Uncertainties and time-series consistency**

[15] $(2.6+4.1)/2)x10^{-3}=0.00335$

The uncertainty analysis of all sectors is presented in Section 1.7. Time-series consistency is ensured by (a) using the same source of data for all years and (b) using the same methodology for the estimation of emissions for all years.

**Source-specific QA / QC and verification**

QA/QC and verification activities are presented in Section 1.6.

**Source-specific recalculations**

No recalculations.

**Source-specific planned improvements**

No source specific improvements are planned.

## 3.4. CO2 Transport and Storage (CRF source 1C)

Not applicable

## 3.5. Memo items (CRF source 1D)

Memo items are emissions from source that have to be estimated and reported but do not count towards the national total. The activities that occur in Cyprus are International bunkers (1D1) and CO2 from biomass (1D3). The emissions during the period 1990-2015 are presented below.

**Table 3.37. Emissions from memo items (Gg CO2 eq.)**

| Gg CO2 eq. | **1990** | **1995** | **2000** | **2005** | **2010** | **2013** | **2014** |
|---|---|---|---|---|---|---|---|
| 1D1. International bunkers | 925 | 1034 | 1453 | 1780 | 1439 | 1547 | 1521 |
| 1D3. CO2 from biomass | 17.9 | 33.3 | 29.1 | 44.1 | 142.6 | 142.6 | 144.8 |

### 3.5.1. International bunkers (CRF 1D1)

#### 3.5.1.1. Source category description

According to the IPCC guidelines, fuels used for international transport should not be included in national totals of emissions from fuels used. However, the emissions from international bunkers should not be omitted entirely but reported separately. Emissions from international bunkers as estimated for the period 1990-2015 are presented in Table 3.38.

**Table 3.38. Emissions from international bunkers 1990-2015**

| | **1990** | **1995** | **2000** | **2005** | **2010** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|
| CO2 (Gg) | 916 | 1024 | 1439 | 1763 | 1424 | 1531 | 1510 | 1519 |
| CH4 (Gg) | 0.019 | 0.023 | 0.055 | 0.081 | 0.053 | 0.064 | 0.062 | 0.066 |
| N2O (Gg) | 0.028 | 0.029 | 0.043 | 0.053 | 0.046 | 0.048 | 0.048 | 0.047 |
| **Total (Gg CO2 eq.)** | 925 | 1034 | 1453 | 1780 | 1439 | 1547 | 1525 | 1535 |
| Gg CO2 eq. | | | | | | | | |
| 1D1a. International Aviation | 739.4 | 814.6 | 839.7 | 852.8 | 842.9 | 782.4 | 783.0 | 758.2 |
| 1D1b. International Navigation | 185.4 | 219.1 | 613.6 | 927.7 | 595.9 | 764.8 | 742.4 | 776.8 |

#### 3.5.1.2. Methodological issues

Activity data used for the estimation of emissions from bunkers is presented in Table 3.39. Data for all fuels except jet-kerosene, was obtained from the energy balance of the national statistical service in kt of fuel consumed. Information on fuel consumption for domestic flights is not available from national statistics. To estimate the emissions from aviation, the available information on fuel consumption from EUROCONTROL was used for 2005-2015. To complete the time series back to 1990, it was assumed that domestic flights during the period 1990-2004 had the same contribution to the total consumption as 2005 (1.48%). Total consumption for 1990-2004 was obtained from the National Statistics.

NCV and emission factors (Table 3.40) are the defaults proposed by the IPCC 2006 guidelines; i.e. 44.1 TJ/kt, 71.5 t $CO_2$/TJ, 0.5 kg $CH_4$/TJ and 2 kg $N_2O$/TJ.

**Table 3.39. Fuel consumption for international aviation and maritime activities 1990-2015 (kt)**

| kt | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| Jet Kerosene | 232.5 | 275.9 | 268.0 | 227.6 | 233.5 | 256.2 | 245.3 | 241.4 | 254.2 | 260.1 |
| Gas/Diesel Oil | 24 | 20 | 21 | 14 | 12 | 15 | 25 | 27 | 35 | 46 |
| RFO | 34 | 36 | 38 | 36 | 50 | 54 | 65 | 71 | 63 | 108 |

| kt | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|
| Jet Kerosene | 264.0 | 309.4 | 297.5 | 318.2 | 290.6 | 264.2 | 266.4 | 262.4 | 272.3 | 257.4 |
| Gas/Diesel Oil | 50 | 47 | 33 | 36 | 27 | 67 | 106 | 104 | 88 | 73 |
| RFO | 143 | 145 | 105 | 88 | 27 | 225 | 190 | 171 | 165 | 146 |

| kt | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| Jet Kerosene | 262.6 | 272.5 | 263.4 | 245.7 | 246.0 | 238.1 |
| Gas/Diesel Oil | 53 | 58 | 69 | 83 | 80 | 75 |
| RFO | 134 | 141 | 128 | 157 | 153 | 169 |

**Table 3.40. Parameters used for the calculation of emissions**

| Fuel | NCV (TJ/kt) | kg CO2/TJ | kg CH4/ TJ | kg N2O/ TJ |
|---|---|---|---|---|
| Jet Kerosene | 44.10 | 71500 | 0.5 | 2 |
| Gas/Diesel Oil | 43 | 74100 | 3.9 | 3.9 |
| RFO | 40.4 | 77400 | 3 | 0.6 |

### 3.5.1.3. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

### 3.5.1.4. Source-specific QA / QC and verification

QA/QC and verification activities are presented in Section 1.6.

### 3.5.1.5. Source-specific recalculations

Recalculations have been performed due to change in the method caused by new data that was obtained from EUROCONTROL for domestic and international aviation. Emission factors are according to the IPCC2006 guidelines.

### 3.5.1.6. Source-specific planned improvements

The options for improving the accuracy in fuel consumption are currently examined.

### 3.5.2. CO2 from biomass (CRF 1D3)

The total national CO2 emissions from biomass are presented in Table 3.41.

**Table 3.41. Emissions from CO2 from biomass 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| CO2 from biomass (Gg) | 17.9 | 33.3 | 29.2 | 44.1 | 142.6 | 127.6 | 125.1 | 134.4 |

#### 3.5.2.1. Methodological issues

Methodological issues have already been described in the Sections where the biomass consumption occurs.

#### 3.5.2.2. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

#### 3.5.2.3. Source-specific QA / QC and verification

QA/QC and verification activities are presented in Section 1.6.

#### 3.5.2.4. Source-specific recalculations

2013 consumption of liquid biomass has been revised by the statistical service leading to changes in the emissions of the particular year.

NCV of biodiesel has been revised from 27 TJ/kt (default IPCC 2006 guidelines) to country specific (37 TJ/kt) which was obtained from the national energy balance.

# Chapter 4: Industrial processes (CRF sector 2)

## 4.1. Overview of sector

This chapter includes information on GHG emissions from Industrial processes and description of the methodologies applied per source for the calculation of emissions. The main industrial activities that take place in Cyprus are food and beverage processing, cement and gypsum production, light chemicals (predominately pharmaceuticals), metal and wood products. Therefore, the following source categories are applicable for Cyprus in this sector: Mineral products (2A), Non – energy products from Fuels and Solvent Use (2D), Product Uses as Substitutes for ODS (2F) and Other Product Manufacture and Use (2G). Activity data for Non – energy products from Fuels and Solvent Use is not available therefore emissions for source 2D have not been estimated.

### 4.1.1. Emissions trends

In 2015, GHG emissions from Industrial processes accounted for 15.7% of total emissions excluding LULUCF compared to 14% in 1990. The emissions have increased by 72% compared to 1990. 67.3% of the industrial processes emissions are from mineral production, 27.3% is from consumption of Halocarbons and SF6, 4.5% is from Other Product Manufacture and Use and the remaining 0.8% is from non-energy products from fuels and solvent use.

**Table 4.1. Total GHG emissions (in Gg $CO_2$ eq) from Industrial Processes, 1990 – 2015**

| **Gg $CO_2$ eq.** | **1990** | **1995** | **2000** | **2005** | **2010** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|
| CO2 | 724 | 808 | 814 | 912 | 602 | 775 | 995 | 897 |
| N2O | 41.3 | 46.2 | 49.1 | 52.4 | 59.1 | 60.4 | 59.6 | 59.6 |
| HFCs | NO | 0.002 | 0.025 | 103.3 | 280.7 | 364 | 359.3 | 359.3 |
| SF6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total | 765 | 856 | 888 | 1068 | 942 | 1199 | 1414 | 1317 |
| A. Mineral industry | 717 | 795 | 803 | 894 | 585 | 765 | 986 | 887 |
| D. Non-energy products from fuels and solvent use | 6.3 | 13.1 | 11.0 | 17.6 | 17.2 | 9.5 | 9.2 | 10.7 |
| F. Product uses as ODS substitutes | NO | 1.6 | 25.2 | 103.3 | 281 | 364 | 359 | 359 |
| G. Other product manufacture and use | 41.4 | 46.3 | 49.4 | 52.5 | 59.3 | 60.6 | 59.8 | 59.8 |

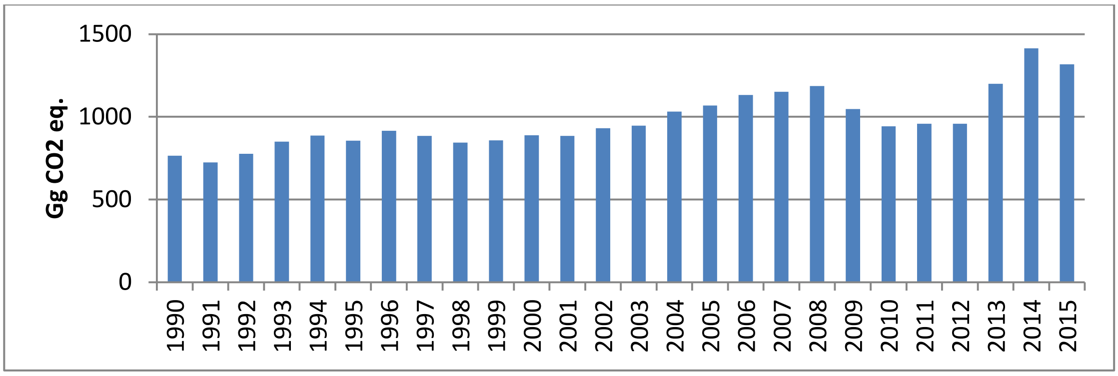


**Figure 4.1. GHG emissions from Industrial Processes (sector 2) for the period 1990 – 2015**

### 4.1.2. Methodology

The calculation of GHG emissions from Industrial Activities is based on the methodologies and emission factors suggested by the IPCC 2006 Guidelines and the GPG. Data used for the estimation on emissions was obtained from the National Statistical Service, and the installations (cement, lime, limestone and dolomite, and ceramics). Tier 1 method with default IPCC 2006 emission factors are used for all calculations except the sources for which CO2 emissions data is available from the EU ETS. The methodologies and emission factors used are summarised in Table 4.2.

**Table 4.2. Industrial processes – methodologies and emission factors applied**

| | $CO_2$ | | $N_2O$ | | HFC | |
|---|---|---|---|---|---|---|
| | **Method** | **EF** | **Method** | **EF** | **Method** | **EF** |
| 2A1. Mineral Industry – cement production | CS | CS | | | | |
| 2A2. Mineral Industry – lime production | T1 | D | | | | |
| 2A4a. Other Process - Ceramics | CS | CS | | | | |
| 2A4b. Other uses of soda ash | T1 | D | | | | |
| 2D1. Lubricant Use | D | D | | | | |
| 2D3. Solvent Use | CS | CS | | | | |
| *Urea-based catalysts* | T1 | D | | | | |
| 2F. Consumption of F-gases | | | | | CS | CS |
| 2G3a. $N_2O$ from products uses – medical applications | | | CS | CS | | |
| 2G3b. Propellant for pressure and aerosol products | | | CS | CS | | |
| 2G4. Other | CS | CS | | | | |

T1: IPCC methodology Tier 1; D: IPCC default methodology and emission factor; CS: Country specific

**Key categories**

The results of the key categories assessment are presented in Section 1.5.

**Uncertainty**

The uncertainty analysis is presented in Section 1.7.

### 4.1.3. Completeness

Table 4.3 gives an overview of the IPCC source categories included in this chapter and presents the status of emissions estimates from all sub-sources in industrial processes. The CO2 emissions from asphalt roofing and road paving with asphalt have not been estimated due to lack of methodology. Emissions from food and drink production (2D2) is not available therefore emissions for source have not been estimated either. Several sources from Consumption of halocarbons & SF6 are also not reported due to lack of activity data.

**Table 4.3. Industrial Processes – completeness**

| | $CO_2$ | $N_2O$ | HFC | PFC | $SF_6$ |
|---|---|---|---|---|---|
| 2A. Mineral products | | | | | |
| 2A1.Cement production | ✓ | | | | |
| 2A2. Lime production | ✓ | | | | |
| 2A3. Glass production | NO | | | | |
| 2A4a. Other process Uses of Carbonates - Ceramics | ✓ | | | | |
| 2A4b. Other uses of soda ash | ✓ | | | | |
| 2B. Chemical industry | NO | | | | |
| 2C. Metal Industry | NO | | | | |
| 2D1. Non-energy Products from Fuels and Solvent Use – Lubricant Use | ✓ | | | | |
| 2D2. Paraffin wax Use | ✓ | | | | |
| 2D3. Lubricant Use | ✓ | | | | |
| 2E. Electronics Industry | | | NO | NO | NO |
| 2F. Product Uses as Substitutes for ODS | | | | | |
| 2F1. Refrigeration & air conditioning | | | ✓ | NO | NO |
| 2F2. Foam blowing agents | | | ✓ | NO | NO |
| 2F3. Fire protection | | | ✓ | NO | NO |
| 2F4a. Metered dose inhalers | | | ✓ | NO | NO |
| 2F5. Solvents | | | NO | NO | NO |
| 2G1. Electrical equipment | | | NO | NO | ✓ |
| 2G3. N2O from product uses | | ✓ | NO | NO | NO |
| 2G4. Other | ✓ | | | | |

NO: Not occurring; IE: Included Elsewhere

## 4.2. Mineral products (2A)

The mineral products that are produced in Cyprus are cement, lime and ceramics. Other products that are consumed in Cyprus are limestone (only in cement and lime production - already accounted for in 2A1 and 2A2) and soda ash. According to the information obtained from the Customs, soda ash in Cyprus is imported for consumption by a bentonite quarry, lab supplies, swimming pools, production of building materials and cleaning products. The emissions estimated by product are presented in Table 4.4.

**Table 4.4. Emissions from mineral products (Gg $CO_2$)**

| Gg CO2 | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| CO2 | 717 | 795 | 803 | 894 | 585 | 765 | 986 | 887 |
| Total | 717 | 795 | 803 | 894 | 585 | 765 | 986 | 887 |
| | | | | | | | | |
| 2A1. Cement production | 668 | 751 | 763 | 822 | 555 | 752 | 974 | 877 |
| 2A2. Lime production | 5.5 | 4.5 | 5.6 | 12.4 | 7.4 | 2.8 | 2.5 | 2.4 |
| 2A4a. Ceramics production | 43.8 | 38.9 | 34.1 | 60.0 | 22.2 | 10.0 | 9.4 | 7.0 |
| 2A4b. Other uses of soda ash | 0.255 | 0.219 | 0.558 | 0.276 | 0.295 | 0.147 | 0.166 | 0.135 |

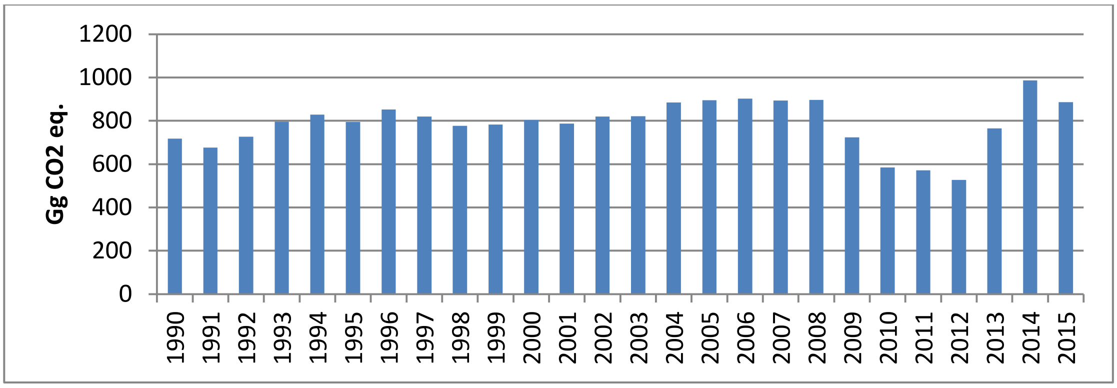


**Figure 4.2. GHG emissions from Mineral products (2A) for the period 1990 – 2015**

### 4.2.1. Methodological issues

**Cement production (2A1)**

Data for clinker production was obtained from the installations that operate in Cyprus (2 installations 1990-2011, one installation thereafter). Data was compared to the data reported by the statistical service and the data used by the department of Labour Inspection for the preparation of air pollutants inventories under Directive 2001/81/EC. The emission factor of 0.5347 tCO2/t clinker was used for 1990-1996, which is the implied emission factor estimated from the CO2 process emissions reported by the two cement producing installations for 1997.

Activity and emissions data was collected for the period 1997-2004 from the preparation of the allocation for the application of the EU ETS Directive for the period 2005-2007. This data is used as reported by the installations. From 2005 CO2 emissions were used as reported by the installations for ETS purposes. All activity and emissions data used has been verified by accredited verifiers according to the EU and national ETS legislation.

All the CKD is bound and recycled into the production process and that therefore emissions from CKD are not estimated, since no CKD is being exported from the system. According to the ETS inspectors this is the case for the two installations that were operating before 2011 and the one installation that has been operating since. The two installations operating before 2011 have been using the same production technologies and process.

The total clinker production and the reported process CO2 emissions are presented in Table 4.5.

**Table 4.5. Total clinker production and CO2 process emissions from cement production (kt)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| **Clinker production (kt)** | | | | | | | | | |
| Installation 1 | 353 | 390 | 380 | 382 | 383 | 369 | 359 | 374 | 337 |
| Installation 2 | 895 | 786 | 902 | 1015 | 1083 | 1035 | 1158 | 1085 | 1045 |
| Total | 1249 | 1176 | 1282 | 1397 | 1466 | 1405 | 1516 | 1459 | 1382 |
| **CO2 process emissions** (Gg) | | | | | | | | | |
| Installation 1 | | | | | | | | 190 | 180 |
| Installation 2 | | | | | | | | 590 | 560 |
| Total | | | | | | | | 780 | 740 |

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| **Clinker production (kt)** | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Installation 1 | 334 | 362 | 361 | 373 | 363 | 367 | 330 | 365 | 350 |
| Installation 2 | 1047 | 1065 | 1033 | 1059 | 1043 | 1142 | 1143 | 1177 | 1166 |
| Total | 1382 | 1428 | 1394 | 1432 | 1405 | 1509 | 1473 | 1542 | 1515 |
| **CO2 process emissions** (Gg) | | | | | | | | | |
| Installation 1 | 180 | 193 | 193 | 200 | 194 | 197 | 195 | 198 | 190 |
| Installation 2 | 560 | 569 | 552 | 566 | 557 | 610 | 626 | 623 | 622 |
| Total | 740 | 763 | 745 | 766 | 751 | 808 | 822 | 821 | 812 |

| | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|
| **Clinker production (kt)** | | | | | | | | |
| Installation 1 | 368 | 231 | 260 | 76 | 0 | 0 | 0 | 0 |
| Installation 2 | 1158 | 1033 | 783 | 961 | 953 | 1418 | 1822 | 1641 |
| Total | 1526 | 1264 | 1043 | 1037 | 953 | 1418 | 1822 | 1641 |
| **CO2 process emissions** (Gg) | | | | | | | | |
| Installation 1 | 200 | 125 | 140 | 41 | 0 | 0 | 0 | 0 |
| Installation 2 | 618 | 548 | 415 | 505 | 505 | 752 | 974 | 877 |
| Total | 818 | 673 | 555 | 546 | 505 | 752 | 974 | 877 |

**Lime production (2A2)**

The activity data for lime production was obtained from the one installation in Cyprus that produces slaked lime. The emission factor chosen was the one for high calcium lime according to the 2006 IPCC Guidelines (volume 3, pg. 2.22, table 2.4), 0.75 t CO2/t lime produced.

**Other process uses of carbonates – ceramics production (2A4a)**

The $CO_2$ process emissions from ceramics production were estimated following the methodology below:

(a) The activity data (Table 4.6) and $CO_2$ process emissions from the 8 ETS installations were tabulated. The years for which activity data and $CO_2$ emissions are available are 2001-2014. For 2001-2004 data was obtained during the preparation of the first ETS national allocation plan of Cyprus and for 2005-2014 the data was obtained from the verified emissions reports submitted annually according to the ETS legislation.

(b) Dividing the total $CO_2$ process emissions of the ETS installations (Table 4.7) by the total production (Table 4.6), the annual implied emission factor was estimated for the years 2001-2014 (Table 4.7).

(c) The activity data for the non-ETS installation for the years 2001-2014 was estimated by subtracting from the total annual production of ceramics obtained from the Department of Labour Inspection, the total annual production of the ETS installations collected from (a).

(d) The $CO_2$ process emissions of the non-ETS installation for 2001-2014 were estimated by multiplying the implied emission factor estimated in (b) for 2003 (0.15988 $tCO_2$/t, which was the highest of the available emission factors) by the annual production.

(e) For the years 1990-2000 the total annual ceramics production data was obtained from the Department of Labour Inspection. For the estimation of total $CO_2$ process emissions, the earliest emissions factor of the estimated ETS annual implied emission factor was used (0.1233 $tCO_2$/t product in 2001).

The reports for the ETS are prepared annually by the installations according to the EU regulations that are based on the IPCC methodologies. The latest regulation that is in force is no. 601/2012. The reports are also verified by an accredited verifier according to the national legislation (law no. 110(I)/2011).

**Table 4.6. Ceramics production (Gg)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| Total production (Gg) | 355 | 343 | 300 | 354 | 311 | 315 | 301 |
| ETS production (Gg) | | | | | | | |
| Non-ETS production (Gg) | | | | | | | |

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| Total production (Gg) | 282 | 261 | 298 | 276 | 278 | 332 | 378 |
| ETS production (Gg) | | | | | 271 | 314 | 364 |
| Non-ETS production (Gg) | | | | | 6.3 | 17.9 | 13.7 |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| Total production (Gg) | 484 | 504 | 491 | 512 | 546 | 356 | 291 |
| ETS production (Gg) | 470 | 493 | 484 | 500 | 533 | 338 | 282 |
| Non-ETS production (Gg) | 13.6 | 10.8 | 7.8 | 12.0 | 13.0 | 17.8 | 9.3 |

| | 2011 | 2012 | 2013 | 2014 | 2015 | | |
|---|---|---|---|---|---|---|---|
| Total production (Gg) | 223 | 168 | 90 | 84 | 84 | | |
| ETS production (Gg) | 211 | 162 | 90 | 84 | 84 | | |
| Non-ETS production (Gg) | 11.5 | 6.3 | 0 | 0 | 0 | | |

**Table 4.7. CO2 process emissions of the ETS ceramics installations and estimated annual implied emission factor (2001-2015)**

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | |
|---|---|---|---|---|---|---|---|---|
| ETS CO2 emissions (Gg) | 33.5 | 39.6 | 58.2 | 64.6 | 58.2 | 70.4 | 69.3 | |
| IEF (Gg CO2/Gg product) | 0.123 | 0.126 | 0.160 | 0.137 | 0.118 | 0.146 | 0.138 | |

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| ETS CO2 emissions (Gg) | 64.4 | 38.8 | 20.7 | 16.5 | 18.5 | 10.0 | 9.4 | 7.02 |
| IEF (Gg CO2/Gg product) | 0.121 | 0.115 | 0.073 | 0.078 | 0.114 | 0.111 | 0.112 | 0.083 |

### Other process uses of carbonates – Other uses of soda-ash (2A4b)

The CO2 emissions from other uses of soda-ash have been estimated using the T1 methodology proposed by the 2006 IPCC guidelines. Equation 2.14 (pg. 2.34, vol. 3, IPCC 2006 guidelines) was adopted for soda ash; i.e. CO2 Emissions = Mc x EF (where CO2 Emissions = emissions of CO2 from other process uses of carbonates, tonnes; Mc = mass of carbonate consumed, tonnes; EF = emission factor for soda ash, tonnes CO2/tonne carbonate (table 2.1, pg. 2.7, vol.3, 2006 IPCC guidelines) 0.41492 tCO2/t CO3 assuming 100% calcination).

Activity data (Table 4.8) was obtained from Statistical Service from imports' statistics. It was assumed that all imported quantities have been consumed in the year the import has taken place.

**Table 4.8. Imports of Soda ash in Cyprus (t)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| Imports of Soda ash (t) | 615 | 499 | 383 | 502 | 504 | 529 | 1063 | 789 | 808 |

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Imports of Soda ash (t) | 832 | 1345 | 823 | 1003 | 813 | 837 | 664 | 1179 | 1132 |

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | |
|---|---|---|---|---|---|---|---|---|---|
| Imports of Soda ash (t) | 1479 | 1438 | 711 | 771 | 560 | 353 | 401 | 326 | |

### 4.2.2. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

### 4.2.3. Source-specific QA / QC and verification

**Cement production**: the emissions estimated were compared to the verified emissions reported for ETS. Clinker production data was compared to the data reported by the statistical service and the data used by the department of labour inspection department for the estimation of air pollutants for the preparation of the air pollutants inventory for the purposes of Directive 2001/81/EC.

All the QA/QC and verification activities are presented in Section 1.6.

### 4.2.4. Source-specific recalculations

The three changes included in the revised 2016 national inventory presented below have caused the changes in mineral industry (source 2A) presented in Table 4.9 and Figure 4.3.

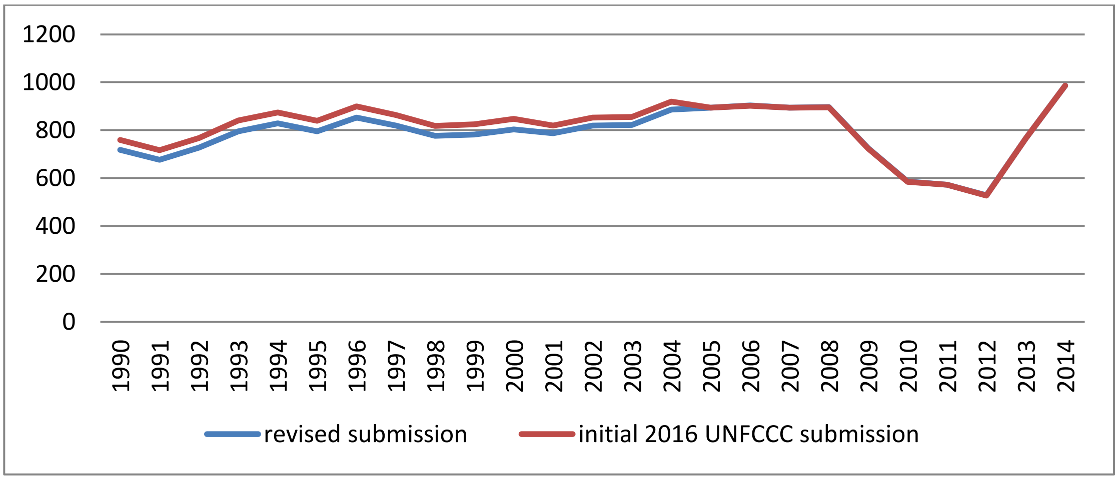


**Figure 4.3. Impact of Recalculations on CO2 emissions from mineral industry**

**Table 4.9. Impact of Recalculations on CO2 emissions from mineral industry**

| **CO2 emissions (Gg)** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 717 | 676 | 727 | 795 | 828 | 795 | 853 |
| After ERT recommendation | 759 | 716 | 768 | 841 | 873 | 839 | 899 |
| Change | -41.9 | -39.8 | -40.8 | -45.4 | -45.5 | -44.2 | -46.0 |
| *% change to initial submission* | *-5.5%* | *-5.6%* | *-5.3%* | *-5.4%* | *-5.2%* | *-5.3%* | *-5.1%* |

| **CO2 emissions (Gg)** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 819 | 777 | 782 | 803 | 787 | 819 | 822 |
| After ERT recommendation | 863 | 818 | 824 | 847 | 819 | 852 | 855 |
| Change | -44.1 | -40.9 | -41.5 | -43.6 | -32.5 | -32.6 | -32.9 |
| *% change to initial submission* | *-5.1%* | *-5.0%* | *-5.0%* | *-5.2%* | *-4.0%* | *-3.8%* | *-3.9%* |

| CO2 emissions (Gg) | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 885 | 894 | 903 | 894 | 896 | 724 | 585 |
| After ERT recommendation | 919 | 894 | 902 | 894 | 895 | 724 | 585 |
| Change | -34.1 | 0.3 | 0.5 | 0.5 | 0.6 | 0.6 | 0.3 |
| *% change to initial submission* | *-3.7%* | *0.03%* | *0.05%* | *0.05%* | *0.07%* | *0.08%* | *0.05%* |

| CO2 emissions (Gg) | 2011 | 2012 | 2013 | 2014 | | | |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 572 | 528 | 765 | 986 | | | |
| After ERT recommendation | 572 | 528 | 765 | 986 | | | |
| Change | 0.3 | 0.2 | 0.1 | 0.2 | | | |
| *% change to initial submission* | *0.06%* | *0.04%* | *0.02%* | *0.02%* | | | |

### 2A1. Cement production

Emissions from cement production have been recalculated according to a recommendation made by the ERT during the in-country review of the 2016 submission. The recommendation was to use the emissions data from the National Allocation Plan for 1997–2004 to calculate emissions in the period 1997–2004 and the annual IEF for 1997 to calculate emissions in the period 1990–1996, since it is more realistic and more consistent to be used for the 1990–1996 inventory years. This has led to a 4% reduction of the emissions from cement production for the years 1990-2004 as indicated in the Table and Figure below.

**Table 4.10. Impact of Recalculations on CO2 emissions from cement production**

| CO2 emissions (Gg) | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 697 | 656 | 715 | 780 | 818 | 784 | 846 | 814 |
| After ERT recommendation | 668 | 629 | 686 | 747 | 784 | 751 | 811 | 780 |
| Change | -29.2 | -27.5 | -30.0 | -32.7 | -34.3 | -32.8 | -35.5 | -34.1 |
| *% change to initial submission* | *4.4%* | *4.4%* | *4.4%* | *4.4%* | *4.4%* | *4.4%* | *4.4%* | *4.4%* |

| CO2 emissions (Gg) | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | |
|---|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 771 | 771 | 797 | 778 | 799 | 784 | 842 | |
| After ERT recommendation | 740 | 740 | 763 | 745 | 766 | 751 | 808 | |
| Change | -31.7 | -30.9 | -34.1 | -32.9 | -33.0 | -33.3 | -34.5 | |
| *% change to initial submission* | *-4.3%* | *-4.2%* | *-4.5%* | *-4.4%* | *-4.3%* | *-4.4%* | *-4.3%* | |

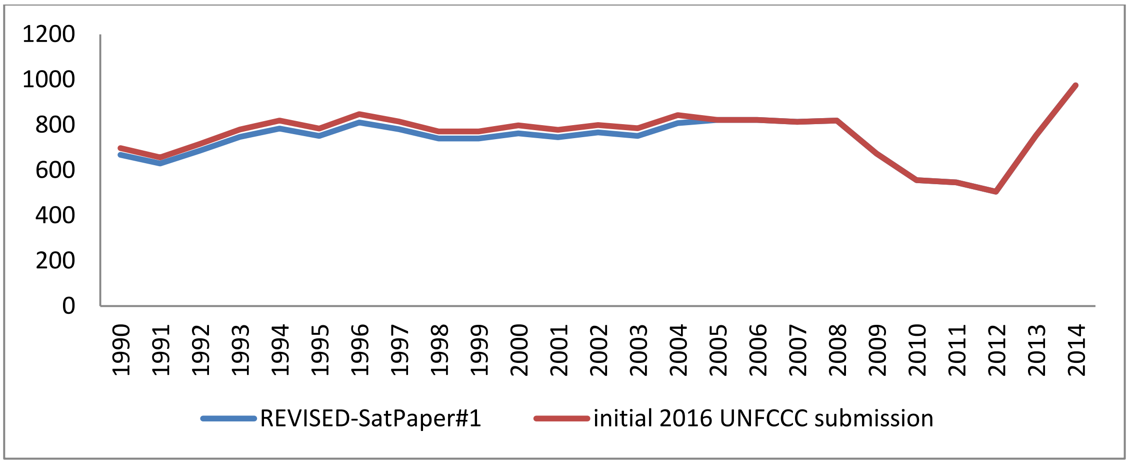


**Figure 4.4. Impact of Recalculations on CO2 emissions from cement production**

### 2A4a. Ceramics production

Emissions from ceramics production have been recalculated according to a recommendation made by the ERT during the in-country review of the 2016 submission. The recommendation was to use the 2001 IEF (the earliest available IEF value coming from the ETS verified emissions report) for calculating the CO2 emissions from ceramic production for the period 1990-2000. This has led to a 30% reduction of the emissions from ceramics production for the years 1990-2000 as indicated in the Table and Figure below.

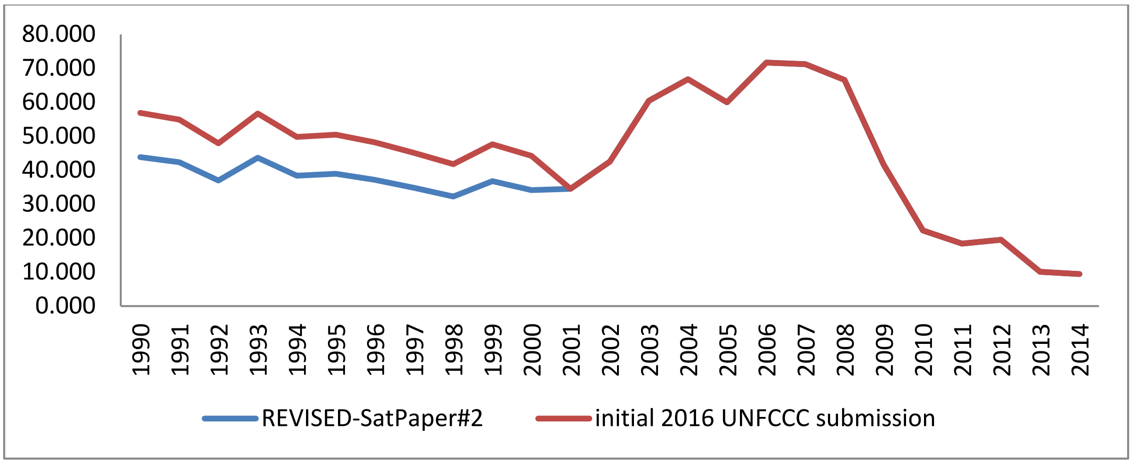


**Figure 4.5. Impact of Recalculations on CO2 emissions from ceramics production**

**Table 4.11. Impact of Recalculations on CO2 emissions from ceramics production**

| **CO2 emissions (Gg)** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 56.8 | 54.8 | 47.9 | 56.6 | 49.8 | 50.4 | 48.1 |
| After ERT recommendation | 43.8 | 42.3 | 36.9 | 43.7 | 38.4 | 38.9 | 37.1 |
| Change | -13.0 | -12.5 | -11.0 | -13.0 | -11.4 | -11.5 | -11.0 |
| *% change to initial submission* | *-29.7%* | *-29.7%* | *-29.7%* | *-29.7%* | *-29.7%* | *-29.7%* | *-29.7%* |

| **CO2 emissions (Gg)** | **1997** | **1998** | **1999** | **2000** | | | |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 45.0 | 41.8 | 47.6 | 44.2 | | | |
| After ERT recommendation | 34.7 | 32.2 | 36.7 | 34.1 | | | |
| Change | -10.3 | -9.6 | -10.9 | -10.1 | | | |
| *% change to initial submission* | *-29.7%* | *-29.7%* | *-29.7%* | *-29.7%* | | | |

### 2A4b Other Uses of Soda Ash

Following a recommendation of the ERT in the Saturday Paper issued after the in-country review of the 2016 submission, i.e. collect AD on soda ash from imports and exports from the Custom Service of Cyprus and identify the soda ash consumption in the country, the CO2 emissions from category 2.A.4.b Other Processes Uses of Carbonates (other uses of soda ash) have been estimated for the entire time-series, replacing NO in the CRF tables.

Moreover, following ERT response to the explanations/documents provided by Cyprus to the Saturday Paper issues, it has been noted that in CRF table 2(i).A-H Sectoral Background Data for Industrial Processes and Product Use, Cyprus has reported the CO2 emissions from soda ash consumption rounded at the level of 3 figures after decimal point (for instance in 2014 year, following the Party response, the CO2 emissions were 0.1662 Gg, while in the CRF table the data have been reported as 0.166 Gg, as consequence the IEF reported value (0.41397 t CO2/t Na2CO3) is also slightly lower than that provided in its response to the Saturday Paper (0.41492 t CO2/t Na2CO3). Respective situation applies to all reported years of the time-series. Considering the explanation above, Cyprus corrected the CRF tables reporting the CO2 emissions from respective category by importing the results obtained from the calculation sheet without using the rounding of emissions figures.

### 4.2.5. Source-specific planned improvement

**Cement production**: improve data quality regarding the materials used in cement production to implement the detailed methodologies of the GPG for all years.

**Ceramics production:** improve methodology for the estimation of emissions to improve consistency.

## 4.3. Non-energy Products from Fuels and Solvent Use (CRF source category 2D)

### 4.3.1. Source category description

According to the 2006 IPCC Guidelines, lubricants are mostly used in industrial and transportation applications. In Cyprus, lubricants are consumed in transport. The total emissions from lubricants use are presented in Table 4.12 and Figure 4.6. CO2 emissions from paraffin wax use (2D2) have been estimated for second time after a recommendation by the ERT during the in-country review of the 2016 submission. CO2 emissions from activities included in 2D3 have also been estimated for second time.
According to the information obtained from the Customs, paraffin wax in Cyprus is imported by dental and lab suppliers, importers of agricultural and beauty products and candle makers.

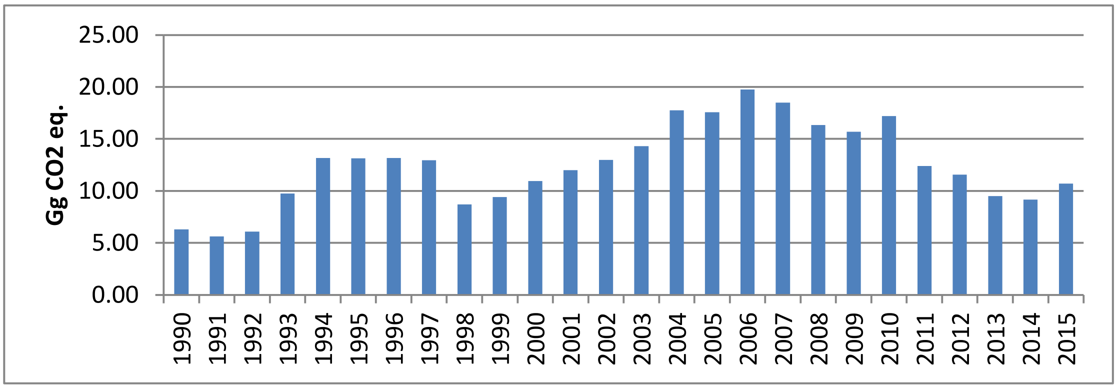


**Figure 4.6. Emissions from non-energy Products from Fuels and Solvent Use (2D) 1990-2015**

**Table 4.12. CO2 emissions from non-energy Products from Fuels and Solvent Use**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| 2D1 Lubricant Use | NO | 6.49 | 4.13 | 5.90 | 6.49 | 4.13 | 4.13 | 4.72 |
| 2D2 Paraffin Wax Use | 0.063 | 0.079 | 0.065 | 0.003 | 0.029 | 0.044 | 0.058 | 0.077 |
| 2D3 Other | 6.24 | 6.57 | 6.77 | 11.69 | 10.67 | 5.34 | 4.97 | 5.91 |
| **TOTAL** | 6.30 | 13.13 | 10.96 | 17.58 | 17.18 | 9.49 | 9.16 | 10.70 |

### 4.3.2. Methodological issues

2D1 Lubricant Use

Amount of lubricant consumption was obtained from Energy balance 2015 by the National Statistical Service. The calculation of $CO_2$ emissions from Lubricants was estimated using Tier1 methodology suggested by the IPCC Guidelines (equation 5.2, pg. 5.7, volume 3).

$$CO2\ Emissions = LC \cdot CCLubricant \cdot ODULubricant \cdot 44/12$$

Carbon content (*CCLubricant*) is assumed to be 20, as proposed by the IPCC 2006 guidelines (table 1.3, pg.1.21, volume 2) used for the calculations ODU factor is assumed to be 0.2, as proposed by the IPCC 2006 guidelines (table 5.2, pg. 5.9, volume 3).

2D2 Paraffin Wax Use

CO2 emissions from use of paraffin wax have been estimated using the T1 methodology proposed by the 2006 IPCC guidelines (eqn. 5.4, pg. 5.11, vol.3, IPCC 2006 guidelines):

CO2 Emissions = PW •CCWax •ODUWax • 44 /12 where CO2 Emissions = CO2 emissions from waxes, tonne CO2; PW = total wax consumption, TJ; CCWax = carbon content of paraffin wax (20; default, IPCC2006, vol.2, pg.1.21), tonne C/TJ (= kg C/GJ) and ODUWax = Oxidised During Use factor for paraffin wax, fraction (0.2; default, IPCC2006, vol.3, pg.5.12).

Activity data (Table 4.13) was obtained from Statistical Service from imports' statistics in kg. It was assumed that all imported quantities have been consumed in the year the import has taken place. Imports data was converted to TJ using the default NCV for paraffin wax 40.2, proposed by the IPCC2006 (vol.2, pg.1.18).

**Table 4.13. Imports of paraffin wax in Cyprus (kt)**

| | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** |
|---|---|---|---|---|---|---|---|
| Imports of paraffin wax (kt) | 0.108 | 0.179 | 0.252 | 0.354 | 0.362 | 0.134 | 0.159 |

| | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** |
|---|---|---|---|---|---|---|---|
| Imports of paraffin wax (kt) | 0.117 | 0.147 | 0.179 | 0.111 | 0.178 | 0.155 | 0.185 |

| | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
|---|---|---|---|---|---|---|---|
| Imports of paraffin wax (kt) | 0.150 | 0.005 | 0.028 | 0.095 | 0.060 | 0.099 | 0.049 |

| | **2011** | **2012** | **2013** | **2014** | **2015** | | |
|---|---|---|---|---|---|---|---|
| Imports of paraffin wax (kt) | 0.035 | 0.071 | 0.074 | 0.099 | 0.131 | | |

2D3 Solvent Use

Carbon dioxide emissions from other product use are calculated from NMVOC emissions (Table 4.25), assuming that the carbon content of NMVOC is 60%[16]. NMVOC emissions are obtained from the Department of Labour Inspection that is responsible for the preparation of the air pollutants inventory for Directive 2001/81/EC. The estimation of NMVOC emissions

[16]2006 IPCC Guidelines volume 3, p. 5.17, the default fossil carbon content fraction of NMVOC is 60 per cent by mass

is based on the CONINAIR methodology. Therefore assuming also that oxidation of carbon is 99%, the equation applied for the estimation of the $CO_2$ emissions is the following:

$$CO_2 \text{ emissions (Gg)} = 60\% * \text{NMVOC emissions (Gg)} * 44/12 * 99\%$$

**Table 4.14. NMVOCs emissions used for the estimation of CO2 emissions from Solvent use**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| Dry cleaning | 0.2002 | 0.2003 | 0.2003 | 0.2004 | 0.2005 | 0.2005 | 0.2007 |
| Coating applications | 1.7387 | 1.4241 | 1.5170 | 1.5202 | 1.7083 | 1.7083 | 1.4097 |
| Chemical products | 0.0388 | 0.0388 | 0.0388 | 0.0413 | 0.0442 | 0.0442 | 0.0498 |
| Asphalt roofing | 0.0325 | 0.0325 | 0.0325 | 0.0325 | 0.0325 | 0.0325 | 0.0325 |
| Domestic solvent use | 0.1403 | 0.1441 | 0.1480 | 0.1513 | 0.1543 | 0.1543 | 0.1592 |
| Road paving with asphalt | 0.0075 | 0.0075 | 0.0075 | 0.0075 | 0.0075 | 0.0075 | 0.0075 |
| Printing | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 |

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| Dry cleaning | 0.2008 | 0.2009 | 0.2012 | 0.2021 | 0.2005 | 0.2004 | 0.2001 |
| Coating applications | 1.5604 | 1.4476 | 1.4578 | 1.6020 | 1.4785 | 2.2579 | 2.8364 |
| Chemical products | 0.0474 | 0.0490 | 0.0512 | 0.0500 | 0.0597 | 0.0636 | 0.0625 |
| Asphalt roofing | 0.0325 | 0.0325 | 0.0325 | 0.0366 | 0.0298 | 0.0324 | 0.0308 |
| Domestic solvent use | 0.1614 | 0.1632 | 0.1650 | 0.1667 | 0.1686 | 0.1706 | 0.1728 |
| Road paving with asphalt | 0.0075 | 0.0075 | 0.0075 | 0.0084 | 0.0069 | 0.0075 | 0.0071 |
| Printing | 0.2000 | 0.2000 | 0.2242 | 0.2298 | 0.2604 | 0.2106 | 0.1975 |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| Dry cleaning | 0.1998 | 0.1930 | 0.1100 | 0.1110 | 0.0789 | 0.0602 | 0.0605 |
| Coating applications | 3.5522 | 3.8150 | 4.6373 | 4.3205 | 3.3507 | 3.1421 | 3.4997 |
| Chemical products | 0.0674 | 0.0574 | 0.0600 | 0.0580 | 0.0254 | 0.0278 | 0.0302 |
| Asphalt roofing | 0.0368 | 0.0293 | 0.0265 | 0.0246 | 0.0233 | 0.0396 | 0.0529 |
| Domestic solvent use | 0.1752 | 0.1778 | 0.1811 | 0.1856 | 0.1905 | 0.1958 | 0.2007 |
| Road paving with asphalt | 0.0085 | 0.0068 | 0.0061 | 0.0057 | 0.0054 | 0.0091 | 0.0122 |
| Printing | 0.2328 | 0.2360 | 0.2485 | 0.2189 | 0.3061 | 0.2233 | 0.2411 |

| | 2011 | 2012 | 2013 | 2014 | 2015 | | |
|---|---|---|---|---|---|---|---|
| Dry cleaning | 0.0600 | 0.0539 | 0.0265 | 0.0262 | 0.0527 | | |
| Coating applications | 1.5792 | 1.6311 | 1.4271 | 1.2511 | 1.6173 | | |
| Chemical products | 0.0137 | 0.0145 | 0.0120 | 0.0099 | 0.0099 | | |
| Asphalt roofing | 0.0516 | 0.0403 | 0.0213 | 0.0098 | 0.0098 | | |
| Domestic solvent use | 0.2060 | 0.2070 | 0.2051 | 0.2024 | 0.2027 | | |
| Road paving with asphalt | 0.0119 | 0.0093 | 0.0049 | 0.0023 | 0.0023 | | |
| Printing | 0.3275 | 0.2601 | 0.2027 | 0.2562 | 0.2472 | | |

Urea-based catalysts

This is the first submission for which emissions from urea-based catalysts have been estimated. The methodology applied is the recommended by the IPCC2006 guidelines (pg. 3.12, volume 2). More specifically equation 3.2.2 (emission=activity*12/60*purity*44/12) is applied. No national data is available, therefore (a) Activity data is estimated using the recommendation given in the guidelines, i.e. 1-3% of diesel consumption by vehicle; 2% is used.(b) Purity is assumed 32.5%, which is also recommended by the guidelines, i.e. 1-3% of diesel consumption by vehicle; 2% is used.

The diesel consumption used is the same as presented in Table 3.20. The resulting activity data used is presented in Table 4.15.

**Table 4.15. Activity data used for estimation of emissions from Urea-based catalysts**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| Activity (kt) | 4.19 | 4.03 | 4.90 | 5.08 | 5.20 | 5.68 | 5.94 | 6.26 | 6.66 | 6.78 |

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|
| Activity (kt) | 6.99 | 7.09 | 6.81 | 7.01 | 7.07 | 6.91 | 6.45 | 6.73 | 6.58 | 6.39 |

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| Activity (kt) | 6.56 | 6.24 | 5.43 | 4.61 | 4.47 | 4.81 |

### 4.3.3. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

### 4.3.4. Source-specific QA / QC and verification

All the QA/QC and verification activities are presented in Section 1.6.

### 4.3.5. Source-specific recalculations

Emissions from Urea-based catalysts have been estimated for the second first time for the complete time-series. Following a recommendation by the TERT during the in-country review of the 2016 submission, emissions from paraffin wax have been estimated and reported for the first time (2D2). The impact to the total emission of 2D is presented in Table 4.16 and Figure 4.7.

**Table 4.16. Impact of estimation of emissions from consumption of paraffin wax on CO2 emissions from Non-energy Products from Fuels and Solvent Use (2D)**

| **CO2 emissions (Gg)** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 6.24 | 5.51 | 5.93 | 9.54 | 13.13 | 13.06 | 13.07 |
| After ERT recommendation | 6.30 | 5.61 | 6.08 | 9.74 | 13.15 | 13.13 | 13.16 |
| Change | 0.06 | 0.11 | 0.15 | 0.21 | 0.02 | 0.07 | 0.09 |
| *% change to initial submission* | *1.02%* | *1.92%* | *2.51%* | *2.16%* | *0.18%* | *0.57%* | *0.68%* |

| **CO2 emissions (Gg)** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 12.89 | 8.62 | 9.53 | 10.90 | 11.90 | 12.88 | 14.18 |
| After ERT recommendation | 12.96 | 8.70 | 9.42 | 10.96 | 12.00 | 12.97 | 14.29 |
| Change | 0.06 | 0.09 | -0.10 | 0.06 | 0.10 | 0.09 | 0.11 |
| *% change to initial submission* | *0.50%* | *0.99%* | *-1.09%* | *0.57%* | *0.85%* | *0.68%* | *0.75%* |

| **CO2 emissions (Gg)** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 17.67 | 17.59 | 19.74 | 18.45 | 16.31 | 15.70 | 17.16 |
| After ERT recommendation | 17.75 | 17.58 | 19.75 | 18.50 | 16.35 | 15.69 | 17.18 |
| Change | 0.08 | -0.02 | 0.01 | 0.05 | 0.03 | 0.00 | 0.02 |
| *% change to initial submission* | *0.47%* | *-0.09%* | *0.06%* | *0.28%* | *0.19%* | *-0.01%* | *0.14%* |

| **CO2 emissions (Gg)** | **2011** | **2012** | **2013** | **2014** | | | |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 12.39 | 11.58 | 9.47 | 9.26 | | | |
| After ERT recommendation | 12.40 | 11.57 | 9.49 | 9.31 | | | |
| Change | 0.02 | -0.01 | 0.02 | 0.06 | | | |
| *% change to initial submission* | *0.14%* | *-0.10%* | *0.17%* | *0.60%* | | | |

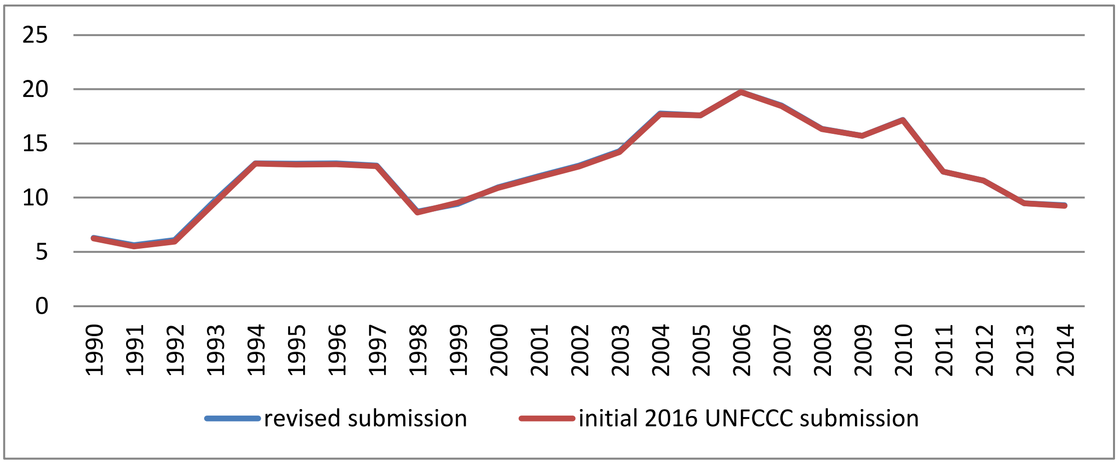


**Figure 4.7. Impact of estimation of emissions from consumption of paraffin wax on CO2 emissions from Non-energy Products from Fuels and Solvent Use (2D)**

### 4.3.6. Source-specific planned improvement

No planned source-specific improvements to report.

## 4.4. Electronic Industry Emissions (CRF source category 2E)

No emissions occur in this source category.

## 4.5. Product Uses as Substitutes for ODS (CRF source category 2F)

### 4.5.1. Source category description

According to the 2006 IPCC Guidelines there are five categories accounting for emissions from the use of fluorinated greenhouse gases (HFCs, PFCs, SF6; together called "F-gases"). In order to obtain a reliable estimation of F-gases emissions, the collection of detailed data for all the activities (e.g. number of refrigerators, type and amount of refrigerant used by each market label, substitutions of refrigerants that took place the late years etc.) is required. The availability of official data in Cyprus is limited and therefore the estimations presented hereafter include the application of country specific methodologies. The emissions have been recalculated for all sources of this sector.

The total emissions by gas and source for the period 1990-2015 are presented in Table 4.17 and Figure 4.8.

**Table 4.17. Emissions from consumption of halocarbons 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| HFC-134a (t) | NO | 0.007 | 0.08 | 2.58 | 6.76 | 7.61 | 7.51 | 7.51 |
| HFC-227ea (t) | NO | 0.002 | 0.09 | 0.38 | 0.86 | 1.11 | 1.1 | 1.1 |
| Unspecified mix of HFCs (t CO2 | NO | 1625 | 23723 | 98354 | 268246 | 349513 | 345032 | 345032 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| eq.) | | | | | | | | |
| Total (Gg CO2 eq.) | NO | 1.64 | 25.20 | 103.28 | 280.66 | 363.98 | 359.31 | 359.31 |
| t CO2 eq. | | | | | | | | |
| 2F1. Refrigeration and air conditioning | NO | 1625 | 23723 | 98354 | 268246 | 349513 | 345032 | 345032 |
| 2F2. Foam Blowing Agents | NO | NO | 803.1 | 892.0 | 1624.7 | 1820.7 | 1797.4 | 1797.4 |
| 2F3. Fire Protection | NO | 7.4 | 297 | 1234 | 2758 | 3585 | 3539 | 3539 |
| 2F4. Aerosols | NO | 10.15 | 375.67 | 2801.09 | 8035.24 | 9056.92 | 8940.81 | 8940.81 |

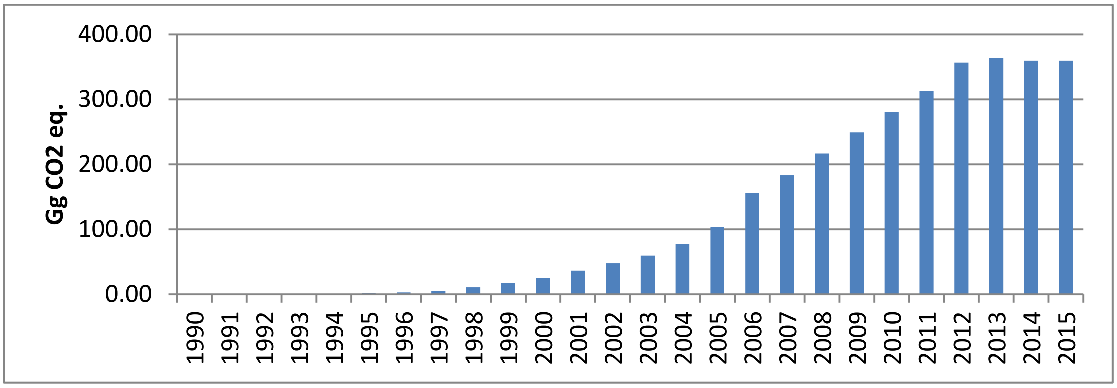


**Figure 4.8. Emissions from consumption of halocarbons 1990-2015**

### 4.5.2. Methodological issues

Due to insufficient information for a long period of time, it was decided to use a country specific methodology for the estimation of the emissions from Product Uses as Substitutes for ODS (2F).

The methodology applied consisted of the following steps:

(a) The stock emissions from the four sources (2F1, 2F2, 2F3 and 2F4) for Greece, Italy, Malta and Spain were obtained from the NIR2016 submissions to the UNFCCC for the years 1990-2014 (CRF – Table 2(II).B-H). The four countries were selected due to their similarity in social and economic conditions to Cyprus. Any fluorinated ozone-depleting substances (ODSs) not imported to Cyprus in bulk, as well as emissions other than those from stocks were disregarded in an effort to better historically match and appraise the situation.

(b) The amounts of substitutes of ODSs used by the four model countries were tabulated in tonnes and modified by their 100-year global warming potential (GWP) to calculate the t CO2 equivalent emissions from each source. The substitutes of ODSs applicable to the estimation of emissions from stocks in Cyprus are listed in Table 1.4 (Section 1.4.3). The equivalent emissions are thus calculated as: substitute of ODS amount (t) × GWP (t CO2eq/t).

(c) The t CO2 equivalent emissions from each substance and 2F subcategory are, then, summed per year and divided by the average total population of each country obtained from EUROSTAT (Table 4.18) to provide for the annual per capita emissions (Table 4.19) for the years 1990-2014.

**Table 4.18. Average total population used for the estimation of per capita emissions from 2F activities (EUROSTAT)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Greece | 10196792 | 10319927 | 10399061 | 10460415 | 10512922 | 10562153 | 10608800 |
| Italy | 56719240 | 56758521 | 56797087 | 56831821 | 56843400 | 56844303 | 56860281 |
| Malta | 354170 | 357727 | 361260 | 364704 | 367941 | 370433 | 372687 |
| Spain | 38850435 | 38939049 | 39067745 | 39189400 | 39294967 | 39387017 | 39478186 |

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| Greece | 10661259 | 10720509 | 10761698 | 10805808 | 10862132 | 10902022 | 10928070 |
| Italy | 56890372 | 56906744 | 56916317 | 56942108 | 56974100 | 57059007 | 57313203 |
| Malta | 375236 | 377516 | 379360 | 381363 | 393028 | 395969 | 398582 |
| Spain | 39582413 | 39721108 | 39926268 | 40263216 | 40756001 | 41431558 | 42187645 |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| Greece | 10955141 | 10987314 | 11020362 | 11048473 | 11077841 | 11107017 | 11121341 |
| Italy | 57685327 | 57969484 | 58143979 | 58438310 | 58826731 | 59095365 | 59277417 |
| Malta | 401268 | 403834 | 405308 | 406724 | 409379 | 412477 | 414508 |
| Spain | 42921895 | 43653155 | 44397319 | 45226803 | 45954106 | 46362946 | 46576897 |

| | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|
| Greece | 11104899 | 11045011 | 10965211 | 10869637 |
| Italy | 59379449 | 59539717 | 60233948 | 60789140 |
| Malta | 416268 | 419455 | 423374 | 427364 |
| Spain | 46742697 | 46773055 | 46620045 | 46476032 |

**Table 4.19. Per capital emissions by source from 2F activities (kg CO2 eq.)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | |
|---|---|---|---|---|---|---|---|---|---|
| **2F1** | | | | | | | | | |
| Malta | 0 | 0 | 0 | 0 | 0 | 32.35 | 0.01 | 0.01 | |
| Spain | 0 | 0 | 0 | 0 | 0 | 0 | 2.1 | 6.06 | |
| Italy | 0 | 0.005 | 0.013 | 0.026 | 1.70 | 3.64 | 6.43 | 10.74 | |
| Greece | 0 | 0 | 0 | 0.003 | 0.007 | 3.79 | 7.40 | 13.67 | |
| AVERAGE | 0 | 0.001 | 0.003 | 0.007 | 0.43 | 9.94 | 3.98 | 7.62 | |
| AVERAGE excl. Malta | 0 | 0.002 | 0.004 | 0.01 | 0.57 | 2.48 | 5.31 | 10.2 | |
| **2F2** | | | | | | | | | |
| Malta | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Spain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Italy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Greece | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AVERAGE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **2F3** | | | | | | | | | |
| Spain | 0 | 0 | 0 | 0.004 | 0.012 | 0.034 | 0.057 | 0.115 | |
| Italy | 0 | 0 | 0 | 0 | 0 | 0 | 0.031 | 0.090 | |
| Greece | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AVERAGE | 0 | 0 | 0 | 0.001 | 0.004 | 0.011 | 0.029 | 0.068 | |
| **2F4** | | | | | | | | | |
| Malta | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Spain | 0 | 0 | 0 | 0 | 0 | 0.059 | 0.122 | 0.129 | |
| Italy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Greece | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| AVERAGE | 0 | 0 | 0 | 0 | 0 | 0.020 | 0.041 | 0.043 | |
| AVERAGE incl. Malta | 0 | 0 | 0 | 0 | 0 | 0.015 | 0.031 | 0.032 | |

| | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | |
|---|---|---|---|---|---|---|---|---|---|
| **2F1** | | | | | | | | | |
| Malta | 0.02 | 0.03 | 5.42 | 20.38 | 32.71 | 39.19 | 65.97 | 142.76 | |
| Spain | 23.27 | 39.51 | 57.26 | 74.46 | 91.13 | 107.85 | 124.73 | 141.31 | |
| Italy | 16.37 | 24.53 | 29.59 | 39.23 | 49.70 | 60.93 | 72.87 | 85.76 | |
| Greece | 21.74 | 31.10 | 45.16 | 63.34 | 83.63 | 107.66 | 134.37 | 158.96 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| AVERAGE | 15.35 | 23.79 | 34.36 | 49.35 | 64.30 | 78.91 | 99.49 | 132.20 | |
| **2F2** | | | | | | | | | |
| Malta | 0 | 0 | 4.26 | 4.17 | 4.17 | 4.18 | 6.20 | 2.62 | |
| Spain | 0 | 0 | 0 | 0 | 0 | 0.006 | 0.060 | 0.115 | |
| Italy | 0.102 | 0.229 | 0.391 | 0.596 | 0.859 | 1.192 | 1.615 | 2.025 | |
| Greece | 0 | 0 | 0 | 0.006 | 0.029 | 0.029 | 0.029 | 0.029 | |
| AVERAGE | 0.025 | 0.057 | 1.163 | 1.194 | 1.266 | 1.352 | 1.977 | 1.199 | |
| **2F3** | | | | | | | | | |
| Spain | 0.211 | 0.340 | 0.501 | 0.680 | 0.875 | 1.148 | 1.515 | 1.865 | |
| Italy | 0.225 | 0.299 | 0.383 | 0.528 | 0.729 | 0.982 | 1.281 | 1.628 | |
| Greece | 0 | 0.295 | 0.404 | 0.543 | 0.694 | 0.897 | 1.179 | 1.482 | |
| AVERAGE | 0.145 | 0.31 | 0.43 | 0.58 | 0.77 | 1.01 | 132 | 1.66 | |
| **2F4** | | | | | | | | | |
| Malta | 0 | 0 | 0 | 0 | 0 | 0 | 8.184 | 10.501 | |
| Spain | 0.105 | 0.099 | 0.120 | 0.120 | 0.101 | 0.092 | 0.100 | 0.087 | |
| Italy | 0 | 1.528 | 2.053 | 2.605 | 2.338 | 3.504 | 4.024 | 4.468 | |
| Greece | 0 | 0.003 | 0.003 | 0.004 | 0.003 | 0.003 | 0.003 | 0.004 | |
| AVERAGE | 0.036 | 0.543 | 0.725 | 0.910 | 0.814 | 1.200 | 1.376 | 1.520 | |
| AVERAGE incl. Malta | 0.027 | 0.408 | 0.544 | 0.682 | 0.611 | 0.900 | 3.078 | 3.765 | |

| | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** |
|---|---|---|---|---|---|---|---|---|---|
| **2F1** | | | | | | | | | |
| Malta | 358.11 | 425.79 | 487.83 | 568.11 | 633.66 | 717.95 | 892.98 | 948.45 | 1000.91 |
| Spain | 157.06 | 170.35 | 216.67 | 227.83 | 256.71 | 273.9 | 279.78 | 266.95 | 253.99 |
| Italy | 98.26 | 109.79 | 120.14 | 129.96 | 139.48 | 148.73 | 157.22 | 163.75 | 170.11 |
| Greece | 183.65 | 206.39 | 225.85 | 240.05 | 247.82 | 252.12 | 253.26 | 250.29 | 242.76 |
| AVERAGE | 199.27 | 228.08 | 262.62 | 291.49 | 319.42 | 348.18 | 395.81 | 407.36 | 416.94 |
| **2F2** | | | | | | | | | |
| Malta | 2.13 | 2.95 | 2.61 | 11.1 | 4.04 | 2.73 | 3.56 | 4.36 | 3.40 |
| Spain | 0.163 | 0.201 | 0.225 | 0.234 | 0.245 | 0.252 | 0.263 | 0.270 | 0.276 |
| Italy | 2.391 | 2.710 | 2.985 | 3.229 | 3.425 | 3.581 | 3.693 | 3.738 | 3.749 |
| Greece | 0.029 | 0.029 | 0.028 | 0.028 | 0.028 | 0.028 | 0.032 | 0.119 | 0.198 |
| AVERAGE | 1.178 | 1.473 | 1.462 | 3.658 | 1.935 | 1.649 | 1.887 | 2.122 | 1.907 |
| **2F3** | | | | | | | | | |
| Spain | 2.202 | 2.657 | 3.062 | 3.451 | 3.810 | 4.162 | 4.606 | 5.059 | 5.092 |
| Italy | 1.957 | 2.263 | 2.546 | 2.816 | 3.075 | 3.323 | 3.554 | 3.738 | 3.916 |
| Greece | 1.761 | 2.089 | 2.389 | 2.673 | 2.967 | 3.278 | 3.483 | 3.736 | 3.974 |
| AVERAGE | 1.973 | 2.336 | 2.666 | 2.980 | 3.284 | 3.588 | 3.881 | 4.178 | 4.327 |
| **2F4** | | | | | | | | | |
| Malta | 9.704 | 9.177 | 14.120 | 5.369 | 6.753 | 7.654 | 8.439 | 6.161 | 4.172 |
| Spain | 0.069 | 0.065 | 0.072 | 11.892 | 24.358 | 25.185 | 26.435 | 27.729 | 27.860 |
| Italy | 4.401 | 5.680 | 6.253 | 7.258 | 7.157 | 7.070 | 6.415 | 8.330 | 7.785 |
| Greece | 0.003 | 0.004 | 0.005 | 0.005 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 |
| AVERAGE | 1.491 | 1.916 | 2.110 | 6.385 | 10.506 | 10.753 | 10.951 | 12.021 | 11.883 |
| AVERAGE incl. Malta | 3.544 | 3.731 | 5.113 | 6.131 | 9.568 | 9.979 | 10.323 | 10.556 | 9.955 |

(d) The annual per capita emissions average of the four countries were, in turn, used to calculate the total t CO2 equivalent annual emissions from stocks in Cyprus, based on the population of Cyprus for each corresponding year (Table 4.20).

- Note: Malta was excluded from the calculation of the average per capita emissions for the source 2F1, because of an outstanding high value of per capita HFC emissions of Malta in 1995 (32.35 kg CO2 eq/capita), as compared with the previous year value (0.0 kg CO2 eq/capita in 1994) and the following years values (i.e., 0.01 kg CO2 eq/capita in 1996-1997, 0.02 and 0.03 kg CO2 eq/capita in 1998 and 1999, respectively). Using such a high value of per capita emissions from Malta significantly increased the average value of per capita emissions used by Cyprus in 1995 (9.94 kg CO2 eq/capita), as compared with the previous year value (0.43 kg CO2 eq/capita) and following years values (3.98 kg CO2 eq/capita in 1996, 7.62 kg CO2 eq/capita in 1997 and 15.35 kg CO2 eq/capita in 1998), thus indicating a potential overestimation of Party's HFCs emissions in 1995, which is the base year for HFCs in Cyprus. This change compared to the initial submission to the UNFCCC for 2016 was triggered by a recommendation by the ERT in the Saturday paper.

**Table 4.20. Total population used for the estimation of emissions from 2F activities**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| Population | 10196792 | 10319927 | 10399061 | 10460415 | 10512922 | 10562153 | 10608800 |
| | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** |
| Population | 10661259 | 10720509 | 10761698 | 10805808 | 10862132 | 10902022 | 10928070 |
| | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
| Population | 10955141 | 10987314 | 11020362 | 11048473 | 11077841 | 11107017 | 11121341 |
| | **2011** | **2012** | **2013** | **2014** | | | |
| Population | 11104899 | 11045011 | 10965211 | 10869637 | | | |

(e) The emissions estimated have been reported in CRF reporter as an unspecified mix of hydrofluorocarbons, and divided in each sector (e.g. commercial, industrial refrigeration etc.) by factoring the t CO2 eq. percent contribution (Table 4.21) to their combined total annual emission estimated for Cyprus (Table 4.22). The emissions for 2015 were estimated assuming the same factors and contribution as 2014. Moreover, the following have been taken into account during the calculations:

- 2F2: According to the information submitted by the four countries and imports of bulk gases in Cyprus, all emissions have been assumed to be HCF-134a and from closed cells.
- 2F3: According to the information submitted by the neighbouring countries, all emissions have been assumed to be HFC-227ea.
- 2F4: For the source MDI-aerosols, only the emissions from Metered Dose Inhalers have been taken into account, since Aerosols do not occur in Cyprus. Moreover, according to the information submitted by the four countries, all emissions have been assumed to be HFC-134a.

**Table 4.21. Contribution of activities to 2F emissions**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|
| **2F1** | | | | | | | | |
| Commercial refrigeration | 0% | 0% | 0% | 0% | 0% | 19% | 40% | 51% |
| Domestic refrigeration | 0% | 0% | 0% | 2% | 0% | 0% | 0% | 0% |
| Industrial refrigeration | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Transport refrigeration | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Mobile air-conditioning | 0% | 100% | 100% | 98% | 100% | 81% | 59% | 48% |
| Stationary air-conditioning | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| **2F2** | | | | | | | | |
| Closed cells | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| **2F4** | | | | | | | | |
| Metered dose inhalers | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| | | | | | | | | |
| | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **2F1** | | | | | | | | |
| Commercial refrigeration | 67% | 72% | 77% | 78% | 80% | 81% | 81% | 82% |
| Domestic refrigeration | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Industrial refrigeration | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Transport refrigeration | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Mobile air-conditioning | 30% | 24% | 21% | 18% | 16% | 14% | 13% | 11% |
| Stationary air-conditioning | 2% | 4% | 3% | 4% | 4% | 5% | 6% | 7% |
| **2F2** | | | | | | | | |
| Closed cells | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| **2F4** | | | | | | | | |
| Metered dose inhalers | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

| | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** |
|---|---|---|---|---|---|---|---|---|---|
| **2F1** | | | | | | | | | |
| Commercial refrigeration | 82% | 82% | 83% | 83% | 84% | 84% | 84% | 84% | 84% |
| Domestic refrigeration | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Industrial refrigeration | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Transport refrigeration | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Mobile air-conditioning | 11% | 11% | 10% | 9% | 8% | 7% | 7% | 7% | 7% |
| Stationary air-conditioning | 7% | 8% | 8% | 8% | 9% | 9% | 9% | 10% | 10% |
| **2F2** | | | | | | | | | |
| Closed cells | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| **2F4** | | | | | | | | | |
| Metered dose inhalers | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

**Table 4.22. Total 2F emissions from Stocks estimated for Cyprus (t)**

| | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** |
|---|---|---|---|---|---|---|---|---|---|
| **2F1** | 0 | 0.69 | 2.05 | 4.49 | 276 | 6527 | 2655 | 5146 | 10482 |
| **2F1 excl. Malta** | | | | | | 1625 | | | |
| **2F2** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| **2F3** | 0 | 0 | 0 | 0.87 | 2.60 | 7.42 | 19 | 46 | 99 |
| **2F4** | 0 | 0 | 0 | 0 | 0 | 14 | 28 | 30 | 25 |
| **2F4 incl. Malta** | 0 | 0 | 0 | 0 | 0 | 10 | 21 | 22 | 19 |

| | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** |
|---|---|---|---|---|---|---|---|---|---|
| **2F1** | 16430 | 23723 | 34818 | 45887 | 57041 | 72924 | 98354 | 151027 | 177080 |
| **2F2** | 40 | 803 | 843 | 904 | 977 | 1449 | 892 | 893 | 1143 |
| **2F3** | 215 | 297 | 412 | 547 | 729 | 971 | 1234 | 1495 | 1814 |
| **2F4** | 375 | 501 | 642 | 581 | 867 | 1008 | 1131 | 1130 | 1488 |
| **2F4 incl. Malta** | 281 | 376 | 481 | 436 | 650 | 2256 | 2801 | 2686 | 2897 |

| | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|
| **2F1** | 209284 | 238759 | 268246 | 300128 | 342736 | 349513 | 345032 | 345032 |
| **2F2** | 1165 | 2996 | 1625 | 1421 | 1634 | 1821 | 1797 | 1797 |
| **2F3** | 2124 | 2441 | 2758 | 3092 | 3360 | 3585 | 3539 | 3539 |
| **2F4** | 1681 | 5230 | 8823 | 9269 | 9483 | 10314 | 10065 | 10065 |
| **2F4 incl. Malta** | 4074 | 5022 | 8035 | 8601 | 8939 | 9057 | 8432 | 8432 |

### 4.5.3. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

### 4.5.4. Source-specific QA / QC and verification

QA/QC and verification activities are presented in Section 1.6.

### 4.5.5. Source-specific recalculations

The emissions for the whole period have been recalculated for the initial 2016 submission due to change of methodology. Additionally, in October 2016 the following changes have been made following the recommendations of the ERT presented in the Saturday Paper presented after the in-country review of the submission:

(a) The HFCs emissions from category 2.F.1 Refrigeration and air conditioning in 1995, were recalculated by using the annual per capita emissions average value of three countries (Spain, Italy and Greece) (2.48 kg CO2 eq/capita), instead of average value of four countries (Malta, Spain, Italy and Greece) (9.94 kg CO2 eq/capita).

(b) During the in-country review, it was identified that Malta was excluded from the calculations of emissions from 2F4. Therefore emissions have been recalculated to include Malta in the estimation of the per-capita emissions used for the estimation of emissions.

These two changes have caused the changes in the emissions reported in source 2F shown in Table 4.23 and Figure 4.9.

**Table 4.23. Changes in emissions from sources 2F1 and 2F4 caused by recalculations**

| **Gg CO2 eq.** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 0.15 | 0.16 | 0.16 | 0.22 | 0.70 | 8.94 | 3.59 |
| After ERT recommendation | 0.15 | 0.16 | 0.16 | 0.22 | 0.70 | 2.69 | 3.59 |
| Change | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -6.25 | -0.01 |
| *% change to initial submission* | *0.0%* | *0.0%* | *0.0%* | *0.0%* | *0.0%* | *-69.9%* | *-0.2%* |

| **Gg CO2 eq.** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 6.05 | 9.27 | 13.98 | 20.14 | 30.49 | 40.63 | 51.81 |
| After ERT recommendation | 6.04 | 9.26 | 13.89 | 20.01 | 30.33 | 40.48 | 51.60 |
| Change | -0.01 | -0.01 | -0.09 | -0.13 | -0.16 | -0.15 | -0.22 |
| *% change to initial submission* | *-0.1%* | *-0.1%* | *-0.7%* | *-0.6%* | *-0.5%* | *-0.4%* | *-0.4%* |

| **Gg CO2 eq.** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 64.64 | 89.29 | 141.17 | 166.02 | 190.15 | 218.09 | 241.92 |
| After ERT recommendation | 65.88 | 90.96 | 142.72 | 167.43 | 192.54 | 218.69 | 242.83 |
| Change | 1.25 | 1.67 | 1.56 | 1.41 | 2.39 | 0.60 | 0.91 |
| *% change to initial submission* | *1.9%* | *1.9%* | *1.1%* | *0.8%* | *1.3%* | *0.3%* | *0.4%* |

| **Gg CO2 eq.** | **2011** | **2012** | **2013** | **2014** | | | |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 269.68 | 310.25 | 319.67 | 315.57 | | | |
| After ERT recommendation | 270.82 | 311.61 | 320.39 | 316.29 | | | |
| Change | 1.14 | 1.36 | 0.72 | 0.72 | | | |
| *% change to initial submission* | *0.4%* | *0.4%* | *0.2%* | *0.2%* | | | |

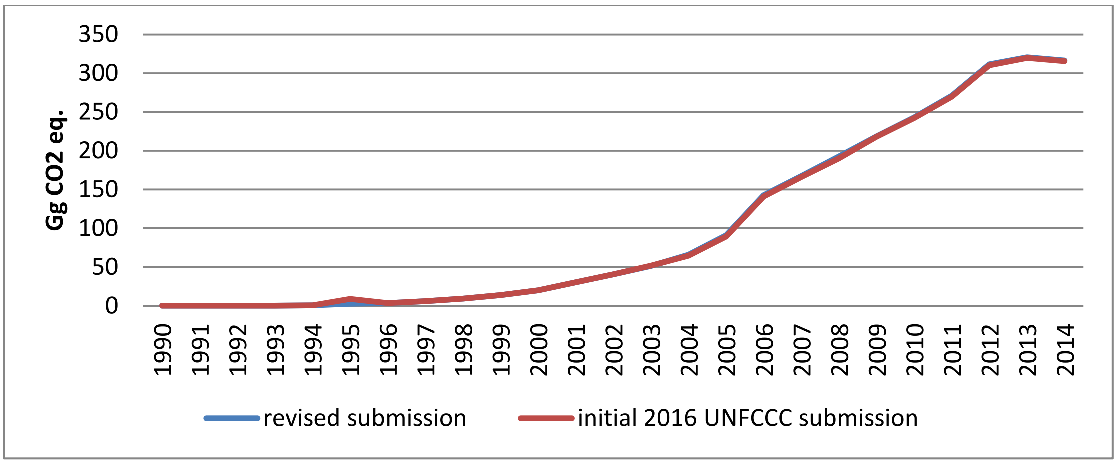


**Figure 4.9. Changes in emissions from sources 2F1 and 2F4 caused by recalculations**

### 4.5.6. Source-specific planned improvement

Data collection will be improved to apply the appropriate IPCC methodologies.

## 4.6. Other Product Manufacture and Use (CRF source category 2G)

### 4.6.1. Source category description

According to 2006 IPCC Guidelines, electrical equipment is the largest consumer and most important use of SF6, globally. Due to insufficient data availability, it was decided to use a country specific methodology for the estimation of the emissions from 2G1 and 2G3. CO2 emissions from other product use (2G4) have been estimated from the NMVOCs emissions. The total emissions by gas and source for the period 1999-2015 are presented in Table 4.24 and Figure 4.10.

**Table 4.24. Emissions from Other Product Manufacture and Use 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| CO2 (t) | 41.21 | 12.36 | 115.03 | 30.94 | 26.26 | 16.21 | 6.43 | 14.8 |
| N2O (t) | 139 | 155 | 165 | 176 | 198 | 203 | 200 | 200 |
| SF6 (t) | 0.0011 | 0.0026 | 0.0033 | 0.0051 | 0.0066 | 0.0066 | 0.0065 | 0.0065 |
| Total (Gg CO2 eq.) | 41.37 | 46.26 | 49.30 | 52.51 | 59.27 | 60.54 | 59.78 | 59.79 |
| kt CO2 eq. | | | | | | | | |
| 2G1. Electrical Equipment | 0.03 | 0.06 | 0.08 | 0.12 | 0.15 | 0.15 | 0.15 | 0.15 |
| 2G.3a. Medical Applications | 3.87 | 4.35 | 4.62 | 4.92 | 5.54 | 5.66 | 5.60 | 5.60 |
| 2G3b. Propellant for Pressure and Aerosol Products | 37.4 | 41.8 | 44.5 | 47.4 | 53.6 | 54.7 | 54.0 | 54.0 |
| 2G4. Other | 0.04 | 0.01 | 0.12 | 0.03 | 0.02 | 0.02 | 0.01 | 0.01 |

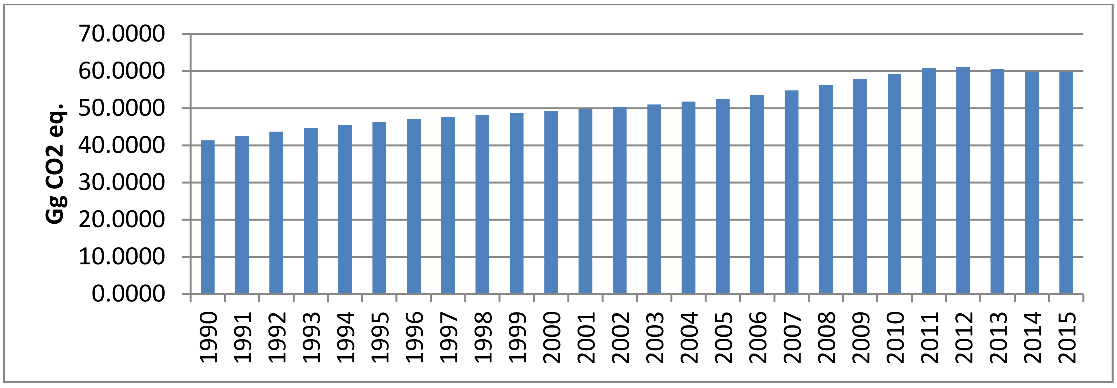


**Figure 4.10. Emissions from Other Product Manufacture and Use 1990-2015**

## 4.6.2. Methodological issues

Due to insufficient information for a long period of time, it was decided to use country specific methodologies for the estimation of the emissions from Other Product Manufacture and Use (2G). While the methodology applied for the estimation of emissions from N2O from Product Uses (2G3) is the same as in NIR2015, the methodology applied for the estimation of emissions from Electrical Equipment (2G1) has been revised. CO2 emissions from other product use (2G4) are estimated for the first time.

### 4.6.2.1. Electrical Equipment (2G1)

The methodology applied consisted of the following steps:

(a) The stock emissions from 2G1 for Greece, Italy and Spain were obtained from the NIR2016 submissions to the UNFCCC for the years 1990-2014 (CRF – Table 2(II).B-H). The three countries were selected due to their similarity in social and economic conditions to Cyprus.

(b) The amounts of SF6 used by the three model countries were tabulated in tonnes and modified by their 100-year global warming potential (GWP) to calculate the t CO2equivalent emissions. The ODSs applicable to the estimation of emissions from stocks in Cyprus are listed in Table 1.4 (Section 1.4.3). The equivalent emissions are thus calculated as: ODS amount (t) × GWP (t CO2eq/t).

(c) The t CO2 equivalent emissions are then divided by the average total population of each country obtained from EUROSTAT (Table 4.18) to provide for the annual per capita emissions (Table 4.25) for the years 1990-2014 for each country.

**Table 4.25. Per capita emissions from 2G1 (kg CO2 eq.)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|
| Spain | 0.102 | 0.106 | 0.109 | 0.112 | 0.115 | 0.123 | 0.129 | 0.133 |
| Italy | 0.012 | 0.025 | 0.038 | 0.052 | 0.099 | 0.123 | 0.147 | 0.155 |
| Greece | 0.018 | 0.018 | 0.019 | 0.019 | 0.020 | 0.020 | 0.021 | 0.021 |
| AVERAGE | 0.033 | 0.038 | 0.103 | 0.107 | 0.119 | 0.154 | 0.135 | 0.138 |

| | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|
| Spain | 0.137 | 0.140 | 0.143 | 0.147 | 0.153 | 0.161 | 0.176 | 0.196 |
| Italy | 0.138 | 0.121 | 0.162 | 0.156 | 0.169 | 0.185 | 0.210 | 0.237 |
| Greece | 0.021 | 0.022 | 0.022 | 0.022 | 0.023 | 0.023 | 0.024 | 0.035 |
| AVERAGE | 0.135 | 0.131 | 0.142 | 0.141 | 0.145 | 0.173 | 0.163 | 0.178 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|
| Spain | 0.213 | 0.229 | 0.239 | 0.246 | 0.257 | 0.253 | 0.260 | 0.260 | 0.262 |
| Italy | 0.227 | 0.252 | 0.295 | 0.316 | 0.249 | 0.248 | 0.257 | 0.235 | 0.245 |
| Greece | 0.045 | 0.054 | 0.041 | 0.028 | 0.033 | 0.029 | 0.029 | 0.029 | 0.028 |
| AVERAGE | 0.182 | 0.195 | 0.211 | 0.204 | 0.199 | 0.306 | 0.153 | 0.230 | 0.178 |

(d) The annual per capita emissions average of the three countries were, in turn, used to calculate the total t CO2 equivalent annual emissions from stocks in Cyprus, based on the population of Cyprus for each corresponding year (Table 4.20).
(e) The emissions were converted back to t SF6 by dividing by the SF6 100 years GWP (22800).

#### 4.6.2.2. N2O from Product Uses (2G3)

Evaporative emissions of nitrous oxide ($N_2O$) can arise from medical applications (anaesthetic use) and from propellant for pressure and aerosol products. An emission factor was multiplied by the population of Cyprus to estimate the total emissions for each source for the given year. The implied emission factor per capita from Greece NIR2013 was used, since the necessary activity data for Cyprus is not available to apply the IPCC methodologies. More specifically, for medical applications it was used 0.0222 kg N20/capita and for Propellant for Pressure and Aerosol Products (Aerosol cans) it was used (0.214 kg N20/capita).

#### 4.6.2.3. Other (2G4)

Carbon dioxide emissions from other product use are calculated from NMVOC emissions (Table 4.25), assuming that the carbon content of NMVOC is 60%[17]. NMVOC emissions are obtained from the Department of Labour Inspection that is responsible for the preparation of the air pollutants inventory for Directive 2001/81/EC. The estimation of NMVOC emissions is based on the CONINAIR methodology. Therefore assuming also that oxidation of carbon is 99%, the equation applied for the estimation of the $CO_2$ emissions is the following:

$$CO_2 \text{ emissions (Gg)} = 60\% * \text{NMVOC emissions (Gg)} * 44/12 * 99\%$$

**Table 4.26. NMVOCs emissions used for the estimation of CO2 emissions from other product use**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| NMVOC (kt) | 0.0185 | 0.0185 | 0.0202 | 0.0056 | 0.0056 | 0.0056 | 0.0173 |

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| NMVOC (kt) | 0.0193 | 0.0197 | 0.0275 | 0.0518 | 0.0159 | 0.0149 | 0.0107 |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| NMVOC (kt) | 0.0160 | 0.0139 | 0.0087 | 0.0091 | 0.0088 | 0.0098 | 0.0105 |

| | 2011 | 2012 | 2013 | 2014 | 2015 | | |
|---|---|---|---|---|---|---|---|
| NMVOC (kt) | 0.0086 | 0.0093 | 0.0073 | 0.0029 | 0.0067 | | |

[17] 2006 IPCC Guidelines volume 3, p. 5.17, the default fossil carbon content fraction of NMVOC is 60 per cent by mass

### 4.6.3. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

### 4.6.4. Source-specific QA / QC and verification

QA/QC and verification activities are presented in Section 1.6.

### 4.6.5. Source-specific recalculations

**2G1**

In the report included in the 2016 submission, there was a mistake identified by the ERT during the in-country review that Malta was not included in the calculations. The text has been revised in this submission to exclude Malta from the description.

**2G4**

The emissions for 2G4 the whole period have been recalculated due to change of the fossil carbon content fraction of NMVOC from 85% to 60%.

### 4.6.6. Source-specific planned improvement

Data collection will be improved to apply the appropriate IPCC methodologies.

# Chapter 5: Agriculture (CRF sector 3)

## 5.1. Overview of sector

In this chapter, GHG emissions estimates from the sector Agriculture are presented and the calculation methodologies per source category are described. According to the IPCC Guidelines, the following source categories are included in this sector: Enteric fermentation (3.A), Manure management (3.B), Rice cultivation (3.C), Agricultural soils (3.D), Prescribed burning of savannas (3.E), Field burning of agricultural residues (3.F), Liming (3.G), Urea Application (3.H), Other Carbon-containing fertilizers (3.I). In Cyprus, activities 3C (rice cultivation), 3E (prescribed burning of savannas), 3G (Liming) and 3I (other carbon-containing fertilizers) do not take place and are therefore reported as NO.

### 5.1.1. Emission trends

Emissions from Agriculture accounted for 6.6% of total emissions in 2015 (without LULUCF), compared to 9.4% in 1990. Emissions increased by 5.3% compared to 1990. The peak of Agriculture emissions was in 2002 (717 Gg CO2 eq.) when an increase of 35% compared to 1990 was observed. Since 2002 a reduction in emissions was observed, due to the reduction of $N_2O$ emissions from agricultural soils, because of the reduction in the use of synthetic nitrogen fertilisers. The reduction of the use of fertilisers was caused by the drought that was taking place during the same period that had an extreme in 2008. Further reduction was caused by the recent changes in manure management. Agriculture is responsible for mainly methane and nitrous oxide emissions. In 2015 agriculture has contributed 41% to the total methane emissions and 59% to the total nitrous oxide emissions. The total emissions by gas and source from agricultural activities for the period 1990-2015 in Cyprus are presented in Table 5.1 and Figure 5.1.

**Table 5.1. GHG emissions from Agriculture, for the period 1990 – 2015**

| Gg $CO_2$ eq. | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| $CO_2$ | 1.82 | 1.54 | 1.67 | 0.97 | 0.74 | 0.79 | 0.41 | 0.40 |
| $CH_4$ | 308.5 | 369.75 | 382.25 | 393.5 | 410 | 362.08 | 355.5 | 362.01 |
| $N_2O$ | 220.52 | 295.02 | 247.34 | 229.46 | 226.48 | 187.7 | 181.78 | 196.7 |
| **Total** | **531.02** | **666.42** | **632.31** | **624.16** | **637.48** | **550.18** | **537.75** | **559.30** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3A. Enteric fermentation | 196.97 | 221.98 | 224.21 | 228.47 | 235.35 | 224.23 | 222.73 | 224.40 |
| 3B. Manure management | 182.79 | 231.66 | 250.97 | 252.25 | 255.23 | 205.48 | 199.13 | 201.67 |
| 3D. Agricultural soils | 148.99 | 210.98 | 155.09 | 142.24 | 145.90 | 119.44 | 115.27 | 132.40 |
| 3F. Field burning of agricultural residues | 0.45 | 0.26 | 0.36 | 0.23 | 0.27 | 0.24 | 0.22 | 0.42 |
| 3H. Urea application | 1.82 | 1.54 | 1.67 | 0.97 | 0.74 | 0.79 | 0.41 | 0.40 |

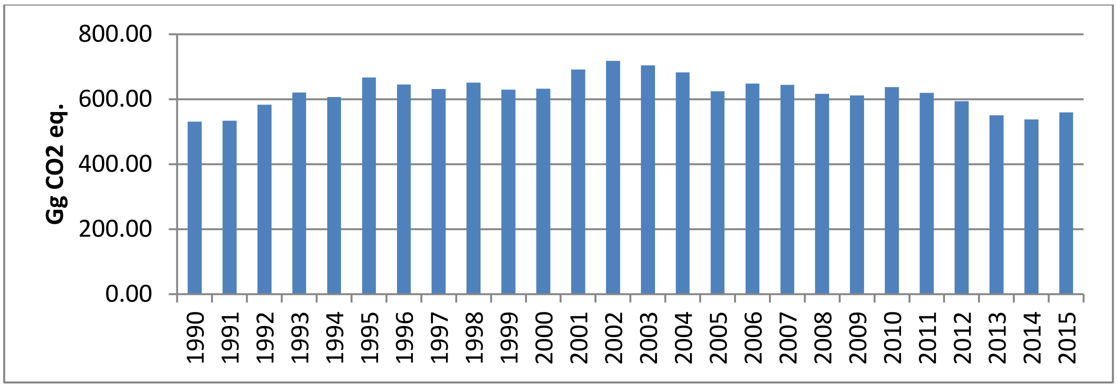


**Figure 5.1. Emissions from Agriculture, 1990 – 2015**

### 5.1.2. Methodology

The calculation of GHG emissions from Agriculture is based on the methodologies and emission factors suggested by the IPCC Guidelines. Data used for the estimation of the emissions was obtained from the National Statistical Service. Tier 1 method with default IPCC 2006 emission factors are used for all calculations except enteric fermentation emissions from dairy cattle that are estimated using Tier 2. The methodologies and emission factors used are summarised in Table 5.2.

**Table 5.2. Agriculture – methodologies and emission factors applied**

| Source category | $CO_2$ | | $CH_4$ | | $N_2O$ | |
|---|---|---|---|---|---|---|
| | Method | EF | Method | EF | Method | EF |
| 3.1.A1. Livestock - Enteric fermentation – dairy cattle | | | T2 | CS | | |
| 3.1.A1.Livestock - Enteric fermentation – non-dairy cattle, sheep, market swine and breeding swine, goats, horses, mules and asses | | | T1 | D | | |
| 3.1.B1. Livestock - Manure management - dairy cattle, non-dairy cattle | | | T2 | D | T1 | D |
| 3.1.B1. Livestock - Manure management - sheep, market swine and breeding swine, goats, horses, mules and asses and poultry | | | T1 | D | T1 | D |
| 3.1.C. Rice cultivation | | | NO | | | |
| 3.1.D. Agricultural soils – Inorganic N Fertilizers | | | | | T1 | D |
| 3E. Prescribed burning of savannahs | | | NO | | NO | |
| 3F. Field burning of agricultural residues | | | T1 | D | T1 | D |
| 3G. Liming | NO | | | | | |
| 3H. Urea Application | T1 | D | | | | |
| 3I. Other Carbon – containing Fertilizers | | | | | | |

T1, T2: IPCC methodology Tier 1, 2 respectively; D: IPCC default methodology and emission factor;

#### Key categories

The results of the key categories assessment are presented in Section 1.5.

**Uncertainty**

The uncertainty analysis is presented in Section 1.7.

### 5.1.3. Completeness

Table 5.3 gives an overview of the IPCC source categories included in this chapter and presents the status of emissions estimates from all sub-sources in agriculture. Methane emissions from agricultural soils are not estimated since appropriate methodologies have not been developed yet.

**Table 5.3. Agriculture – Inventory completeness**

| **Source category** | **$CO_2$** | **$CH_4$** | **$N_2O$** |
|---|---|---|---|
| 3A. Enteric fermentation | | ✓ | |
| 3B. Manure management | | ✓ | ✓ |
| 3C. Rice cultivation | | NO | |
| 3D. Agricultural soils | | NE | ✓ |
| 3E. Prescribed burning of savannahs | | NO | NO |
| 3F. Field burning of agricultural residues | | ✓ | ✓ |
| 3G. Liming | NO | | |
| 3H. Urea Application | ✓ | | |
| 3I. Other Carbon – containing Fertilizers | NO | | |

NO: Not occurring; NE: Not estimated due to method unavailability

## 5.2. Enteric fermentation (CRF source category 3A)

### 5.2.1. Source category description

Methane is produced during the normal digestion of food by herbivorous animals and the amount emitted depends on the animal species, their digestive system and feed intake.

Enteric fermentation ($CH_4$ emissions) has been assessed as a key category according to the level and trend. Tier 1 methodology is applied and the default emission factors suggested by the IPCC Guidelines are used for the estimation of methane emissions from enteric fermentation for non-dairy cattle, sheep, goats, horses, mules and asses and swine. The emissions from dairy cattle are estimated using Tier 2 methodology. Poultry emissions were not estimated, since an emission factor is not available in the IPCC guidelines.

Methane emissions from enteric fermentation in 2015 account for 41% of total GHG emissions from Agriculture, 24% of the total methane emissions excluding LULUCF. Methane emissions from enteric fermentation are presented in Table 5.4 and Figure 5.2.

**Table 5.4. $CH_4$ emissions from enteric fermentation for 1990 – 2015**

| | **1990** | **1995** | **2000** | **2005** | **2010** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|
| $CH_4$ (kt) | 7.88 | 8.88 | 8.97 | 9.14 | 9.41 | 8.97 | 8.91 | 8.98 |

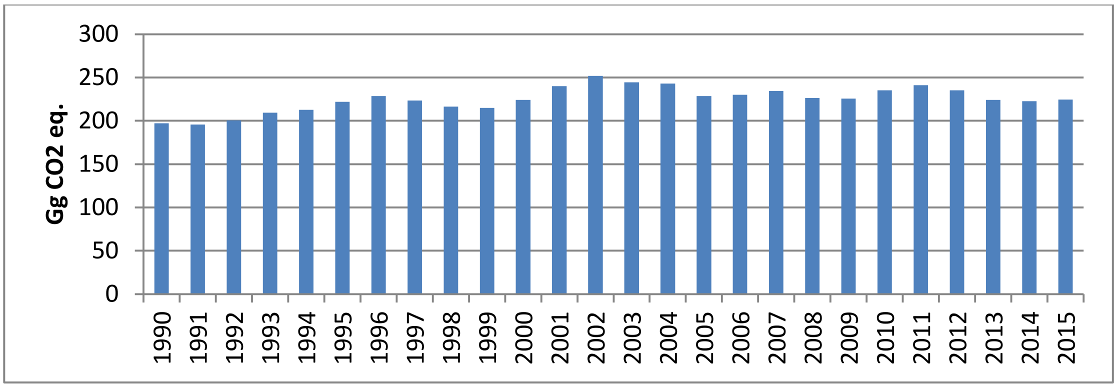


**Figure 5.2. Emissions from enteric fermentation, 1990 – 2015**

### 5.2.2. Methodological issues

Tier 1 methodology is applied and the default emission factors suggested by the IPCC Guidelines are used for the estimation of methane emissions from enteric fermentation for non-dairy cattle, sheep, goats, horses, mules and asses and swine. The emissions from dairy cattle are estimated using Tier 2 methodology. Poultry emissions were not estimated, since an emission factor is not available in the IPCC guidelines.

**Activity data**

The animal population used for the calculation of methane emissions from enteric fermentation is the annual average and it is presented in Table 5.5. The source of animal population is the Department of Agriculture, except mules and asses. Following a recommendation of the ERT in the Saturday Paper prepared during the in-country review of the 2016 submission to the UNFCCC, the population for horses, mules and asses was obtained from the Agricultural Censuses of the Statistical Service for the years 1985, 1994, 2002 and 2010 and linearly interpolated to complete the time series. Information after 2010 was not available therefore it was assumed that the population for the period 2010-2014 is constant for horses. For mules and asses, even though there is a trend which fits most accurately ($R^2$=0.9681) to the exponential relation y=-2086ln(x)+6928.2, the application of the particular trend gives very small, unrealistic numbers, therefore it was assumed that the population for the period 2010-2015 is also constant. Changes in the animal population are marked with red, including the revised population for horses, mules and asses.

**Dairy cattle, Tier 2**

Methane emissions from the enteric fermentation of dairy cattle are estimated according to the Tier 2 IPCC methodology, as it is described in the IPCC Guidelines (pg. 10.31, volume 4). The calculation of the $CH_4$ emission factor for is based on the following equation (eqn 10.21, pg. 10.30, volume 4):

$$EF = [[(GE * (YM/100) * 365\ days/yr] / 55.65\ MJ/kg\ CH_4]$$

where EF is the estimated emission factor for CH4 (kg $CH_4$/head/yr), GE is the gross energy intake (MJ/head/day) and Ym is the methane conversion rate which is the fraction of the gross energy in feed converted to $CH_4$.

**Table 5.5. Animal population for 1990 – 2015 (in 1000s)**

| | Dairy cattle | Other cattle | Market swine (all except sows) | Breeding swine (sows) | Sheep | Goats | Horses | Mules and Asses |
|---|---|---|---|---|---|---|---|---|
| **1990** | 22.4 | 32.3 | 244.2 | 33.8 | 290.0 | 205.0 | 0.460 | 5.026 |
| **1991** | 23.1 | 31.9 | 258.7 | 37.6 | 295.0 | 205.0 | 0.433 | 4.438 |
| **1992** | 23.9 | 31.9 | 299.5 | 42.4 | 285.0 | 200.0 | 0.405 | 3.850 |
| **1993** | 25.6 | 35.5 | 325.8 | 43.6 | 275.0 | 198.0 | 0.378 | 3.262 |
| **1994** | 27.6 | 36.8 | 308.2 | 48.0 | 255.0 | 210.0 | 0.350 | 2.674 |
| **1995** | 29.5 | 38.6 | 325.7 | 48.4 | 250.0 | 220.0 | 0.440 | 2.534 |
| **1996** | 27.3 | 42.8 | 350.7 | 48.9 | 252.0 | 240.0 | 0.530 | 2.395 |
| **1997** | 25.5 | 36.9 | 361.5 | 53.3 | 245.0 | 302.0 | 0.621 | 2.255 |
| **1998** | 23.8 | 32.0 | 381.5 | 49.8 | 240.0 | 322.0 | 0.711 | 2.115 |
| **1999** | 24.1 | 30.2 | 374.3 | 44.2 | 233.0 | 346.0 | 0.801 | 1.976 |
| **2000** | 23.5 | 30.7 | 356.3 | 52.1 | 246.0 | 378.6 | 0.891 | 1.836 |
| **2001** | 24.4 | 29.1 | 395.6 | 55.7 | 296.6 | 427.1 | 0.982 | 1.696 |
| **2002** | 26.2 | 31.9 | 435.1 | 56.3 | 294.0 | 459.5 | 1.072 | 1.557 |
| **2003** | 26.6 | 31.9 | 432.5 | 55.6 | 264.6 | 407.9 | 1.162 | 1.417 |
| **2004** | 26.1 | 34.2 | 418.8 | 51.7 | 279.0 | 378.0 | 1.103 | 1.289 |
| **2005** | 24.6 | 33.0 | 379.1 | 50.6 | 268.9 | 329.3 | 1.045 | 1.161 |
| **2006** | 23.9 | 32.2 | 399.7 | 53.0 | 272.2 | 344.9 | 0.986 | 1.033 |
| **2007** | 23.7 | 31.2 | 413.0 | 54.0 | 292.2 | 368.1 | 0.928 | 0.904 |
| **2008** | 23.6 | 32.0 | 416.6 | 48.3 | 267.3 | 318.4 | 0.869 | 0.776 |
| **2009** | 23.2 | 30.9 | 416.2 | 47.0 | 300.2 | 280.8 | 0.811 | 0.648 |
| **2010** | 23.4 | 31.3 | 417.4 | 46.3 | 328.9 | 307.4 | 0.752 | 0.520 |
| **2011** | 24.1 | 32.8 | 398.7 | 40.5 | 355.9 | 290.2 | 0.752 | 0.520 |
| **2012** | 24.1 | 32.8 | 358.4 | 36.3 | 346.8 | 271.2 | 0.752 | 0.520 |
| **2013** | 24.7 | 32.5 | 322.8 | 35.1 | 313.5 | 243.1 | 0.752 | 0.520 |
| **2014** | 25.3 | 34.2 | 308.1 | 34.0 | 293.0 | 232.0 | 0.752 | 0.520 |
| **2015** | 26.2 | 32.7 | 326.2 | 31.8 | 296.9 | 233.9 | 0.752 | 0.520 |

The calculation of gross energy is based on the following equation (eqn 10.16, pg. 10.21, volume 4):

$$GE = \{[(NE_m + NE_a + NE_l + NE_{work} + NE_p) / REM] + [(NE_g + NE_{wool}) / REG]\} / (DE\% / 100)$$

where $NE_m$ is the net energy required for animal maintenance in MJ/day, $NE_a$ is the net energy for animal activity in MJ/day, $NE_l$ is the net energy for lactation in MJ/day, $NE_{work}$ is the net energy for work, $NE_p$ is the net energy required for pregnancy in MJ/day, REM is the ratio of the net energy available in a diet for maintenance to digestible energy consumed, $NE_g$ is the net energy for growth in MJ/day, $NE_{wool}$ is the net energy required to produce a year of wool, REG is the ratio of net energy available for growth in a diet to digestible energy consumed and DE% is the digestible energy expressed as a percentage of gross energy.

The dairy cattle population used for the calculation of methane emissions from enteric fermentation is presented in Table 5.6. Information for average weight (W), live body weight (BW), mature body weight (MW), milk production and digestibility of feed has been obtained from the Department of Agriculture[18]. The remaining parameters have the value of the default

[18] Mr. George Papaioannou, Agricultural Officer, Department of Agriculture, tel. no. +357 22408566

proposed by the IPCC GPG. The fat percentage in milk is assumed 3.5% taking into account the suggestion that was made during the volunteered participation of Cyprus in the Effort Sharing Decision review (ESD review) that was took place on year 2015. Table 5.6 presents the values used for the calculations, while Table 5.7 presents the daily milk production and the % pregnant population. The resulting Gross energy (GE) and the emissions factors (EFs) for the period 1990-2015 are presented in Table 5.8.

GE estimates have been revised due to the Identification of a mistake in the calculations. More specifically, it was found that GE was calculated with constant milk production of 1990 instead of annual milk production, which was corrected in this submission. The revised GE and the respective EF estimated are presented in Table 5.8

Moreover, GE estimates have been affected of the change of DE from 60 to 68.

**Table 5.6. Information for the application of Tier 2 methodology for dairy cattle**

| **Parameter** | **Value** | **Source** |
|---|---|---|
| Average weight (W), kg | 550 | Department of Agriculture |
| Net energy maintenance coefficient ($Cf_i$) | 0.386 | IPCC Guidelines (cattle, Table 10.4, pg. 10.16, vol. 4) |
| Activity coefficient ($C_a$) | 0.00 | IPCC Guidelines (stall, Table 10.5, pg. 10.17, vol. 4) |
| Live body weight (BW), kg | 550 | Department of Agriculture |
| Growth coefficient (C) | 0.8 | IPCC Guidelines (eqn.10.6, pg. 10.17, vol. 4) |
| Mature body weight of an adult animal (MW), kg | 550 | Department of Agriculture |
| Daily weight gain (WG), kg/day | 0 | IPCC Guidelines (footnote 1, pg. 10.12,vol.4) |
| Fat in milk | 3.5% | Recommendation which was identified by technical Expert review team during the ESD trial Review |
| Hours of work / day | 0 | Department of Agriculture |
| $C_{pregnancy}$ | 0.10 | IPCC Guidelines (table 10.7, pg.10.20, vol.4) |
| Digestibility of feed, DE | 68 | recommendation of the review expert of the TERT (comment no. CY-3A-2016-0002) |
| CH4 conversion rate (Ym) | 0.065 | IPCC Guidelines (table 10.12, pg.10.30, vol.4) |

**Table 5.7. Daily milk production per dairy cow (kg) and per cent pregnant population of cows in Cyprus**

| **Year** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** |
|---|---|---|---|---|---|---|---|---|---|
| Milk production (kg/day/cow) | 12.22 | 12.30 | 12.25 | 12.60 | 12.49 | 12.90 | 13.84 | 14.30 | 15.40 |
| % pregnant population* | 81.3 | 81.3 | 81.3 | 81.3 | 81.3 | 81.3 | 81.3 | 81.3 | 81.3 |

| **Year** | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** |
|---|---|---|---|---|---|---|---|---|---|
| Milk production (kg/day/cow) | 15.07 | 17.07 | 15.89 | 14.77 | 16.71 | 15.86 | 16.41 | 17.01 | 16.65 |
| % pregnant population | 81.3 | 81.3 | 81.3 | 81.3 | 81.3 | 81.3 | 80.3 | 80.7 | 79.4 |

| **Year** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|
| Milk production (kg/day/cow) | 17.64 | 17.95 | 17.64 | 17.42 | 17.29 | 16.96 | 17.18 | 17.08 |
| % pregnant population | 77.6 | 76.3 | 76.3 | 72.2 | 72.2 | 72.2 | 72.2 | 72.2 |

* No data available for 1990-2003, 2010 and 2011. 1990-2003 assumed that is equal to 2004, 2010 assumed equal to 2009 and 2011, 2013 - 2015 assumed equal to 2012.

**Table 5.8. Gross energy (GE) and emissions factor (EF) for dairy cattle for the period 1990 – 2015**

| **Year** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** |
|---|---|---|---|---|---|---|---|
| GE (MJ/head/day) | 231.8 | 232.4 | 232.0 | 234.9 | 234.0 | 237.3 | 244.8 |
| EF (kg $CH_4$/head/yr) | 98.8 | 99.1 | 98.9 | 100.1 | 99.8 | 101.2 | 104.4 |

| **Year** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** |
|---|---|---|---|---|---|---|---|
| GE (MJ/head/day) | 248.6 | 257.4 | 254.7 | 270.9 | 261.4 | 252.3 | 268.0 |
| EF (kg $CH_4$/head/yr) | 106.0 | 109.7 | 108.6 | 115.5 | 111.4 | 107.6 | 114.3 |

| **Year** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
|---|---|---|---|---|---|---|---|
| GE (MJ/head/day) | 261.2 | 265.5 | 270.4 | 267.3 | 275.1 | 277.3 | 274.9 |
| EF (kg $CH_4$/head/yr) | 111.3 | 113.2 | 115.3 | 114.0 | 117.3 | 118.2 | 117.2 |

| **Year** | **2011** | **2012** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|
| GE (MJ/head/day) | 272.6 | 271.5 | 268.9 | 270.7 | 269.9 |
| EF (kg $CH_4$/head/yr) | 116.2 | 115.8 | 114.6 | 115.4 | 115.1 |

**Non-dairy cattle, sheep, goats, horses, mules and asses and swine; Tier 1**

The methane emission factors used for enteric fermentation of non-dairy cattle, sheep, goats, horses, mules and asses and swine for the application of the Tier 1 methodology, are according to the IPCC 2006 guidelines (volume 4, pg. 10.29, Table 10.11) and are presented in Table 5.9.

Poultry emissions were not estimated, since an emission factor is not available in the IPCC guidelines (volume 4, pg.10.28, Table 10.10). The animal populations used are presented in Table 5.5.

**Table 5.9. Methane emission factor applied for enteric fermentation, according to animal**

| | **Emission factor (kg $CH_4$/head)** | **Source** |
|---|---|---|
| Non-dairy cattle | 57 | IPCC 2006, pg10.29@ volume 4, western Europe* |
| Sheep | 8 | IPCC 2006, pg10.28@ volume 4, developed |
| Goats | 5 | IPCC 2006, pg10.28@ volume 4, developed |
| Horses | 18 | IPCC 2006, pg10.28@ volume 4, developed |
| Mules and asses | 10 | IPCC 2006, pg10.28@ volume 4, developed |
| Swine | 1.5 | IPCC 2006, pg10.28@ volume 4, developed |
| Poultry | Insufficient data for calculation | IPCC 2006, pg10.28@ volume 4 |

* Milk production closer to North America but production system as west Europe

### 5.2.3. Uncertainties and time-series consistency

Uncertainty analysis is presented in section 1.7.

### 5.2.4. Source-specific QA/QC and verification

QA/QC and verification activities are presented in section 1.6.

### 5.2.5. Source-specific recalculations

Recalculations that took place have been caused by (a) the change of the daily weight gain, the % fat in milk, (b) the change of fat percentage in milk, (c) correction of the calculations of

GE for dairy-cattle and (d) changes in animal population. The recalculations have affected the whole reporting period, i.e. 1990-2015.

**(a) Change of the daily weight gain**

Taking into account that dairy cattle, following the IPCC definition comprises mature animals that have reach their maximum weight, the daily weight gain (WG) is assumed 0 (footnote 1, pg.1.12, volume 4, IPCC Guidelines).

**(b) Change of the fat percentage in milk**

The fat percentage in milk is assumed 3.5% taking into account the recommendation that was made during the volunteered participation of Cyprus in the 2015 Effort Sharing Decision review (ESD review).

**(c) Correction of the calculations of GE for dairy-cattle**

GE estimates have been revised due to the identification of a mistake in the calculations. More specifically, it was found that GE was calculated with constant milk production of 1990 instead of annual milk production, which was corrected in this submission. GE estimates have been also been affected by the change of DE from 60 to 68.

**(d) Changes in animal population**

The changes in the animal population for horse, mules and asses of the years indicated with red in Table 5.5 have led to the changes in methane emissions from enteric fermentation shown in Table 5.10 and Figure 5.3. The revision of animal population has led to a change ranging from -65% to -88%.

**Table 5.10. Changes in methane emissions from enteric fermentation caused by changes in the animal population for horse, mules and asses (1990-2014)**

| CH4 emissions (Gg) | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 0.166 | 0.166 | 0.166 | 0.166 | 0.166 | 0.166 | 0.166 |
| After ERT recommendation | 0.059 | 0.052 | 0.046 | 0.039 | 0.033 | 0.033 | 0.033 |
| Change | -0.107 | -0.114 | -0.120 | -0.127 | -0.133 | -0.133 | -0.133 |
| *% change to initial submission* | *-65%* | *-69%* | *-72%* | *-76%* | *-80%* | *-80%* | *-80%* |

| CH4 emissions (Gg) | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 0.166 | 0.166 | 0.166 | 0.166 | 0.166 | 0.175 | 0.166 |
| After ERT recommendation | 0.034 | 0.034 | 0.034 | 0.034 | 0.035 | 0.035 | 0.035 |
| Change | -0.132 | -0.132 | -0.132 | -0.132 | -0.131 | -0.140 | -0.131 |
| *% change to initial submission* | *-80%* | *-80%* | *-79%* | *-79%* | *-79%* | *-80%* | *-79%* |

| CH4 emissions (Gg) | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 0.166 | 0.166 | 0.166 | 0.157 | 0.157 | 0.157 | 0.157 |
| After ERT recommendation | 0.033 | 0.030 | 0.028 | 0.026 | 0.023 | 0.021 | 0.019 |
| Change | -0.133 | -0.136 | -0.138 | -0.131 | -0.134 | -0.136 | -0.138 |
| *% change to initial submission* | *-80%* | *-82%* | *-83%* | *-84%* | *-85%* | *-87%* | *-88%* |

| CH4 emissions (Gg) | 2011 | 2012 | 2013 | 2014 | | | |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 0.157 | 0.157 | 0.157 | 0.157 | | | |
| After ERT recommendation | 0.019 | 0.019 | 0.019 | 0.019 | | | |
| Change | -0.138 | -0.138 | -0.138 | -0.138 | | | |
| *% change to initial submission* | *-88%* | *-88%* | *-88%* | *-88%* | | | |

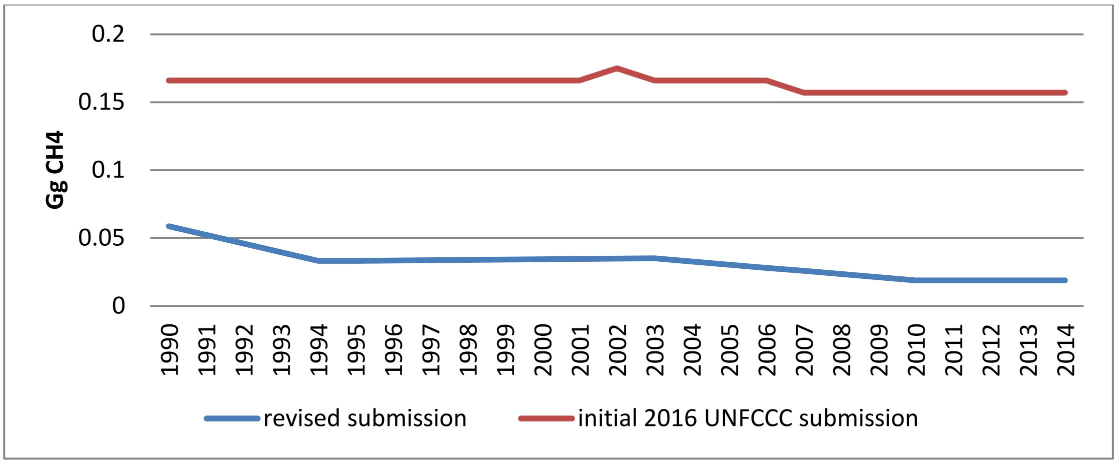


**Figure 5.3. Changes in methane emissions from enteric fermentation caused by changes in the animal population for horse, mules and asses (1990-2014)**

### 5.2.6. Source-specific planned improvements

Source specific improvements are planned to improve data accuracy for the dairy cattle category concerning the average weight.

## 5.3. Manure management (CRF source category 3B)

### 5.3.1. Source category description

**Animal waste management in Cyprus[19]**

Most small-scale pig farms in Cyprus use mechanical separation for the treatment of their waste. The separated liquid is sent to evaporation lagoons or is used for irrigation, and the solid fraction is used as soil improver. Nine large pig farms have installed a combination of anaerobic / aerobic treatment plants (Anaerobic digestion). The treated liquid fraction is used for irrigation or washing the housing areas or placed in evaporation lagoons. The produced biogas is combusted onsite by Combined Heat Power generators for the production of heat and electricity. Both heat and electricity are consumed at the farms. Any excess electricity is sold to the electricity provider and directed to the electricity distribution network. Heat is not distributed outside the farm because there is no heat distribution network in Cyprus. The emissions from the electrical energy from the biogas used onsite and offsite has been taken into account in the energy sector according to the national energy balance.

The waste from cattle, sheep, goats, horses, mules and asses are collected and left to dry before applied on land for soil improver (Solid storage and dry lot). Poultry waste is characterised by high content of solids (almost dry) and it is collected, left to dry and then used as soil improver (Solid storage and dry lot).

[19] Kythreotou, N., G. Florides, S.A. Tassou, 2010. Production and management of biodegradable waste in Cyprus a paper published in the proceedings of SEEP2010 Conference Proceedings, June 29th– July 2nd 2010, Bari, Italy

Manure management is responsible for methane and nitrous oxide emissions. Methane is produced during the anaerobic decomposition of manure, while nitrous oxide is produced during the storage and treatment of manure before its use as fertilizer.

Emissions from manure management in 2015 accounted for 2.4% of the total national emissions without LULUCF. $CH_4$ and $N_2O$ from manure management in 2015 accounted for 37.9% and 75.9% of GHG emissions from Agriculture respectively. Total emissions in 2015 increased by 10.5% compared to 1990 levels. $CH_4$ and $N_2O$ emissions from manure management for the period 1990 – 2015 are presented in Table 5.11 and Figure 5.4.

**Table 5.11. $CH_4$ and $N_2O$ emissions from manure management for 1990 – 2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| CH4 (kt) | 4.44 | 5.91 | 6.32 | 6.59 | 6.98 | 5.51 | 5.31 | 5.49 |
| N2O (kt) | 0.24 | 0.28 | 0.31 | 0.29 | 0.27 | 0.23 | 0.22 | 0.22 |
| Total (CO2 eq) | 182.79 | 233.66 | 250.97 | 252.25 | 255.23 | 205.48 | 199.13 | 201.67 |

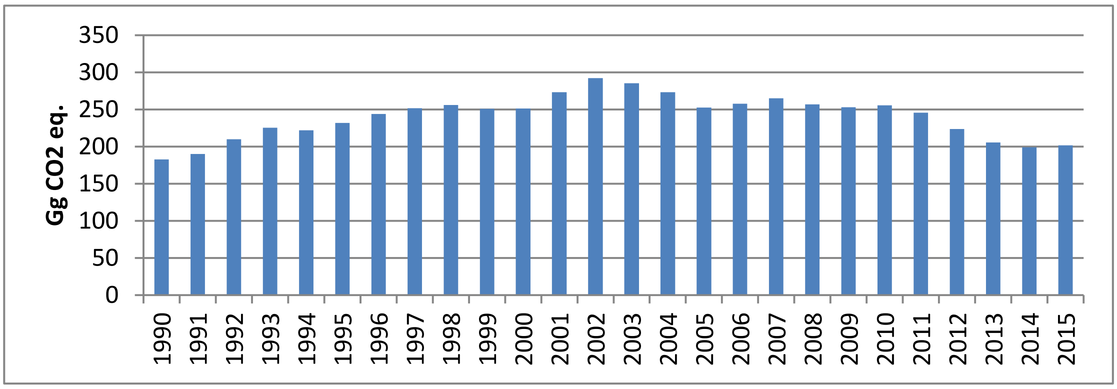


**Figure 5.4. Emissions from manure management, 1990 – 2015**

## 5.3.2. Methodological issues

The amount of methane emitted by a population of animals is calculated by multiplying the emission rate per animal by the number of animals. Tier 1 methodology is a simplified approach that relies on default emission factors drawn from previous studies. The Livestock population used has been already presented in Table 5.5.

### 3B1. $CH_4$ emissions

The EFs for manure management were chosen according to the manure management practices that are applied in Cyprus for the particular specie[20]. The following emission factors were used for the estimation or methane from manure management (Table 5.12):

- For sheep, goats, horses, mules and asses, laying chicken, broiler chicken, turkeys and other poultry, EFs for temperate developed countries were used (0.28, 0.2, 2.34, 1.1 and 0.03, 0.02, 0.09, 0.03 kg $CH_4$/head/yr respectively), as indicated in Table 10.15 of the IPCC2006 guidelines volume 4 (pg.10.40).

[20]The choice for the EFs was based on discussions with Mr. Antis Athanasiades the responsible officer for manure management at the Department of Environment (aathanasiades@environment.moa.gov.cy, +35722408935).

- For dairy and non-dairy cattle, Tier 2 methodology was applied using the following parameters: MCF: Solid 4% (IPCC 2006 Guidelines, Table 10.17), anaerobic digesters 2% (Common loss from anaerobic digesters (eg. Germany and Austria)); Volatile substance excretion (VS): Dairy cattle 4.5 kg/head/day, Non-dairy cattle 2.7 kg/head/day (IPCC 2006 Guidelines, Tables 10A-4 and 10A-5, Eastern Europe); B0: Dairy cattle 0.24, Non-dairy cattle 0.17 (IPCC 2006 Guidelines, Tables 10A-4 and 10A-5, Eastern Europe).
- For swine, EF for temperate Western Europe were used (13 kg $CH_4$/head/yr), as indicated in Table 10.14 of the IPCC2006 guidelines volume 4 (pg. 10.38).

**Table 5.12. Emission factors used for the estimation of methane emissions from manure management**

| Animal | kg $CH_4$/head/yr | Source |
|---|---|---|
| Sheep | 0.28 | Table 10.15, pg.10.40, IPCC 2006 guidelines, volume 4 – developed countries, temperate |
| Goats | 0.20 | Table 10.15, pg.10.40, IPCC 2006 guidelines, volume 4– developed countries, temperate |
| Swine | 13 | Table 10.14, pg.10.38, IPCC 2006 guidelines, volume 4 – western Europe, temperate* |
| Horses | 2.34 | Table 10.15, pg.10.40, IPCC 2006 guidelines, volume 4 – developed countries, temperate |
| Mules and asses | 1.10 | Table 10.15, pg.10.40, IPCC 2006 guidelines, volume 4 – developed countries, temperate |
| Laying chicken | 0.03 | Table 10.15, pg.10.40, IPCC 2006 guidelines, volume 4 – developed countries, temperate/dry |
| Broiler chicken | 0.02 | Table 10.15, pg.10.40, IPCC 2006 guidelines, volume 4 – developed countries, temperate |
| Turkeys | 0.09 | Table 10.15, pg.10.40, IPCC 2006 guidelines, volume 4 – developed countries, temperate |
| Other Poultry | 0.03 | Table 10.15, pg.10.40, IPCC 2006 guidelines, volume 4 – developed countries, temperate/ducks |

* Manure management practices for swine used in Cyprus are more appropriate to be categorised under Western Europe.

### 3B2. Direct $N_2O$ emissions

To estimate the direct $N_2O$emissions from manure management three steps were applied, according to the Tier 1 methodology: (a) estimation of annual nitrogen excretion per animal type (kg Nex/year), (b) allocation of waste to waste management system used, (c) estimation of annual nitrogen excretion per waste management system (kg N ex/year), and (d) estimation of N2O emissions using kgN2O-N/kg Nex factors per technology. These steps are summarised in the equation below:

$$N_2O_{D(mm)}= [\Sigma_s[\Sigma_T(N_{(T)}*N_{ex(T)}*MS_{(T,S)})]*EF_{3(S)}]*44/28$$

where $N_2O_{D(mm)}$ is direct N2O emissions, $N_{(T)}$ is the number of head of livestock species, $Nex_T$ the annual average N excretion per head of species, $MS_{(T,S)}$ the fraction of total annual excretion for each livestock species that is managed in system S, $EF_{3(S)}$ is the $N_2O$ emission factor for system S (equation 10.25, pg.10.54, volume 4, IPCC guidelines).

(a) Estimation of annual nitrogen excretion rates $N_{ex(T)}$ (kg N ex/year)

The annual nitrogen excretion rate per animal type using the nitrogen excretion rates (kg N ex/animal/year) is shown in Table 5.13. These are the defaults proposed by the IPCC methodologies. The Nitrogen excretion rate has been determined by the IPPC 2006 Guidelines equation 10.30, pg. 10.57.The animal population used is presented in Table 5.5. It should be noted that Cyprus has used Western Europe default values for N excretion and Eastern Europe default values for CH4 for manure management. The reason of different approach is that manure management practises for cattle waste used in Cyprus are more appropriate to be categorised under Eastern Europe. However for the calculation of the N2O emissions from manure management, the factor has been changed to Western Europe, due to the high milk production, based on the comment received by the UNFCCC review team in 2013.

**Table 5.13. Default values for Nitrogen excretion rate (IPCC 2006 guidelines, volume 4, table 10.19, pg. 10.59)**

| Animal | Default values for Nitrogen excretion rate (kg N /animal/day) |
|---|---|
| Dairy Cattle | 0.48 |
| Non-Dairy Cattle | 0.33 |
| Market swine | 0.51 |
| Breading swine | 0.42 |
| Sheep | 0.85 |
| Poultry | 0.83 |
| Goats | 1.28 |
| Horses | 0.26 |
| Mules and asses | 0.26 |

**Table 5.14. Waste management per technology contribution**

| Animal | 1990-2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|
| Dairy Cattle | | | | | | | |
| Solid storage and dry lot | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Anaerobic digestion | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Non-Dairy Cattle | | | | | | | |
| Solid storage and dry lot | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Anaerobic digestion | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Sheep | | | | | | | |
| Solid storage and dry lot | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Goats | | | | | | | |
| Solid storage and dry lot | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Horses | | | | | | | |
| Solid storage and dry lot | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Mules and asses | | | | | | | |
| Solid storage and dry lot | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Market Swine | | | | | | | |
| Aerobic treatment | 100% | 97% | 94% | 91% | 88% | 85% | 82% |
| Anaerobic digestion | 0% | 3% | 6% | 9% | 12% | 15% | 18% |
| Breading Swine | | | | | | | |
| Aerobic treatment | 100% | 97% | 94% | 91% | 88% | 85% | 82% |
| Anaerobic digestion | 0% | 3% | 6% | 9% | 12% | 15% | 18% |
| Poultry | | | | | | | |
| Solid storage and dry lot | 100% | 100% | 100% | 100% | 100% | 100% | 98% |
| Anaerobic digestion | 0% | 0% | 0% | 0% | 0% | 0% | 2% |

| Animal | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| Dairy Cattle | | | | | | | | | |
| Solid storage and dry lot | 100% | 99% | 99% | 99% | 99% | 97% | 97% | 95% | 95% |
| Anaerobic digestion | 0% | 1% | 1% | 1% | 1% | 3% | 3% | 5% | 5% |
| Non-Dairy Cattle | | | | | | | | | |
| Solid storage and dry lot | 100% | 99% | 99% | 99% | 99% | 97% | 97% | 95% | 95% |
| Anaerobic digestion | 0% | 1% | 1% | 1% | 1% | 3% | 3% | 5% | 5% |
| Sheep | | | | | | | | | |
| Solid storage and dry lot | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Goats | | | | | | | | | |
| Solid storage and dry lot | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Horses | | | | | | | | | |
| Solid storage and dry lot | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Mules and asses | | | | | | | | | |
| Solid storage and dry lot | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Market Swine | | | | | | | | | |
| Aerobic treatment | 79% | 76% | 73% | 70% | 70% | 60% | 60% | 50% | 50% |
| Anaerobic digestion | 21% | 24% | 27% | 30% | 30% | 40% | 40% | 50% | 50% |
| Breading Swine | | | | | | | | | |
| Aerobic treatment | 79% | 76% | 73% | 70% | 70% | 60% | 60% | 50% | 50% |
| Anaerobic digestion | 21% | 24% | 27% | 30% | 30% | 40% | 40% | 50% | 50% |
| Poultry | | | | | | | | | |
| Solid storage and dry lot | 96% | 94% | 92% | 90% | 90% | 90% | 90% | 90% | 85% |
| Anaerobic digestion | 4% | 6% | 8% | 10% | 10% | 10% | 10% | 10% | 15% |

(b) Allocation of waste to waste management system used

The distribution of waste to the waste management systems has been estimated based on the information presented in Table 5.14. A mistake concerning the distribution of waste to the waste management systems for market swine and breading swine for the year 2014 has been indentified and corrected (indicated with red).

(c) Estimation of annual nitrogen excretion per waste management system (kg N ex/year)

The annual nitrogen excretion per waste management system is estimated by multiplying the % of waste allocated to a particular system by the annual nitrogen excretion per animal type estimated in step (a).

(d) Estimation of $N_2O$ emissions using kg$N_2O$-N/kg Nex factors per technology.

The total annual nitrogen excretion per waste management system (regardless animal type) is then multiplied by the kgN2O-N/kg N ex coefficient, to estimate the $N_2O$ emissions. The kgN2O-N/kg N ex coefficients used are presented in Table 5.15.

**Table 5.15. kg $N_2O$-N/kg N ex coefficients per technology used**

| Animal | kg$N_2O$-N/kg N ex | Source |
|---|---|---|
| Solid storage and dry lot | 0.005 | 2006 IPCC Guidelines, volume 4, pg. 10.62, table 10.21 |
| Aerobic treatment (forced aeration) | 0.005 | |
| Anaerobic digestion | 0.000 | |

### 3B2.5. Indirect $N_2O$ emissions from Manure Management

**I. Indirect $N_2O$ emissions from volatilisation of N from Manure Management**

To estimate the indirect N2O emissions from manure management four steps were applied, according to Tier 1 methodology: (a) Estimation of annual nitrogen excretion per animal type (kg N ex/year), (b) Allocation of waste to waste management system used, (c) Estimation of amount of manure nitrogen that is lost due to volatilisation (d) Estimation of N2O emissions using the totals volatilisation N-losses (kg N/yr). The indirect N2O emissions were estimated using the following equation (eqn. 10.27, pg. 10.56, volume 4 IPCC guidelines):

$$N_2O_{G(mm)} = (N_{volatilisation-MMS} * EF_4)*44/28$$

where $N_2O_{G(mm)}$ is indirect N2O emissions, $N_{volatilisation-MMS}$ is the amount of manure nitrogen that is lost due to volatilisation and $EF_4$ is the N2O emission factor for system S.

<u>Estimation of annual nitrogen excretion per animal type (kg N ex/year)</u>

The annual nitrogen excretion per animal type using the nitrogen excretion rates (kg N ex/animal/year) is shown in Table 5.13. These are the defaults proposed by the IPCC methodologies. The animal population used is presented in Table 5.5.

<u>Allocation of waste to waste management system used</u>

The distribution of waste to the waste management systems has been estimated based on the information presented in Table 5.14.

<u>Estimation of amount of manure nitrogen that is lost due to volatilization</u>

The annual amount of manure nitrogen that is lost due to volatilisation ($N_{volatilisation-MMS}$) is estimated by multiplying the % of waste allocated to a particular waste management system by the annual nitrogen excretion per animal estimated in step (a) and by multiplying the % of managed manure nitrogen for livestock category T in the manure system S ($Frac_{GASMS}$ (%)). The per cent of managed manure nitrogen for livestock is presented in Table 5.16.

<u>Estimation of N2O emissions using the totals volatilisation N-losses (kg N/yr)</u>

The total annual amount of manure nitrogen that is lost due to volatilisation ($N_{vol.atilization-MMS}$) is multiplied by the emission factor for N2O emissions from atmospheric deposition of nitrogen on soils and water surfaces ($EF_4$) to estimate the N2O emissions. The emission factor used is 0.01 kg N2O-N (default value). The equation used to estimate the indirect N2O emissions from volatilisation summarised in the equation below:

$$N_2O_{G(mm)} = (N_{volatilisation-MMS} * EF_4) * 44/28$$

**Table 5.16. Default values for volatilisation N losses.**

| Animal | Manure management system | N volatilisation losses |
|---|---|---|
| Dairy cattle | Solid storage | 38%* |
| | Anaerobic digestion | 0% |
| Non-dairy cattle | Solid storage | 38%* |
| | Anaerobic digestion | 0% |
| Market swine | Anaerobic digestion | 0% |
| | Aerobic treatment | 0% |
| Breeding swine | Anaerobic digestion | 0% |
| | Aerobic treatment | 0% |
| Sheep | Solid storage | 12%** |
| Goats | Solid storage | 12%** |

| | | |
|---|---|---|
| Horses | Solid storage | 12%** |
| Mules and Asses | Solid storage | 12%** |
| Poultry | Solid storage | 12%** |
| | Anaerobic digestion | 0% |

* The average of 30% and 45% was used as default value due to the fact in Cyprus dairy and non-dairy cattle are in same farm; ** No default available for this animal - use other. IPCC guidelines, volume 4, pg. 10.65, table 10.22

**II. Indirect $N_2O$ emissions from leaching and runoff of nitrogen from manure management**

Indirect N2O emissions from leaching and runoff of nitrogen from manure management have been estimated using eqns. 10.28 and 10.29 (pg. 10.56 - 10.57, vol.4) of the IPCC 2006 guidelines.

The annual nitrogen excretion per animal type using the nitrogen excretion rates (kg N ex/animal/year) is shown in Table 5.13. These are the defaults proposed by the IPCC methodologies. The animal population used is presented in Table 5.5.

Per cent of managed manure nitrogen losses for livestock category T due to runoff and leaching during solid and liquid storage of manure (Frac(leachMS)) used is 10%, since the typical range proposed by the guidelines is 1-20% (pg. 10.56, vol.4).

The default emission factor for N2O emissions from nitrogen leaching and runoff, kg N2O-N/kg N leached and runoff (EF5) proposed by the IPCC guidelines is used, 0.0075 kg N2O-N (kg N leaching/runoff)-1 (Chapter 11, Table 11.3).

### 5.3.3. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

### 5.3.4. Source-specific QA/QC and verification

QA/QC and verification activities are presented in Section 1.6.

### 5.3.5. Source-specific recalculations

The changes in the emissions' estimates compared to the previous submission are the following:

(a) T2 methodology has been applied for the estimation of CH4 emissions from dairy and other cattle. In previous submissions T1 was used.
(b) Revised calculations have been made for N2O emissions from sheep, swine and goats for the whole time series of emissions due to the fact that the sum of manure excretion over the different manure management systems did not match the total N excreted by the animals.
(c) Revised calculations have been made for N2O emissions per technology and N2O emissions per animal, due to the mistake identified to the conversion of (N2O-N) emissions to N2O emissions (44/26 change into 44/28).
(d) Indirect N2O emissions from leaching and runoff of nitrogen from manure management have been estimated for the first time.

(e) Changes in horse, mules and asses animal population

The changes in the animal population for horse, mules and asses of the years indicated with red in Table 5.5 have led to the changes in CH4 and N2O emissions from manure management and Indirect N2O emissions shown in Table 5.17 and Figure 5.5. The revision of animal population has led to a change ranging from -3.7% to -5.2%.

(f) Distribution of waste to the waste management systems for market swine and breading swine for the year 2014 has been revised.

**Table 5.17. Changes in emissions from manure management and indirect N2O emissions caused by changes in the animal population for horse, mules and asses (1990-2014)**

| **CH4 and N2O emissions (Gg)** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 31.82 | 32.02 | 34.21 | 36.90 | 36.78 | 38.16 | 39.81 |
| After ERT recommendation | 30.63 | 30.77 | 32.89 | 35.50 | 35.32 | 36.70 | 38.35 |
| Change | -1.18 | -1.25 | -1.32 | -1.39 | -1.46 | -1.46 | -1.46 |
| *% change to initial submission* | *-3.7%* | *-3.9%* | *-3.9%* | *-3.8%* | *-4.0%* | *-3.8%* | *-3.7%* |

| **CH4 and N2O emissions (Gg)** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 40.63 | 40.48 | 39.90 | 40.77 | 43.11 | 45.27 | 43.47 |
| After ERT recommendation | 39.17 | 39.03 | 38.45 | 39.32 | 41.66 | 43.72 | 42.02 |
| Change | -1.46 | -1.45 | -1.45 | -1.45 | -1.45 | -1.54 | -1.44 |
| *% change to initial submission* | *-3.6%* | *-3.6%* | *-3.6%* | *-3.6%* | *-3.4%* | *-3.4%* | *-3.3%* |

| **CH4 and N2O emissions (Gg)** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 41.37 | 38.50 | 37.42 | 38.04 | 35.96 | 34.74 | 35.08 |
| After ERT recommendation | 39.90 | 37.00 | 35.90 | 36.59 | 34.49 | 33.24 | 33.56 |
| Change | -1.47 | -1.49 | -1.52 | -1.45 | -1.47 | -1.50 | -1.52 |
| *% change to initial submission* | *-3.5%* | *-3.9%* | *-4.1%* | *-3.8%* | *-4.1%* | *-4.3%* | *-4.3%* |

| **CH4 and N2O emissions (Gg)** | **2011** | **2012** | **2013** | **2014** | | | |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 34.48 | 31.61 | 29.45 | 31.32 | | | |
| After ERT recommendation | 32.95 | 30.08 | 27.93 | 29.80 | | | |
| Change | -1.52 | -1.52 | -1.52 | -1.52 | | | |
| *% change to initial submission* | *-4.4%* | *-4.8%* | *-5.2%* | *-4.9%* | | | |

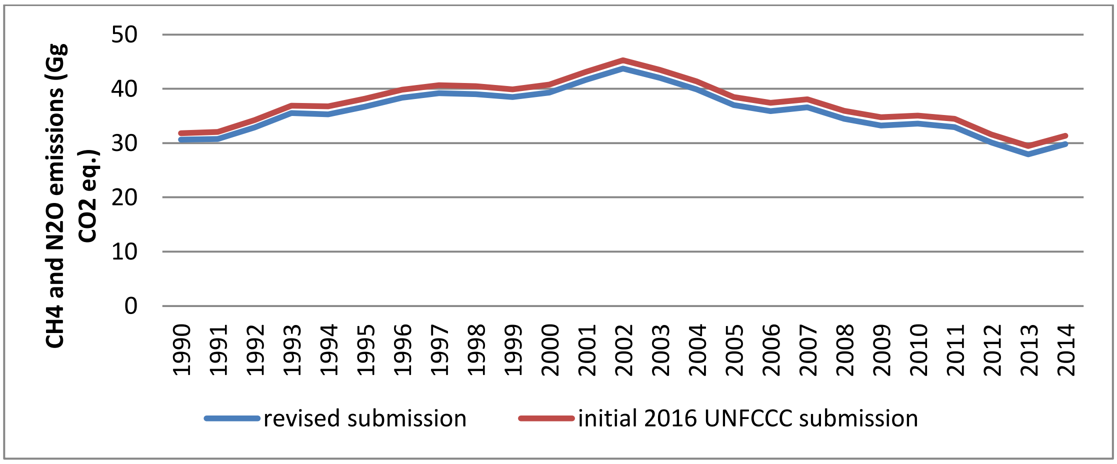

**Figure 5.5. Changes in emissions from manure management and indirect N2O emissions caused by changes in the animal population for horse, mules and asses (1990-2014)**

### 5.3.6. Source-specific planned improvements

The possibility of applying Tier 2 methodology for the estimation of methane emissions from the manure management for more animals is under examination. Moreover the collection of information regarding the manure management systems and livestock breeding practices in Cyprus is planned.

## 5.4. Rice cultivation (CRF source category 3C)

Not occurring.

## 5.5. Agricultural soils (CRF source category 3D)

### 5.5.1. Source category description

Agricultural soils constitute the largest anthropogenic source of nitrous oxide emissions. $N_2O$ is produced naturally in soils through the microbial processes of nitrification and denitrification. Agricultural activities add nitrogen to soils, increasing the amount of $N_2O$ released in the atmosphere. Anthropogenic $N_2O$ emissions from agriculture are produced either directly from nitrogen inputs to soils or indirectly, after the removal of nitrogen from soils. The $N_2O$ emissions sources examined are the following:
- Direct $N_2O$ emissions
- Indirect $N_2O$ emissions

Total emissions from agricultural soils in 2015 contributed 24% to the emissions from agriculture and 1.6% to the total emissions of the country (excluding LULUCF). The total emissions from soils in 2015 reduced by 11.13% compared to 1990. Emissions from agricultural soils for the period 1990 – 2015 are presented in Table 5.18 and Figure 5.6.

**Table 5.18. $N_2O$ emissions from agricultural soils for 1990 – 2015**

| | **1990** | **1995** | **2000** | **2005** | **2010** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|
| $N_2O$ (kt) | 0.50 | 0.71 | 0.52 | 0.48 | 0.49 | 0.40 | 0.39 | 0.44 |

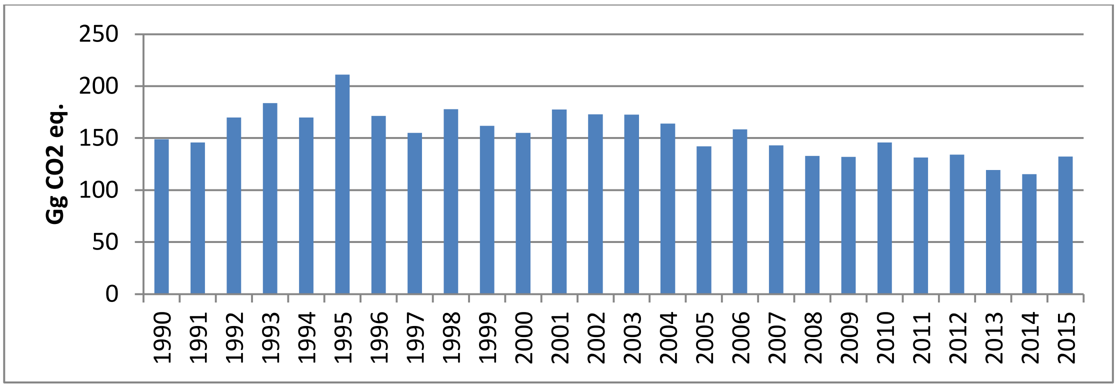


**Figure 5.6. N2O emissions from agricultural soils, 1990 – 2015**

### 5.5.2. Methodological issues

**Direct N2O Emissions from managed soils (3D1)**

Direct $N_2O$ emissions from agricultural soils derive from: the use of inorganic N fertilisers – $F_{SN}$ (CRF source category 3D1.1), use of organic N fertilisers (animal manure applied to soils and sewage sludge applied to soils – CRF source category 3D1.2a and 3D1.2b respectively) and crop residues - $F_{CR}$ (CRF source category 3D1.4).

**Use of Inorganic fertilisers (3D1.1)**

$N_2O$ emissions from the use of inorganic N fertilisers were estimated using Tier 1 methodology suggested by the IPCC Guidelines. Emission factor (EF1 (kg N2O-N/kg N)) is assumed 0.01, as proposed by the IPCC 2006 guidelines (Table 11.1, pg.11.11, volume 4, 2006 IPCC guidelines).

**Table 5.19. N input from application of inorganic fertilisers for the period (in kt) 1990-2015**

| Year | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| Inorganic fertilisers (kt N) | 12.4 | 12.2 | 14.8 | 16.2 | 14.3 | 20.5 | 13.6 | 11.1 | 14.6 |

| Year | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| Inorganic fertilisers (kt N) | 11.6 | 10.5 | 12.4 | 10.6 | 11.2 | 10.7 | 8.6 | 11.3 | 8.2 |

| Year | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Inorganic fertilisers (kt N) | 7.5 | 7.7 | 9.4 | 7.1 | 8.3 | 7.1 | 6.7 | 0.8 |

**Use of organic N fertilisers (3D1.2)**

Animal manure used as fertilisers (3D1.2a)

$N_2O$ emissions from animal manure used as fertilisers were estimated using Tier 1a methodology suggested by the IPCC Good Practice Guidance. The data used is the animal population as shown in Table 5.5. Using nitrogen excretion factors as listed in Table 5.13, total nitrogen excretion by livestock was calculated from livestock numbers. No manure is used as fuel in Cyprus therefore the percentage of the manure-N used as fuel ($Frac_{FUEL}$) is assumed 0. It is also assumed that no animals are grazing (Pasture range and Paddock) therefore fraction of livestock nitrogen excreted and deposited onto soil during grazing ($Frac_{GRAZ}$) is also assumed 0. Fraction of total nitrogen excretion that is emitted as NOx or

$NH_3$ (kg N/kg N) is assumed 0.2 as proposed by the IPCC guidelines as default. The fraction of N input converted to $N_2O$ (EF1) is assumed 0.0125 kg $N_2O$-N/kg nitrogen input, as proposed by the IPCC guidelines. The total nitrogen excretion by animals in country (Nex) and the manure nitrogen used as fertiliser in Cyprus, corrected for $NH_3$ and NOx emissions and excluding manure produced during grazing ($F_{AW}$) are presented in Table 5.20.

Due to changes in the animal population, caused by a recommendation of the ERT during the review of the 2016 submission, total nitrogen excretion by animals in country and manure nitrogen used as fertiliser have been revised, leading to revision of the emissions' estimated.

**Table 5.20. Total nitrogen excretion by animals in country (Gg N) and manure nitrogen used as fertiliser, corrected for $NH_3$ and NOx emissions and excluding manure produced during grazing (Gg N/yr) 1990-2014**

| **Year** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** |
|---|---|---|---|---|---|---|---|
| Total nitrogen excretion by animals in country (Nex), Gg N | 17.8 | 17.8 | 18.6 | 19.7 | 19.6 | 20.3 | 21.2 |
| Manure nitrogen used as fertiliser*($F_{AW}$), Gg N/yr | 14.2 | 14.3 | 14.9 | 15.7 | 15.7 | 16.3 | 17.0 |

| **Year** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** |
|---|---|---|---|---|---|---|---|
| Total nitrogen excretion by animals in country (Nex), Gg N | 22.2 | 22.3 | 22.3 | 23.1 | 25.1 | 26.5 | 25.2 |
| Manure nitrogen used as fertiliser*($F_{AW}$), Gg N/yr | 17.7 | 17.8 | 17.8 | 18.5 | 20.1 | 21.2 | 20.2 |

| **Year** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
|---|---|---|---|---|---|---|---|
| Total nitrogen excretion by animals in country (Nex), Gg N | 24.2 | 22.4 | 22.3 | 23.3 | 21.8 | 21.3 | 22.2 |
| Manure nitrogen used as fertiliser*($F_{AW}$), Gg N/yr | 19.3 | 17.9 | 17.9 | 18.6 | 17.5 | 17.1 | 17.8 |

| **Year** | **2011** | **2012** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|
| Total nitrogen excretion by animals in country (Nex), Gg N | 21.9 | 20.7 | 19.1 | 19.2 | 18.9 |
| Manure nitrogen used as fertiliser*($F_{AW}$), Gg N/yr | 17.5 | 16.6 | 15.3 | 15.3 | 15.1 |

* corrected for $NH_3$ and NOx emissions and excluding manure produced during grazing

Sewage sludge applied to soils (3D1.2b)

$N_2O$ emissions from sewage sludge on land were estimated using Tier 1a methodology suggested by the IPCC Good Practice Guidance. The treated sewage sludge applied to land data was obtained from the national statistics and the relevant reports from the Department of Environment[21]. Data was available for all wastewater treatment plants for the years 2004 and 2005. Data for the public waste water treatment plants was available for 2004-2012. All data was available in tonnes of dry matter. The sewage sludge used in agriculture during 1990-2003 and 2006-2014, was estimated using (a) the ratio of the public treatment plants compared to all treatment plants for 2004 and 2005 and (b) the percentage of the population

[21]Perikenti, S. 2011&2013. Questionnaire according to Commission Decision 94/741/EC for the report of the Member States on the transposition and implementation of Directive 86/278/EEC on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture, amended by Directive 91/692/EEC. Department of Environment

served by a sewer system data for 1997 to 2004. The resulting data is presented in Table 5.20. Nitrogen content per kg dry sludge was assumed 3% for all years and was obtained from S. Perikenti[22]. The resulting nitrogen in sewage sludge applied on land is presented in Table 5.21. The fraction of N input converted to $N_2O$ (EF6) is assumed 0.01 kg $N_2O$-N/kg sewage-N produced, as proposed by the IPCC guidelines.

**Table 5.21. Dry sludge applied to soils and nitrogen in sewage sludge in t**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| Dry sludge (t) | 97 | 97 | 97 | 97 | 492 | 887 | 1281 | 2082 | 2082 |
| Nitrogen in sewage sludge (t) | 2.9 | 2.9 | 2.9 | 2.9 | 14.8 | 26.6 | 38.4 | 62.5 | 62.5 |

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| Dry sludge (t) | 2242 | 2563 | 2883 | 3684 | 4485 | 6372 | 5459 | 6074 | 6339 |
| Nitrogen in sewage sludge (t) | 67.3 | 76.9 | 86.5 | 110.5 | 134.5 | 191.2 | 163.8 | 182.2 | 190.2 |

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Dry sludge (t) | 6303 | 7003 | 5778 | 5620 | 5454 | 5454 | 5454 | 5454 |
| Nitrogen in sewage sludge (t) | 189.1 | 210.1 | 173.3 | 168.6 | 163.6 | 163.6 | 163.6 | 163.6 |

Crop residues (3D1.4)

$N_2O$ emissions from crop residues were estimated using Tier 1 methodology suggested by the IPCC Guidelines. Emission factor (EF1 (kgN2O-N/kg N)) is assumed 0.01, as proposed by the IPCC 2006 guidelines (Table 11.1, pg.11.11, volume 4, 2006 IPCC guidelines). Changes in N2O emissions have occurred due to changes (a) in crop production data by crop and (b) in cultivated area data by crop both taken by Eurostat. Irregular time series have been caused by environmental conditions (the type of cultivation and areas cultivated are affected to a great extent by the weather conditions).

**Table 5.22. N input from application of crop residues for the period (in kt) 1990-2015**

| Year | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| Crop residues (kt) | 9.3 | 6.2 | 14.7 | 16.5 | 13.0 | 12.7 | 12.6 | 4.6 | 6.5 |

| Year | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| Crop residues (kt) | 11.3 | 5.0 | 11.1 | 12.6 | 14.2 | 10.2 | 7.3 | 6.8 | 6.9 |

| Year | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Crop residues (kt) | 6.5 | 6.1 | 6.6 | 7.4 | 7.2 | 5.7 | 2.1 | 8.8 |

### Indirect Soil Emissions (3D2)

Indirect $N_2O$ emissions from agricultural soils are caused by:

- Atmospheric deposition: Volatilisation of nitrogen included in synthetic fertilisers, animal manure (used as fertilizer) and sewage sludge (used also as fertilizer) as NOx and NH3, followed by atmospheric deposition as NOx, NO3 and $NH_4$+ on soils and surface waters and subsequent N2O formation.
- Leaching: leaching and runoff of nitrogen contained in applied fertilisers (synthetic, animal manure and sewage sludge).

For both sources, the Tier 1 methodology suggested by IPCC Guidelines was applied.

[22]Environment Officer responsible for sewage treatment plants, email dated 18/10/2013

Atmospheric deposition

Emissions from atmospheric deposition were estimated using data for synthetic fertiliser N applied to soils. The Fraction of Synthetic Fertiliser N Applied that Volatilises ($Frac_{GASF}$) is the default value according to the IPCC guidelines (0.1 kgN/kgN, table 11.3, pg.11.24, vol.4, IPCC 2006). The resulting total N volatilised is presented in Table 5.23. It was used the default emission factor proposed by the IPCC guidelines.

**Table 5.23. Total Nitrogen volatilised (Gg N/year)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| Total Nitrogen volatilised (Gg N/year) | 1.2 | 1.2 | 1.5 | 1.6 | 1.4 | 2.1 | 1.4 | 1.1 | 1.1 |

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| Total Nitrogen volatilised (Gg N/year) | 1.2 | 1.1 | 1.2 | 1.1 | 1.1 | 1.1 | 0.9 | 1.1 | 0.8 |

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Total Nitrogen volatilised (Gg N/year) | 0.7 | 087 | 0.9 | 0.7 | 0.8 | 0.7 | 0.7 | 0.8 |

Nitrogen Leaching and runoff

Emissions from atmospheric deposition were estimated using data for synthetic fertiliser N applied to soils. The Fraction of nitrogen leached and runoff ($Fr_{LEACH}$) used is 0.3 and the default value according to the IPCC guidelines (table 11.3, pg.11.24, vol.4, IPCC2006). The resulting total N leached is presented in Table 5.24. A recalculation only for year 2015 has been performed due to the fact that organic N fertilizers were not considered as a source of indirect N2O emissions from managed soils.

**Table 5.24. Total Nitrogen leached and runoff (Gg N/year)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| Total Nitrogen leached and runoff (Gg N/year) | 4.0 | 3.8 | 4.9 | 5.4 | 4.7 | 6.5 | 4.5 | 3.5 | 4.6 |

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| Total Nitrogen leached and runoff (Gg N/year) | 3.8 | 3.3 | 4.0 | 3.6 | 3.8 | 3.5 | 2.8 | 3.6 | 2.7 |

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Total Nitrogen leached and runoff (Gg N/year) | 2.4 | 2.5 | 3.0 | 2.4 | 2.7 | 2.3 | 2.1 | 6.2 |

### 5.5.3. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

### 5.5.4. Source-specific QA/QC and verification

QA/QC and verification activities are presented in Section 1.6.

### 5.5.5. Source-specific recalculations

The changes in this submission compared to previous submissions concern changes caused (a) by changes in crop production data by crop and in cultivated area data by crop both taken by Eurostat, (b) changes that have been caused by changes in data source (Department of Agriculture[23]) regarding the annual amount of synthetic fertiliser N applies to soils and (c) caused by recalculation only for year 2015 has been performed due to the fact that organic N fertilizers were not considered as a source of indirect N2O emissions from managed soils.

### 5.5.6. Source-specific planned improvements

There are no planned improvements for this source.

## 5.6. Prescribed burning of savannahs (CRF source category 3E)

Not occurring.

## 5.7. Field burning of agricultural residues (CRF source category 3F)

### 5.7.1. Source category description

The generation of crop residues is a result of the farming practices used. Disposal practices for residues include ploughing them back into the ground, composting, landfilling and burning on-site. Burning of agricultural residues is responsible for emissions of $CH_4$, $N_2O$, CO and NOx.

$CH_4$ and $N_2O$ emissions from field burning of agricultural residues in 2015 accounted for 0.02% of total GHG emissions from Agriculture and for 0.001% of total national emissions (without LULUCF). Total emissions from field burning of agricultural residues for the period 1990-2015 are presented in Table 5.25.

The emissions have been calculated based on the 2006 IPCC guidelines.

**Table 5.25. Total emissions from Field burning of agricultural residues (3F) 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| $CH_4$ (kt) | 0.0138 | 0.0079 | 0.0111 | 0.0071 | 0.0082 | 0.0075 | 0.0066 | 0.0129 |
| $N_2O$ (kt) | 0.00036 | 0.0002 | 0.00029 | 0.00018 | 0.00021 | 0.00019 | 0.00017 | 0.00034 |
| Total ($CO_2$ eq) | 0.45 | 0.26 | 0.36 | 0.23 | 0.27 | 0.24 | 0.22 | 0.42 |

[23] Mr. George Theophanous, T. +357 22464028, gtheophanous@da.moa.gov.cy

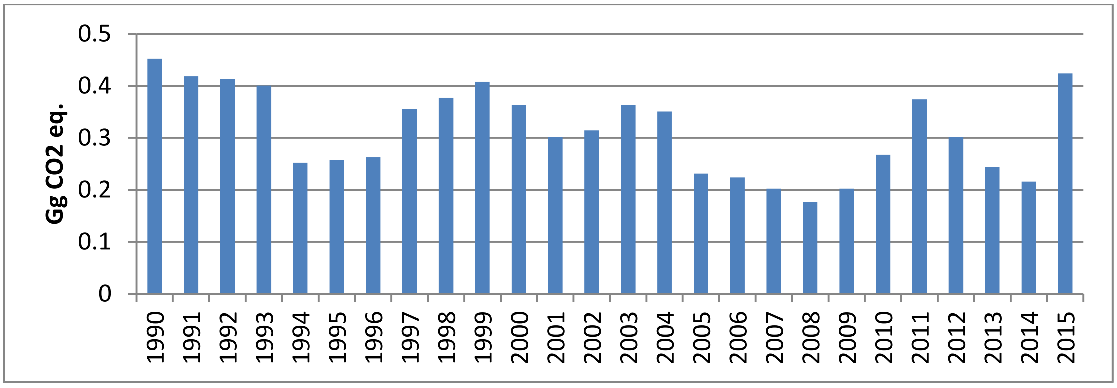


**Figure 5.7. Emissions from Field burning of agricultural residues (3F) 1990-2015**

### 5.7.2. Methodological issues

Emissions were estimated only for wheat because there is no carbon fraction available for the other crops in the IPCC 2006 guidelines. Carbon fraction for wheat is assumed 0.9 (table 2.6, pg.2.49, vol.4, IPCC2006) and dry matter 0.89 (table 11.2, pg.11.17, vol.4, IPCC2006).

Crop production and cultivated area are presented in Table 5.26. Any changes to the activity data are indicated with red. The fraction of crop residue that is burned (FracBURN) used (Table 5.27) is the default proposed by the IPCC guidelines as follows: the fraction used was the 0.25 which is proposed for the developing countries in 1990 and linearly decreased to 0.1 in 2008 which the value proposed for the developed countries. After 2008 it was maintained constant at 0.1. There are no supporting documents to support this choice, only the fact that in 1990 it was a widespread practice to burn crop residues, which was banned by law in 2003. Fraction oxidised is assumed 0.9 as proposed by the IPCC guidelines.

**Table 5.26. Crop production (t) and cultivated area (ha) for wheat 1990-2015**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| Crop production (t) | 10400 | 5600 | 10500 | 11700 | 8000 | 12297 | 13000 |
| Cultivated area (ha) | 98000 | 59500 | 171000 | 193000 | 154000 | 133818 | 128000 |

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| Crop production (t) | 11500 | 11500 | 14000 | 10000 | 10500 | 12900 | 14280 |
| Cultivated area (ha) | 5250 | 5800 | 6600 | 6150 | 5400 | 5900 | 7225 |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| Crop production (t) | 9930 | 9249 | 7520 | 10712 | 24720 | 14690 | 18890 |
| Cultivated area (ha) | 7450 | 5264 | 5389 | 5287 | 4990 | 5761 | 7560 |

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| Crop production (t) | 23740 | 22923 | 15180 | 4440 | 35360 |
| Cultivated | 10590 | 8550 | 6920 | 6140 | 11970 |

| area (ha) | | | | | |
|---|---|---|---|---|---|

**Table 5.27. Crop residue that is burned (FracBURN)**

| Year | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| FracBURN | 0.25 | 0.24 | 0.23 | 0.23 | 0.22 | 0.21 | 0.20 | 0.19 | 0.18 |

| Year | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| FracBURN | 0.18 | 0.17 | 0.16 | 0.15 | 0.14 | 0.13 | 0.13 | 0.12 | 0.11 |

| Year | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| FracBURN | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |

### 5.7.3. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

### 5.7.4. Source-specific QA/QC and verification

QA/QC and verification activities are presented in Section 1.6.

### 5.7.5. Source-specific recalculations

The changes have been caused by changes in crop production data by crop (year 2014) both taken by Eurostat.

### 5.7.6. Source-specific planned improvements

There are no planned improvements for this source.

## 5.8. Liming (CRF source category 3G)

Not occurring.

## 5.9. Urea Application (CRF source category 3H)

### 5.9.1. Source category description

Adding urea to soils during fertilisation leads to a loss of CO2 that was fixed in the industrial production process. This source category is included because the CO2 removal from the atmosphere during urea manufacturing is estimated in the Industrial Process Sector. It has been assumed that CO2 emissions form urea fertilisation caused by sales. Emissions from urea fertilisation for the period 1990 – 2015 are presented in Table 5.28 and in Figure 5.8. Irregular time series have been caused by environmental conditions (the cultivation of specific species for which urea is used and how this is affected by weather conditions).

**Table 5.28. Emissions from urea fertilisation for the period 1990 – 2015**

| Year | 1990 | 1995 | 2000 | 2005 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ (kt) | 1.82 | 1.54 | 1.67 | 0.97 | 0.74 | 0.91 | 0.55 | 0.79 | 0.41 | 0.40 |

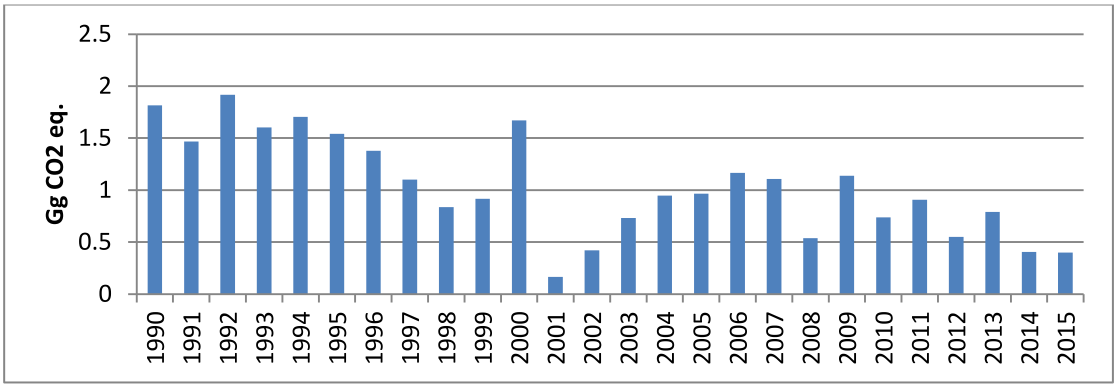


**Figure 5.8. Emissions from urea fertilisation for the period 1990 – 2015**

### 5.9.2. Methodological issues

$CO_2$ emissions from Urea fertilisation were estimated using T1, methodology suggested by the 2006 IPCC Guidelines. Emission factor (EF (tC/t urea)) is assumed 0.2, as proposed by the 2006 IPCC Guidelines (page 11.34, volume 4). Urea fertilisation data is presented in Table 5.29.

**Table 5.29. Urea Fertilisation data (1990-2015)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| Urea applied to soils (t) | 2475 | 2000 | 2615 | 2185 | 2323 | 2101 | 1879 | 1502 | 1140 |

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| Urea applied to soils (t) | 1250 | 2280 | 227 | 572 | 997 | 1291 | 1318 | 1590 | 1508 |

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Urea applied to soils (t) | 732 | 1553 | 1006 | 1239 | 748 | 1078 | 555 | 543 |

### 5.9.3. Source-specific recalculations

No Recalculations have been made.

## 5.10. Other Carbon – containing Fertilizers (CRF source category 3I)

Not occurring.

# Chapter 6: Land use, land-use change and forestry (CRF sector 4)

## 6.1. Overview of sector

The LULUCF sector differs from the other sectors in that it contains both sources and sinks of carbon dioxide. Removals are reported as negative figures and emissions are reported as positive figures according to the guidelines. $CO_2$ is the main greenhouse gas emitted and removed to/ from the atmosphere following carbon stocks changes in different carbon pools.Non-$CO_2$ greenhouse gases ($CH_4$ and $N_2O$) and indirect GHG ($NO_X$ and CO) are released in relatively small quantities when biomass is burnt.

LULUCF sector is the most incomplete sector of the national GHG inventory of Cyprus. The system for the collection of data is not yet fully completed to collect the necessary activity data for the complete reporting of emissions. Therefore, the only emissions reported for LULUCF by Cyprus are the removals from Forest Land remaining Forest including biomass burning from wildfire. Emissions/ removals from the Forest Land category are the result of the balance mainly in biomass increment from forest growth and biomass loss due to felling and wildfires.

The system for the estimation of emissions from LULUCF has been in development since the summer of 2013. Between July 2013 and January 2014, two meetings have taken place with all the involved governmental Departments and several meetings with specific Departments such as the Department of Forests. In January 2014 a meeting has also taken place in Ispra with experts from the JRC to assist Cyprus in the preparation of the GHG inventory for the LULUCF sector. Two more bilateral meetings with JRC experts took place at Arona in May 2014 and May 2015.

During this period several data sets have been collected, assessed and compared regarding land uses in Cyprus. The proposal of the LULUCF inventory expert which was agreed by all the involved Departments was to use the available information from the CORINE Land Cover Maps that are prepared from the nature protection sector of the Department of the Environment. CORINE Land Cover (CLC) is a map of the European environmental landscape based on interpretation of satellite images. It provides comparable digital maps of land cover for each country for much of Europe. CORINE stands for Coordination of Information on the Environment.

Currently, there are three such maps available for Cyprus for the years 2000, 2006, and 2012. The CORINE categories were correlated to the LULUCF IPCC categories to get to land remaining in the same land category for years 2000, 2006, and 2012. Then, it was assumed that land change was linear over time and the land areas were extrapolated back to 1990 and forward to 2014.

The final results for **Land remaining in the Same Land Category** are presented below (Table 6.1) and the areas are shown in percentages in order to get a more complete picture of land use in Cyprus. In respect to previous NIR submissions, the CLC324 category, transitional woodland/ shrub, was allocated to Coniferous Forest instead of Woody Grassland, since this category represents land that is only transitionally covered by shrubs, but will eventually become forest land. In this way, the total forest area is more closely correlated with the Cyprus FRA 2015 data.

It should be noted that **the information presented for land areas below (LULUCF categories) is for the whole of the country and not only the areas under the effective control of the Republic of Cyprus.** Nevertheless, emissions were calculated only for the government controlled areas, in order to be able to have comparable results with the rest of the inventory.

**Table 6.1. Land remaining in the Same Land Category**

| LULUCF Category | 1990 | 1995 | 2000 | 2005 | 2010 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|
| Forest | 20.24% | 20.49% | 20.74% | 20.99% | 21.05% | 21.05% | 21.05% |
| Cropland | 48.79% | 48.58% | 48.36% | 48.15% | 47.96% | 47.81% | 47.77% |
| Grassland | 23.98% | 23.10% | 22.23% | 21.35% | 21.14% | 21.11% | 21.10% |
| Wetland | 0.35% | 0.39% | 0.43% | 0.48% | 0.50% | 0.50% | 0.50% |
| Settlements | 5.51% | 6.46% | 7.40% | 8.35% | 8.71% | 8.88% | 8.92% |
| Other land | 1.14% | 0.98% | 0.83% | 0.68% | 0.65% | 0.65% | 0.65% |
| Total | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |

## 6.2. Emission trends

The emissions from LULUCF changed from about -100 Gg CO2 eq. in 1990 to -168 Gg CO2 in 2015. Overall the trend is one of increased removals from the LULUCF sector, with the exception of peaks in emissions in years with increased wildfires. The emissions from LULUCF are presented in Table 6.2 and Figure 6.1.

**Table 6.2 Total GHG removals/ emissions (in Gg CO2 eq) from LULUCF for the period 1990 – 2015**

| Gg $CO_2$ eq. | 1990 | 1995 | 2000 | 2005 | 2010 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|
| $CO_2$ | -100.3928 | -126.6206 | -83,1295 | -179,4778 | -167,2647 | -173,6279 | -168.2517 |
| $CH_4$ | 0.0017 | 0.0131 | 0,2282 | 0,0061 | 0,0297 | 0,0097 | 0.0034 |
| $N_2O$ | 0.0001 | 0.0007 | 0,0126 | 0,0003 | 0,0016 | 0,0005 | 0.0002 |
| **Total** | **-100.3235** | **-126.0788** | **-73,6617** | **-179,2231** | **-166,0318** | **-173,2246** | **-168.1071** |

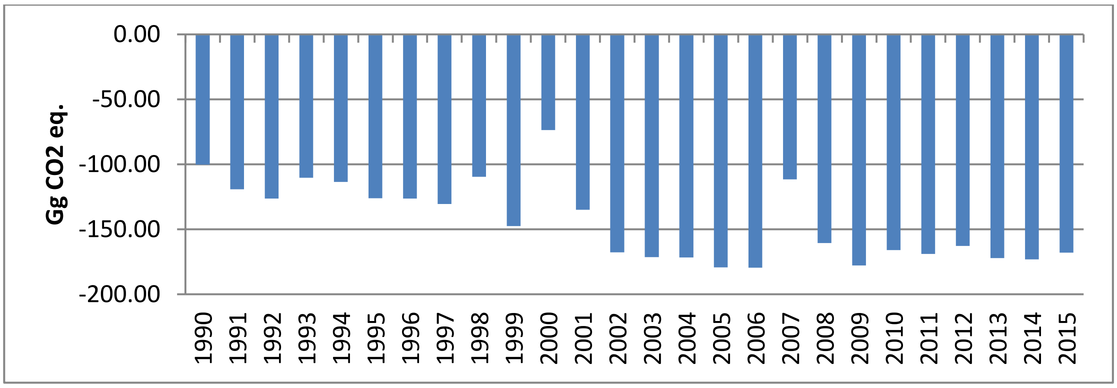

**Figure 6.1. LULUCF emissions 1990-2015**

### 6.2.1. Methodology

Emissions were estimated using the methodologies proposed by the IPCC guidelines. For the emission factors the Tier 2 Biomass Gain-Loss method was used and the activity data was calculated using Approach 1 to determine the land categories (using CORINE 2000, 2006 and 2012). For forest wildfires, emissions were calculated using the official activity data for state and private forests burnt that was provided by the Forest Department.

For the calculations it was preferred to use country-specific emission factors, but for the most part, default values were used. Cyprus is classified in the sub-tropical climate domain, warm temperate dry climate region, and the subtropical dry forest ecological zone, code SCs. Adjustments in the calculations were made following the in- country review of last September from Experts Review Team from UNFCCC.

**Table 6.3. Summary of methodologies**

| | **Method** | **Calculating Steps/ equations** |
|---|---|---|
| Activity data (LULUCF categories) | Approach 1 | Use of CORINE country data |
| Forest Land remaining Forest Land | Tier 2Method: Biomass Gain-Loss method (pg.4.11, vol.4, IPCC2006) | 1. Annual change in carbon stocks in biomass in land remaining in a particular land-use category (gain-loss method)<br>$\Delta CB = \Delta CG - \Delta CL$<br>$\Delta CG = A*GTOTAL*CF$<br>$GTOTAL = GW *(1+R)$<br>$\Delta CL = L_{wood\text{-}removals} + L_{fuelwood} + L_{disturbance}$<br><br>2. Annual carbon in biomass transfer to dead organic matter<br>Tier 1 method assumes that the net carbon stock changes in DOM pools are zero because the simple input and output equations used in Tier 1 methods are not suitable to capture the DOM pool dynamics.Therefore, DOMin = 0<br><br>3. Soil carbon<br><u>Mineral soils</u><br>It is assumed in the Tier 1 method that forest mineral soil C stocks do not change with management.(Tier 1, pg.4.23)<br>Therefore, SOCMineral =0<br><u>Organic soils</u><br>Since Cyprus does not have organic soils, SOCOrganic=0<br><br>4. Non-CO2 greenhouse gas emissions from biomass burning<br>$L_{fire} = A * MB * Cf * Gef * 0,001$ |

### 6.2.2. Completeness

Emissions/removals have been estimated only for Forest Land remaining Forest Land and for Forest Wildfires. The emissions/removals from Harvested Wood Products, Cropland remaining Cropland and Grassland remaining Grassland are in preparation. Since Cyprus was not required to report LULUCF for the first commitment period, there has not been any previous expertise, which led to delays. So far, emphasis has been given on the collection of the activity data.

### 6.2.3. Methodological issues

Approach 1 was used for the determination of land areas for the six (6) categories of LULUCF utilizing data from CORINE for years 2000, 2006 and 2012 alongside with data of CORINE Land Use Change between 2000-2006 and 2006-2012. The trends found were extrapolated backward to 1990 and forward to 2015.

#### 6.2.3.1. Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

The data used to arrive to LULUCF categories was taken from the CORINE Land Area Maps of 2000, 2006 and 2012.Also correlations were drawn from the CORINE Land Change Maps of 2000-2006 and 2006-2012.It was assumed that the land changed linearly between 2000 and 2006 and this was extrapolated back to 1990.Similarly, it was assumed that land changed linearly between 2006 and 2012 and this was extrapolated to 2015.The overall raw data for 2000, 2006 and 2012 is shown in Table 6.3, together with the correspondence to LULUCF categories.

**Table 6.4. CORINE RAW DATA and Correlation of CLC to IPCC categories**

| CLC codes | Level 3 | LULUCF Categories | Sum of AREA for 2000 (ha) | Sum of AREA for 2006 (ha) | Sum of AREA for 2012 (ha) |
|---|---|---|---|---|---|
| **111** | Continuous urban fabric | SL | 567 | 568 | 568 |
| **112** | Discontinuous urban fabric | SL | 41439 | 47770 | 49564 |
| **121** | Industrial or commercial units | SL | 13022 | 14300 | 14773 |
| **122** | Road and rail networks and associated land | SL | 324 | 615 | 682 |
| **123** | Port areas | SL | 432 | 430 | 430 |
| **124** | Airports | SL | 2507 | 2531 | 2614 |
| **131** | Mineral extraction sites | SL | 2824 | 2654 | 2554 |
| **132** | Dump sides | SL | 320 | 311 | 311 |
| **133** | Construction sites | SL | 1181 | 2280 | 1375 |
| **141** | Green urban areas | SL | 1081 | 982 | 997 |
| **142** | Sport and leisure facilities | SL | 4712 | 6443 | 7389 |
| **211** | Non-irrigated arable land | Annual CL | 240522 | 229330 | 228433 |
| **212** | Permanently irrigated land | Annual CL | 19223 | 25466 | 25457 |
| **221** | Vineyards | Woody CL | 14136 | 14032 | 13999 |
| **222** | Fruit trees and berry plantations | Woody CL | 16566 | 17093 | 16983 |
| **223** | Olive groves | Woody CL | 6504 | 7125 | 7125 |
| **231** | Pastures | Grass GL | 1163 | 885 | 885 |
| **241** | Annual crops associated with permanent crops | Annual CL | 33205 | 32274 | 32186 |
| **242** | Complex cultivation | Woody CL | 74112 | 72258 | 71584 |
| **243** | Land principally occupied by agriculture, with significant areas of natural vegetation | Woody CL | 40983 | 46950 | 46745 |
| **311** | Broad leaved forest | Broadleaved Forest | 763 | 608 | 608 |

| CLC codes | Level 3 | LULUCF Categories | Sum of AREA for 2000 (ha) | Sum of AREA for 2006 (ha) | Sum of AREA for 2012 (ha) |
|---|---|---|---|---|---|
| **312** | Coniferous forest | Coniferous Forest | 153449 | 152752 | 153319 |
| **313** | Mixed forest | Coniferous Forest | 357 | 346 | 346 |
| **321** | Natural grassland | Grass GL | 29689 | 26080 | 26025 |
| **323** | Sclerophyllous vegetation | Woody GL | 159738 | 156170 | 154501 |
| **324** | Transitional woodland/shrub | Coniferous Forest | 29797 | 40641 | 39766 |
| **331** | Beaches, dunes and sand plains | OL | 5161 | 4653 | 4653 |
| **332** | Bare rock | OL | 2549 | 1386 | 1378 |
| **333** | Scarcely vegetated areas | Grass GL | 12101 | 12521 | 12214 |
| **334** | Burnt areas | See point 3 below | 11698 | 184 | 2071 |
| **411** | Inland marshes | WL | 520 | 497 | 497 |
| **421** | Salt marshes | WL | 1955 | 1965 | 1965 |
| **511** | Water courses | WL | 0 | 26 | 26 |
| **512** | Water bodies | WL | 1543 | 2018 | 2122 |
| | ***Total land area*=** | | **924145** | **924145** | **924145** |

The assumptions and corrections used are the following:

1. The total land area for 2000 and 2006 was corrected to the area that was found for 2012.
2. All CORINE Land Categories were categorized into IPCC LULUCF categories, as shown above, as Forest Land (Broadleaved and Coniferous), Cropland (Annual and Woody), Grassland (Grass and Woody), Wetland, Settlements Land and Other Land.
3. Mixed forest category was allocated to Coniferous forest which is the most abundant in Cyprus.
4. Burnt areas category was appropriated accordingly using the CORINE Land Change 2000-2006 and the CORINE Land Change 2006-2012 data. At first, for the years 2006 and 2012 the burnt areas were allocated according to what these areas used to be in 2000 and 2006 respectively by getting the percentages from the CLC Change tables and multiplying with the actual burnt area recorded. Then these areas were added to their specific categories as annual cropland, coniferous forest and woody grassland.
5. For 2000, since there is no previous data available, it was checked to see what the burnt areas turned into by 2006.It was found that 14.83% became “land principally occupied by agriculture with significant areas of natural vegetation”, CLC Code 243 (woody cropland) and 85.17% was turned into “transitional woodland/shrub”, CLC Code 324 (coniferous forest). We assume, though, that part of the land that was burnt was also annual cropland and coniferous forest (categories that were also found for burnt land in 2006 and 2012). Therefore, to compensate for our lack of more specific data, the area burnt for 2000 was allocated as follows: 50% of the area burnt was allocated according to what the area was found to be in 2006 and the other 50% was allocated according to the average % for 2006 and 2012 burnt areas Finally, the burnt areas were distributed (added) to the LULUCF categories.

**Table 6.5.** **Burnt areas of 2006 and 2012 categorized for LULUCF according to 2000 and 2006 status respectively**

| | 2006 | 2012 | Average | Level 3 | LULUCF Category |
|---|---|---|---|---|---|
| **CLC Code 211** | 28,04% | 0,00% | 14,02% | Non-irrigated arable land | Annual CL |
| **CLC Code 312** | 35,86% | 18,27% | 27,06% | Coniferous forest | Coniferous F |
| **CLC Code 323** | 15,20% | 77,27% | 46,23% | Sclerophyllous vegetation | Woody GL |
| **CLC Code 324** | 20,90% | 4,46% | 12,68% | Transitional woodland/shrub | Coniferous F |

| | 2006 | 2012 |
|---|---|---|
| **CLC Code 211** | 515408,94 | 0,00 |
| **CLC Code 312** | 659019,17 | 3784294,64 |
| **CLC Code 323** | 279262,54 | 16003440,70 |
| **CLC Code 324** | 384167,49 | 924381,30 |
| ***Total land area in m2:*** | **1837858,14** | **20712116,64** |

**Table 6.6** **Burnt areas of 2000 categorized for LULUCF according to 2006 status taking into account also the categories found for burnt areas in 2006 and 2012**

| | 2000 | | |
|---|---|---|---|
| **Total burnt area in m$^2$** | 116984953 | | |
| **50% of the burnt area in m$^2$** | 58492476.4 | | |
| **Half of the area allocated as:** | % | Area in m$^2$ | LULUCF Category |
| **CLC 243** | 14.83% | 8674293.22 | Woody CL |
| **CLC 324** | 85.17% | 49818183.2 | Coniferous F |
| **The rest half of the area was allocated as:** | | | |
| **CLC 211** | 14.02% | 8201815.04 | Annual CL |
| **CLC 312** | 27.06% | 15830673.42 | Coniferous Forest |
| **CLC 323** | 46.23% | 27041387.82 | Woody GL |
| **CLC 324** | 12.68% | 7418600.117 | Coniferous F |

**Table 6.7.** **Burnt areas of 2000, 2006 and 2012categorized for LULUCF**

| ***End of Year*** | **2000** | **2006** | **2012** |
|---|---|---|---|
| **Coniferous forest** | 7306.75 | 104.32 | 470.87 |
| **Annual cropland** | 820.18 | 51.54 | 0.00 |
| **Woody cropland** | 867.43 | 0.00 | 0.00 |
| **Woody grassland** | 2704.14 | 27.93 | 1600.34 |
| **Total** | 11698.50 | 183.79 | 2071.21 |

6. Having established the LULUCF categories for 2000, 2006 and 2012, it was assumed that land change per year was linear and data was computed for land area in hectares for the years 2000-2006 and 2007-2012 and then extrapolated back to 1990 and forward to 2015. The result is presented in Table 6.8.

**Table 6.8. LULUCF Categories for years 2000, 2006 and 2012**

| ***End of Year*** | **2000** | **2006** | **2012** |
|---|---|---|---|
| **Broadleaved Forest** | 763 | 608 | 608 |
| **Coniferous Forest** | 190910 | 193843 | 193902 |
| **Annual Cropland** | 293771 | 287121 | 286076 |
| **Woody Cropland** | 153168 | 157458 | 156436 |
| **Grass Grassland** | 42953 | 39486 | 39124 |
| **Woody Grassland** | 162442 | 156198 | 156101 |
| **Wetland** | 4019 | 4506 | 4610 |
| **Settlements Land** | 68408 | 78886 | 81257 |
| **Other Land** | 7710 | 6039 | 6031 |
| **Total Land Area (ha)** | **924145** | **924145** | **924145** |

The LULUCF areas in Cyprus (hectares), for the period 1990 – 2015 as these have been estimated through the methodology above are presented in Table 6.9.

**Table 6.9. LULUCF areas remaining in the same land category for the period 1990-2015 (ha)**

| ***End of Year*** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** |
|---|---|---|---|---|---|---|---|
| Broadleaved Forest | 1022 | 996 | 970 | 944 | 918 | 892 | 866 |
| Coniferous Forest | 186020 | 186509 | 186998 | 187487 | 187976 | 188465 | 188954 |
| Annual Cropland | 304854 | 303746 | 302638 | 301529 | 300421 | 299313 | 298204 |
| Woody Cropland | 146019 | 146734 | 147449 | 148164 | 148878 | 149593 | 150308 |
| Grass Grassland | 48732 | 48154 | 47576 | 46998 | 46420 | 45842 | 45264 |
| Woody Grassland | 172850 | 171809 | 170768 | 169728 | 168687 | 167646 | 166605 |
| Wetland | 3208 | 3289 | 3370 | 3451 | 3532 | 3613 | 3695 |
| Settlements Land | 50945 | 52691 | 54438 | 56184 | 57930 | 59677 | 61423 |
| Other Land | 10495 | 10217 | 9938 | 9660 | 9381 | 9103 | 8824 |
| **Total Land Area** | **924145** | **924145** | **924145** | **924145** | **924145** | **924145** | **924145** |

| ***End of Year*** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** |
|---|---|---|---|---|---|---|---|
| Broadleaved Forest | 840 | 815 | 789 | 763 | 737 | 711 | 685 |
| Coniferous Forest | 189443 | 189932 | 190421 | 190910 | 191399 | 191888 | 192377 |
| Annual Cropland | 297096 | 295988 | 294879 | 293771 | 292663 | 291554 | 290446 |
| Woody Cropland | 151023 | 151738 | 152453 | 153168 | 153883 | 154598 | 155313 |
| Grass Grassland | 44687 | 44109 | 43531 | 42953 | 42375 | 41797 | 41219 |
| Woody Grassland | 165565 | 164524 | 163483 | 162442 | 161402 | 160361 | 159320 |
| Wetland | 3776 | 3857 | 3938 | 4019 | 4100 | 4181 | 4262 |
| Settlements Land | 63169 | 64916 | 66662 | 68408 | 70154 | 71901 | 73647 |
| Other Land | 8546 | 8267 | 7989 | 7710 | 7432 | 7153 | 6875 |
| **Total Land Area** | **924145** | **924145** | **924145** | **924145** | **924145** | **924145** | **924145** |

| ***End of Year*** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
|---|---|---|---|---|---|---|---|
| Broadleaved Forest | 659 | 633 | 608 | 608 | 608 | 608 | 608 |
| Coniferous Forest | 192866 | 193355 | 193843 | 193853 | 193863 | 193873 | 193882 |
| Annual Cropland | 289338 | 288229 | 287121 | 286947 | 286773 | 286598 | 286424 |
| Woody Cropland | 156028 | 156743 | 157458 | 157288 | 157117 | 156947 | 156777 |
| Grass Grassland | 40641 | 40063 | 39486 | 39425 | 39365 | 39305 | 39244 |
| Woody Grassland | 158279 | 157239 | 156198 | 156182 | 156166 | 156149 | 156133 |
| Wetland | 4344 | 4425 | 4506 | 4523 | 4541 | 4558 | 4575 |
| Settlements Land | 75393 | 77140 | 78886 | 79281 | 79676 | 80072 | 80467 |
| Other Land | 6596 | 6318 | 6039 | 6038 | 6037 | 6035 | 6034 |
| **Total Land Area** | **924145** | **924145** | **924145** | **924145** | **924145** | **924145** | **924145** |

| *End of Year* | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| Broadleaved Forest | 608 | 608 | 608 | 608 | 608 |
| Coniferous Forest | 193892 | 193902 | 193912 | 193921 | 193931 |
| Annual Cropland | 286250 | 286076 | 285902 | 285727 | 285553 |
| Woody Cropland | 156606 | 156436 | 156266 | 156095 | 155925 |
| Grass Grassland | 39184 | 39124 | 39063 | 39003 | 38943 |
| Woody Grassland | 156117 | 156101 | 156085 | 156069 | 156052 |
| Wetland | 4593 | 4610 | 4627 | 4645 | 4662 |
| Settlements Land | 80862 | 81257 | 81653 | 82048 | 82443 |
| Other Land | 6033 | 6031 | 6030 | 6029 | 6027 |
| **Total Land Area** | **924145** | **924145** | **924145** | **924145** | **924145** |

### 6.2.4. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

### 6.2.5. Source-specific QA / QC and verification

QA/QC and verification activities are presented in Section 1.6.

### 6.2.6. Source-specific recalculations

No recalculations took place in regards to land areas compared to last submission. Minor recalculations took place regarding emissions from losses for Forest Land remaining Forest Land. The data for estimated salvage logging was given as the average of 5-year cycles, i.e. 1990-1994, 1995-1999, 2000-2004, 2005-2009, 2010-2014. In summary these are as follows (Table 6.10).

**Table 6.10. Changes in emissions caused by recalculations**

| Emissions for LULUCF - Gg CO2 eq. | 1990 | 1995 | 2000 | 2005 | 2010 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|
| **Last submission** | -97.30 | -119.03 | -73.66 | -179.22 | -166.03 | -173.22 | ---------- |
| **Current submission** | -100.32 | -126.08 | -73.66 | -179.22 | -166.03 | -173.22 | -168.10 |
| **% change** | 3.1% | 5.9% | 0% | 0% | 0% | 0% | -------- |

## 6.3. Forest Land (CRF source 4A)

The relevant carbon pools and non-$CO_2$ gases are biomass (above-ground and below-ground), dead organic matter (dead wood and litter), soil organic matter and the following non-$CO_2$ gases ($CH_4$, CO, $N_2O$, $NO_X$).The IPCC Guidelines provide methods for the estimation and reporting of sources and sinks of greenhouse gases only from managed forests. National definitions should cover all forests subject to human intervention, including the full range of management practices from protecting forests, raising plantations, promoting natural regeneration, commercial timber production, non-commercial fuel-wood extraction and abandonment of managed land. In Cyprus, all forests are considered (state and private) as subject to human intervention, and consequently, all land that may be considered forest by the national definition of forest, is thus considered as managed. Therefore, all forested land is accounted for under Forest Land remaining Forest Land.

### 6.3.1. Source category description

Emissions have been estimated for Forest Land remaining Forest Land. Land converted to Forest Land was included in the category Forest Land remaining Forest Land. Firstly, the carbon stock change emissions were calculated (Table 6.13) for all managed forests. As illustrated in Figure 6.2, there is an increasing trend of net removals by forests. Following the recommendation by Experts Review Team of UNFCCC, emissions were calculated only for the areas under the effective control of the Republic of Cyprus (managed). The areas for Broadleaved Forest and Coniferous Forest were calculated using the CORINE land cover maps of 2000, 2006 and 2012 and were found to be as follows (Table 6.11).

**Table 6.11. Forest areas (managed)**

| Government Controlled Area | 1990 | 1995 | 2000 | 2005 | 2010 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|
| Broadleaved Forest | 1022 | 892 | 763 | 633 | 608 | 608 | 608 |
| Coniferous Forest | 157109 | 157451 | 157793 | 158135 | 158236 | 158268 | 158276 |
| **Total Land Area (ha)** | **158131** | **158344** | **158556** | **158769** | **158843** | **158875** | **158883** |

The gain-loss method was used to calculate emissions. In relation to the annual biomass growth per unit area, Gw for conifers was recalculated following the advice of the Experts Revision Team, who evaluated Cyprus´s NIR2016 during 12-17 September 2016, using the average annual increment, Iv, of ***Pinus brutia*** of years 2000-2014 from data provided by the Forest Department multiplied by the BCEFI of ***Pinus brutia*** found in Turkey, as published in a Research Article by D. TOLUNAY, titled “Total carbon stocks and carbon accumulation in living tree biomass in forest ecosystems of Turkey”, 16.09.20009. Average Iv was found to be equal to **0.8444** and the BCEFI value used was 0.645, thus Gw for conifers was calculated to be **0.5446**.

For broadleaves the average annual increment, Iv, of **2.0** was used after consultation with the Department of Forests which is an estimation and for BCEFI the default value of **0.550**, (Hardwoods, pg. 4.51, table 4.5, Mediterranean dry tropical, subtropical, growing stock level: 41-100 m3). Thus Gw for Broadleaves was calculated to be 1.1 tdm/ha/year.

In relation to the default values for root-to-shoot ratio, R, and for the fraction of carbon in dry matter, CF, the recommendations of the ERT were adopted and these were changed to 0.28 and 0.47 respectively.

In order to calculate losses, data from the Department of Forests was used. Calculations were made in order to account for salvage logging after fires. Losses were calculated separately for Broadleaved Forest and Conifers and further subdivided into roundwood and fuelwood. It was assumed that all fuelwood was gathered as whole trees. For the calculations, equations 2.12 and 2.13, page 2.17, vol.4, IPCC2006 were used respectively. The default values that were used were: BCEFR for conifers, 0.67 and for broadleaves, 0.89. Root to shoot ratio remained 0.28 and CF 0.47.

**Table 6.12. Roundwood and fuelwood harvest in Cyprus**

| State Forests Harvest (m3) | 1990 | 1995 | 2000 | 2005 | 2010 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|
| Roundwood + Fuelwood | 62847 | 47827 | 25137 | 11835 | 11176 | 10964 | 13186 |
| Fuelwood | 14913 | 11242 | 6639 | 4738 | 4522 | 6003 | 9315 |
| Roundwood | 47934 | 36585 | 18498 | 7097 | 6654 | 4961 | 3871 |
| Estimated salvage logging, roundwood | 725 | 2289 | 1196 | 1644 | 480 | 480 | 1 |
| Estimated salvage logging, fuelwood | 1667 | 5264 | 2795 | 3837 | 1228 | 1228 | 40 |
| Net roundwood harvest | 47209 | 34296 | 17302 | 5453 | 6174 | 4481 | 3871 |
| Net fuelwood harvest | 13246 | 5978 | 3844 | 901 | 3294 | 4775 | 9275 |
| Broadleaved Harvest | 1934 | 1934 | 1934 | 1934 | 895 | 2100 | 2306 |
| Coniferous Harvest | 60913 | 45893 | 23203 | 9901 | 10281 | 8864 | 10880 |
| Ratio, Broadleaved: Coniferous | 0.032 | 0.042 | 0.083 | 0.195 | 0.087 | 0.237 | 0.212 |
| Estimated broadleaved roundwood harvest | 1499 | 1445 | 1442 | 1065 | 537 | 1062 | 820 |
| Estimated conifer roundwood harvest | 45710 | 32851 | 15859 | 4388 | 5636 | 3419 | 3050 |
| Estimated broadleaved fuelwood harvest | 421 | 252 | 320 | 176 | 287 | 1131 | 1966 |
| Estimated conifer fuelwood harvest | 12825 | 5726 | 3524 | 725 | 3007 | 3644 | 7309 |

**Table 6.13. Forest Land Remaining Forest Land/Carbon stock change emissions 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|
| Net emissions/ removals CO2 (Gg) | -100.32 | -126.08 | -73.66 | -179.22 | -166.03 | -173.22 | -168.10 |

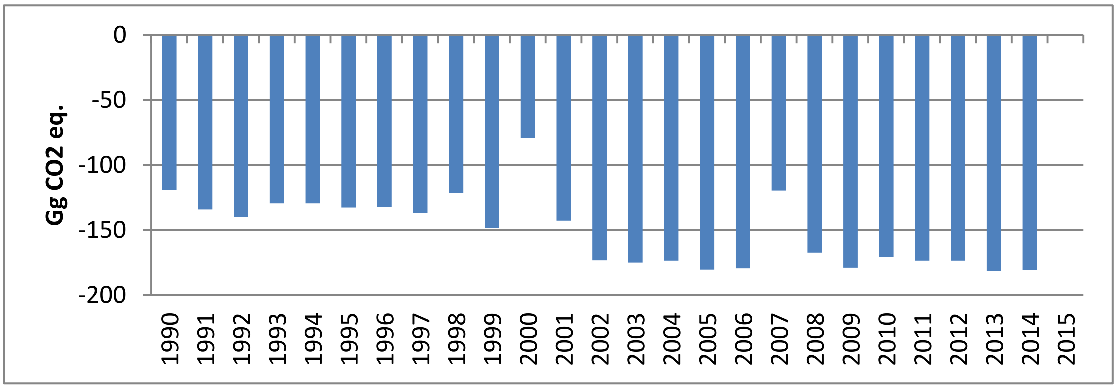


**Figure 6.2. Forest Land Remaining Forest Land/Carbon stock change emissions 1990-2015**

On the other hand, emissions from Wildfires (Table 6.14) vary greatly from year to year as the land burnt may be as little as close to 6 ha in 1999 and as high as 2141 ha in 2000.

**Table 6.14. Forest Land Remaining Forest Land- Biomass Burning/Wildfires emissions 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|
| CO2 (t) | 557.5 | 4359.6 | 76187.3 | 2049.7 | 9921.1 | 3245.3 | 1120.9 |
| CH4 (t) | 1.7 | 13.1 | 228.2 | 6.1 | 29.7 | 9.7 | 3.4 |
| N2O (t) | 0.1 | 0.7 | 12.6 | 0.3 | 1.6 | 0.5 | 0.2 |
| Total (Gg CO2 eq.) | 626.8 | 4901.4 | 85655.1 | 2304.4 | 11154.0 | 3648.6 | 1260.2 |

Table 6.15 shows the great variations of burnt forest area from year to year. The figures were provided by the Forest Department and show total forest area burnt (stare and private) since 2000.The data between1990-1999 did not include private forests and this was adjusted by multiplying with the ratio of state to private forests, which is 1.76.

**Table 6.15. Forest area burnt (ha)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| Forest area burnt (ha) | 15.7 | 47.9 | 15.3 | 121.8 | 313.5 | 122.5 | 204.4 | 293.4 | 997.0 |

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| Forest area burnt (ha) | 6.0 | 2141.0 | 713.6 | 20.6 | 89.1 | 171.6 | 57.6 | 140.3 | 1302.8 |

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | |
|---|---|---|---|---|---|---|---|---|---|
| Forest area burnt (ha) | 45.5 | 73.4 | 278.8 | 226.8 | 246.6 | 83.6 | 91.2 | 31.5 | |

As illustrated in Figure 6.3 emissions in wildfires can have a significant effect on total LULUCF emissions/removals. Thus, forest protection measures against fires are of utmost importance for Cyprus.

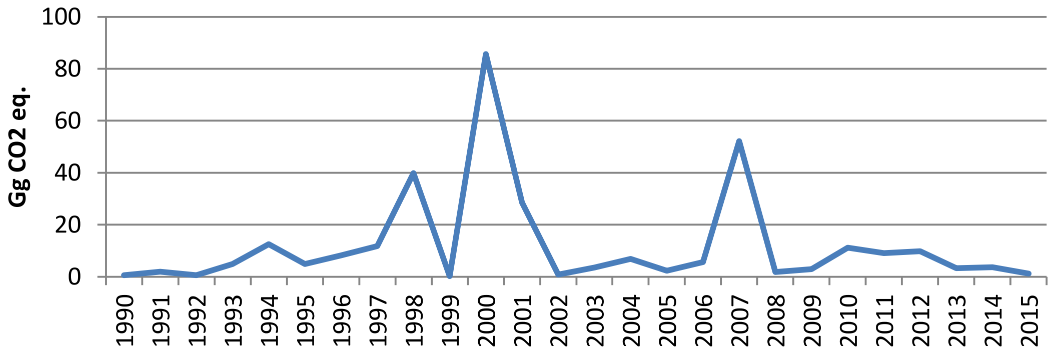


**Figure 6.3. Forest Land Remaining Forest Land/Carbon stock change emissions 1990-2015**

## 6.4. Sector-specific planned improvements

The main issues that need to be addressed in 2017 and be ready for the 2018 submission are the following:

(a) Determination of Land Change in Other Land Categories

(b) Complete Land Matrices for years 1990 to 2016
(c) Calculation of Emissions for Cropland remaining Cropland, Grassland remaining Grassland and Harvested Wood Products
(d) Collection of the necessary information to apply the IPCC 2006 and GPG for completion of KP LULUCF tables and reporting of Forest Management, Afforestation/Reforestation and Deforestation. We are currently in the process of obtaining satellite images of Cyprus from other departments. Processing of these images will allow us to get more complete and precise information regarding land use, which will include information on the geographical location of the boundaries of the areas that encompass: (1) units of land subject to afforestation, reforestation, deforestation and forest management; (2) units of land of afforestation, reforestation, and deforestation that would otherwise be included in land subject to forest management; and (3) land subject to forest management in the second commitment period.
(e) Revision/ completion of CRF tables
(f) Improve the completeness of the NIR in order to determine whether LULUCF is a net source for Cyprus.
(g) Recalculate the estimates of the background level following the recommendations of the ERT

# Chapter 7: Waste (CRF sector 5)

## 7.1. Overview of sector

Disposal and treatment of industrial and municipal wastes can produce emissions of GHG. Solid wastes can be disposed of through landfilling, recycling, incineration or waste-to-energy. Incineration and waste-to-energy technologies are not implemented for the management of municipal solid waste in Cyprus. This chapter will deal with $CH_4$ and $N_2O$ emissions resulting from solid waste disposal, biological treatment of solid waste and wastewater treatment and discharge. The most important gas produced in this source category is methane (CH4). Emissions from incineration and open burning of waste are reported as NO as no incineration takes place in Cyprus.

### 7.1.1. Emissions trends

Emissions from the Waste Sector in 2015 contributed 6% of the total emissions without LULUCF. In 2015, 89% of the emissions is from solid waste disposal, 1.5% from biological treatment of solid waste and 9.5% from waste water treatment and discharge. 57% of the total methane emissions and 6.2% of the nitrous oxide emissions of the country are from the sector of waste. The emissions from waste have changed considerably between 1990 and 2015 due to changes that are taking place in the waste and wastewater management practices of the country. Recycling and composting have been reducing the amount of waste disposal on land since 2010. The emissions from industrial wastewater have increased since there is an increase in the amount of waste treated by anaerobic digestion.

**Table 7.1. Total GHG emissions (in Gg CO2 eq) from waste for the period 1990-2015**

| Gg CO2 eq | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| CH4 | 372.75 | 412.25 | 445.5 | 471.5 | 483 | 492.75 | 494.25 | 495.5 |
| N2O | 11.92 | 14.30 | 14.54 | 14.24 | 16.96 | 17.87 | 18.37 | 19.37 |
| Total | 385.06 | 426.63 | 460.00 | 485.78 | 499.98 | 510.68 | 512.62 | 514.94 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5A. Solid Waste Disposal | 258.34 | 284.39 | 319.38 | 359.91 | 407.48 | 441.24 | 450.25 | 458.32 |
| 5B. Biological Treatment of Solid Waste | NO | NO | NO | NO | 1.36 | 3.37 | 5.07 | 7.52 |
| 5D. Wastewater Treatment and Discharge | 126.72 | 142.24 | 140.62 | 125.88 | 91.15 | 66.07 | 57.31 | 49.09 |

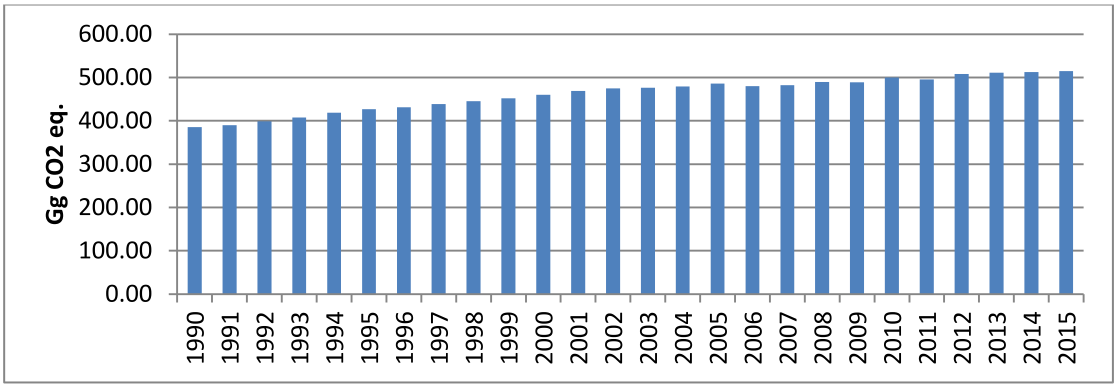


**Figure 7.1. GHG emissions from waste for the period 1990-2015**

### 7.1.2. Methodology

The calculation of GHG emissions from Waste is based on the methodologies and emission factors suggested by the IPCC Guidelines. Data used for the estimation of the emissions was obtained from the National Statistical Service. Tier 2 method with default IPCC 2006 emission factors and parameters is implemented for Solid Waste Disposal and Tier 1 for Biological Treatment of Solid Waste (5B) and Wastewater Treatment and Discharge (5D). The methodologies and emission factors used are summarised in Table 7.2.

**Table 7.2. Waste– methodologies and emission factors applied**

| | $CO_2$ | | $CH_4$ | | $N_2O$ | |
|---|---|---|---|---|---|---|
| | **Method** | **EF** | **Method** | **EF** | **Method** | **EF** |
| 5A. Solid Waste Disposal | NA | NA | T2 | D | | |
| 5B. Biological Treatment of Solid Waste | | | T1 | D | T1 | D |
| 5D. Wastewater Treatment and Discharge | | | T1 | D | T1, OTH | D, OTH |

T1: IPCC methodology Tier 1; D: IPCC default methodology and emission factor; OTH: other methodology – EMEP/CORINAIR 2007

**Key categories**

The results of the key categories assessment are presented in Section 1.5.

**Uncertainty**

The uncertainty analysis is presented in Section 1.7.

### 7.1.3. Completeness

Table 7.3 gives an overview of the IPCC source categories included in this chapter and presents the status of emissions estimates from all sub-sources in the sector of waste.

**Table 7.3. Waste – completeness**

| | $CO_2$ | CH4 | N2O |
|---|---|---|---|
| 5A. Solid Waste Disposal | NA | ✓ | NA |
| 5B. Biological Treatment of Solid Waste | | ✓ | ✓ |
| 5D. Wastewater Treatment and Discharge | | ✓ | ✓ |

NA: Not applicable

## 7.2. Solid Waste Disposal (CRF 5A)

Solid waste disposal on land is responsible for methane emissions. Methane is emitted during the anaerobic decomposition of organic waste disposed solid waste disposal sites. The main characteristic of this process is that organic waste decomposes at a diminishing rate over time and takes many years to decompose completely. Other factors that affect the decomposition rate are the type of waste disposed, the characteristics of the disposal sites and the climate conditions.

Municipal solid waste management in Cyprus

In Cyprus household waste collected by local authorities or individuals and disposed of in sites of different characteristics. In 2005[24] five disposal sites were in operation, of which none met the standards for landfills in accordance with the requirements of the relevant EU Directives. The landfills in Nicosia and Limassol operated with controlled drop while the other three sites operate under semi-controlled deposition conditions. These sites have been categorised as deep unmanaged for the purposes of inventory preparation.

Until 2010 they were also in operation 113 sites of uncontrolled disposal of household and other solid waste. These sites have been categorised as shallow unmanaged. Most active UWDS have been active for more than 25 years while the smallest portion of the active UWDS were active for less than 5 years (Figure 7.2). Approximately half of UWDS (48%) started their operation during 1990-2000, while a significant number became operational during 1980-1990. Before 1970 only two sites operated of which one was closed in mid 1990s while the other is still in operation (Figure 7.3).

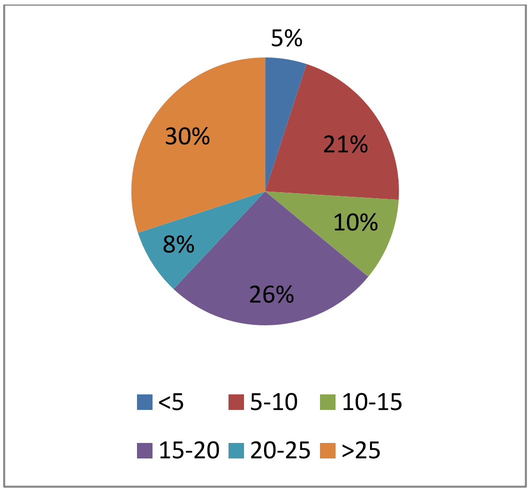


**Figure 7.2. Years of activity of active Uncontrolled Waste Disposal Sites**

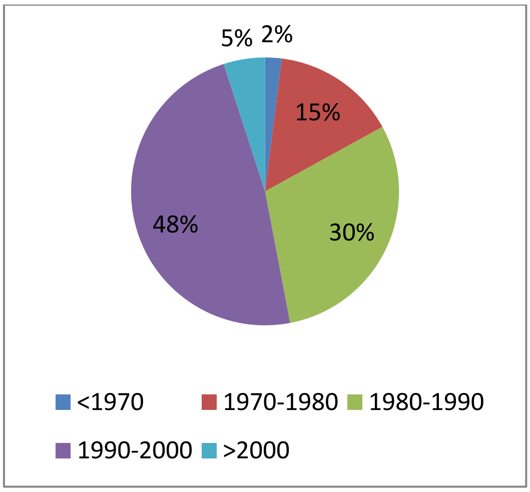


**Figure 7.3. Starting year of activity for all Uncontrolled Waste Disposal Sites**

[24] In 2005 a census of all the solid waste disposal sites took place in Cyprus through the study "Παροχή συμβουλευτικών υπηρεσιών για την ετοιμασία στρατηγικού σχεδίου, περιβαλλοντικής και τεχνοοικονομικής μελέτης και εγγράφων προσφορών για την αποκατάσταση και μετέπειτα φροντίδα των χώρων ανεξέλεγκτης απόρριψης απορριμμάτων στην Κύπρο" ("Consultancy services for the preparation of the strategic plan, environmental and techno-economic studies and tender documents for the rehabilitation and aftercare of uncontrolled waste disposal sites in Cyprus")

The situation started changing in 2006 when the first managed waste disposal site started its operation in Pafos. Then the second managed waste disposal site started its operation in 2010, serving the districts of Larnaca and Ammochostos. For Limassol and Nicosia, the new farcicalities are under construction and all the municipal solid waste produced are transferred to the existing deep unmanaged sites.

Emissions

Methane emissions were calculated using the Tier 2 method proposed by the IPCC 2006 guidelines using the IPCCWasteModel excel spreadsheet provided with the 2006 IPCC guidelines.

Carbon dioxide emissions occur during the flaring of biogas released from the decomposition of waste. These emissions should not be included in the total GHG emissions of this source as they are of biogenic origin. However, recovery and flaring of biogas does not occur in Cyprus and is therefore reported as NO.

$CH_4$ emissions from solid waste disposal on land in 2015 accounted for 65.9% of total GHG emissions from Waste, 5.5% of total national emissions without LULUCF and 50% of the total CH4 emissions without LULUCF. All solid waste disposal on land emissions is considered managed in 2015. The emissions between 1990 and 2014 increased by 82%. Emissions from Solid Waste Disposal Sites are presented in Table 7.4 and Figure 7.4.

**Table 7.4. Total GHG emissions from solid waste disposal sites for the period 1990 – 2015**

| Year | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| 5A1a Managed waste disposal sites – anaerobic (Gg CH4) | 0.00 | 0.00 | 0.00 | 0.00 | 0.59 | 1.78 | 2.11 | 2.42 |
| 5A2 Unmanaged (Gg CH4) | 10.33 | 11.38 | 12.78 | 14.40 | 15.71 | 15.87 | 15.90 | 15.91 |
| Total (Gg $CO_2$ eq.) | 258.3 | 284.4 | 319.4 | 359.9 | 407.5 | 441.2 | 450.2 | 458.3 |

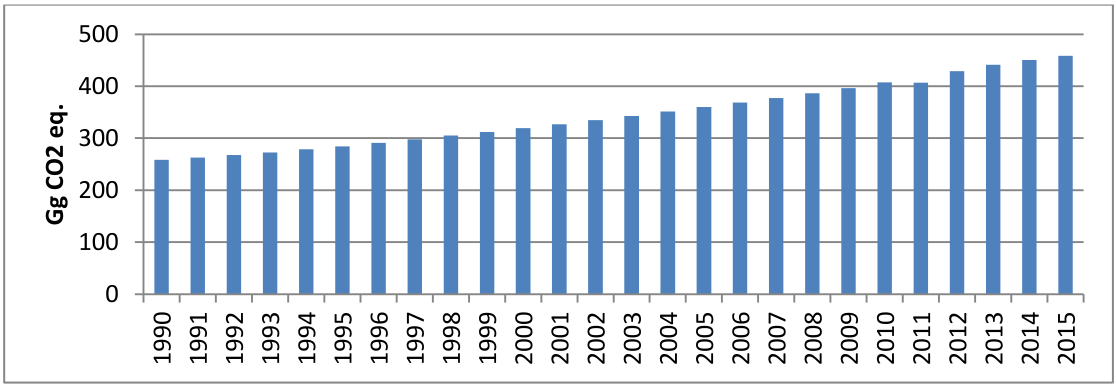


**Figure 7.4. Total GHG emissions from solid waste disposal sites for the period 1990 – 2015**

### 7.2.1. Methodological issues

The 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines) outlines three methods to estimate $CH_4$ emissions from solid waste disposal sites: (a) the Tier 1 method based on the IPCC First Order Decay method (FOD), (b) the Tier 2 method using the IPCC FOD method, some default parameters and good quality country specific activity data and (c) the Tier 3 method using good quality country specific activity data and either the FOD IPCC FOD method with country specific key parameters or measurement derived county-specific parameters. According to the 2006 IPCC Guidelines, is a *good practice* to use the FOD method in order to account for time dependence of the emissions. Tier 2 methodology was implemented for the estimation of emissions from land disposal of solid waste through the use of the IPCCWasteModel excel spreadsheet. The parameters are set to Southern Europe region, the DOC is calculated based on waste by composition and the methane generation constant is the default for dry temperate.

**Total municipal solid waste ($MSW_T$)**

Data on total MSW production and annual per capita production are available for the period 1996-2013 from the National Statistical Service. The data for the period 1990-1995 was obtained using the linear trend equation of 1996-2008 that was obtained from plotting the annual per capita production against time as shown in Figure 7.5. The years 2009 to 2015 were excluded from the trend, because during those years there are considerable changes in (a) the economy of the country and (b) the waste management practices of the country, which resulted in a decrease of the waste production. The total municipal solid waste production ($MSW_T$) was then estimated by multiplying the annual per capita production by the total population at the end of the year.

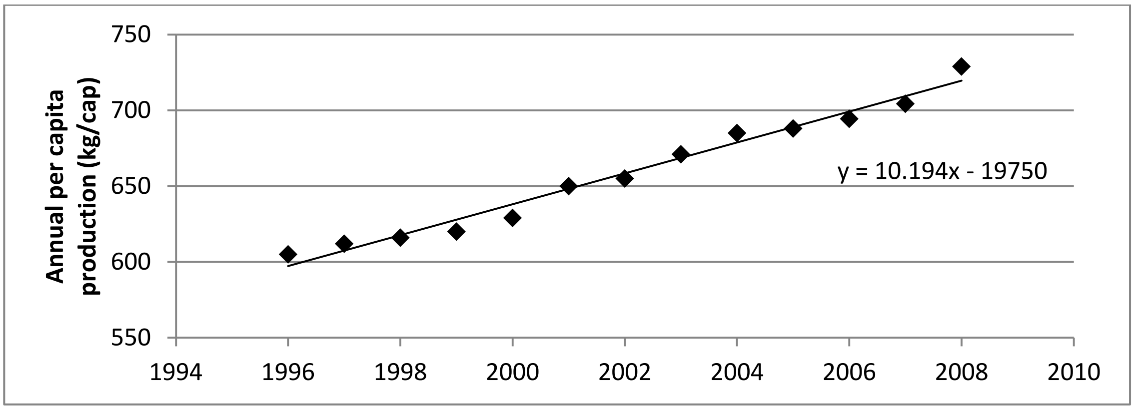


**Figure 7.5. Plot used to estimate the annual per capita production for 1990-1995 (kg/cap)**

The total population used, the annual per capita production and the resulting total municipal solid waste production for the whole reporting period, are presented in Table 7.5. Total MSW and Annual per capita production of 2010-2014 were revised according to revised data provided by the Statistical Service.

**Table 7.5. Total population, annual per capita production (kg/cap), total MSW production (1000t)**

| | Total population | Annual per capita production (kg/cap) | Total MSW production (1000t) |
|---|---|---|---|
| **1990** | 587100 | 536.1 | 314.7 |
| **1991** | 603100 | 546.3 | 329.4 |
| **1992** | 619200 | 556.4 | 344.6 |
| **1993** | 632900 | 566.6 | 358.6 |
| **1994** | 645400 | 576.8 | 372.3 |
| **1995** | 656300 | 587.0 | 385.3 |
| **1996** | 666300 | 605.0 | 400.1 |
| **1997** | 675200 | 612.0 | 410.5 |
| **1998** | 682900 | 616.0 | 418.2 |
| **1999** | 690500 | 620.0 | 425.8 |
| **2000** | 697500 | 629.0 | 436.1 |
| **2001** | 705500 | 650.0 | 456.1 |
| **2002** | 713700 | 655.0 | 464.6 |
| **2003** | 722900 | 671.0 | 481.4 |
| **2004** | 733000 | 685.0 | 498.1 |
| **2005** | 744000 | 688.0 | 507.9 |
| **2006** | 757900 | 694.4 | 521.0 |
| **2007** | 776400 | 704.3 | 539.8 |
| **2008** | 796900 | 728.9 | 572.7 |
| **2009** | 819100 | 729.9 | 589.1 |
| **2010** | 839800 | 690.0 | 571.4 |
| **2011** | 862000 | 674.0 | 571.9 |
| **2012** | 865900 | 657.0 | 567.6 |
| **2013** | 858000 | 618.0 | 533.0 |
| **2014** | 847000 | 615.0 | 524.3 |
| **2015** | 848300 | 642.0 | 541.2 |

Determining Historical Waste per Capita Data

The IPCC Waste Model requires MSW activity data to be reported annually going back to the year 1950. However, MSW activity data in Cyprus were only recorded between the years of 1996-2015, while the previously reported period of 1990-1995 was linearly extrapolated from the trend observable in years 1996-2009.

In an attempt to determine the historical waste per capita data going back to the year 1950, as recommended during the TERT review, a linear extrapolation from the small sample size of recorded data would not have sufficed, or otherwise been applicable. Therefore, a more pertinent indicator of waste activity was required, and, as such, the national GDP was used to correlate the annual waste activity against the corresponding years.

The methodology used to determine the historical waste per capita data was applied as follows:

(a) The 1960-2014 GDP data[25] was extrapolated backwards, to expand the range to the year 1950.

[25] Maria Matsi, Economic Officer, Directorate of Economic Research and EU Affairs, Ministry of Finance. Tel. no.: +357 22 60 1231. Email: mmatsi@mof.gov.cy

(b) Waste activity data from 1996-2009 was fitted exponentially to the respective GDP value of each year to provide for a correlation between waste per capita and GDP.

(c) Hence, a hind cast of the annual waste activity was calculated going back to 1950 using the derived relation of waste per capita to GDP.

GDP data alongside the calculated waste activity derived from the methodology of the model is summarized annually in Table 7.6. The aforementioned methodology is described analytically below in conjunction with the relevant data.

**Table 7.6. Data used for fitting and extrapolating GDP and waste activity is tabulated by year. Figures in bold are calculated by the models illustrated in Figures 7.4 and 7.5**

| | GDP (€m) | Waste (kg/capita) |
|---|---|---|
| **1950** | **1052.3** | **457.96** |
| **1951** | **1103** | **458.65** |
| **1952** | **1156.2** | **459.37** |
| **1953** | **1211.9** | **460.13** |
| **1954** | **1270.2** | **460.92** |
| **1955** | **1331.4** | **461.76** |
| **1956** | **1395.6** | **462.64** |
| **1957** | **1462.8** | **463.56** |
| **1958** | **1533.3** | **464.52** |
| **1959** | **1607.1** | **465.54** |
| **1960** | 1468.8528 | **463.64** |
| **1961** | 1631.9978 | **465.88** |
| **1962** | 1778.7189 | **467.91** |
| **1963** | 1888.7596 | **469.44** |
| **1964** | 1709.1906 | **466.95** |
| **1965** | 2090.2273 | **472.24** |
| **1966** | 2217.787 | **474.03** |
| **1967** | 2519.4411 | **478.28** |
| **1968** | 2635.504 | **479.92** |
| **1969** | 2880.769 | **483.42** |
| **1970** | 2970.0061 | **484.69** |
| **1971** | 3349.9479 | **490.17** |
| **1972** | 3571.1244 | **493.39** |
| **1973** | 3606.7097 | **493.91** |
| **1974** | 2997.3794 | **485.09** |
| **1975** | 2428.0142 | **476.98** |
| **1976** | 2870.3672 | **483.27** |
| **1977** | 3323.122 | **489.78** |
| **1978** | 3577.1465 | **493.48** |
| **1979** | 3930.2624 | **498.66** |
| **1980** | 4162.9357 | **502.11** |
| **1981** | 4289.948 | **504** |
| **1982** | 4559.849 | |
| **1983** | 4802.3767 | **511.7** |
| **1984** | 5227.7582 | **518.18** |
| **1985** | 5478.4979 | **522.03** |
| **1986** | 5675.5858 | **525.09** |
| **1987** | 6078.5212 | **531.38** |
| **1988** | 6583.8328 | **539.39** |
| **1989** | 7117.0653 | **547.96** |
| **1990** | 7650.2977 | **556.68** |
| **1991** | 7703.9494 | **557.56** |
| **1992** | 8428.2477 | **569.64** |
| **1993** | 8487.3741 | **570.64** |
| **1994** | 8987.7585 | **579.15** |
| **1995** | 10190.74 | **600.13** |
| **1996** | 10406.57 | 605 |
| **1997** | 10673.59 | 612 |
| **1998** | 11232.34 | 616 |
| **1999** | 11774.76 | 620 |
| **2000** | 12448.76 | 629 |
| **2001** | 12897.04 | 650 |
| **2002** | 13335.42 | 655 |
| **2003** | 13665.57 | 671 |
| **2004** | 14290.13 | 685 |
| **2005** | 14822.31 | 688 |
| **2006** | 15490.85 | 694.38 |
| **2007** | 16237.64 | 704.31 |
| **2008** | 16865.03 | 728.88 |
| **2009** | 16566.06 | 729.86 |
| **2010** | 16784.41 | 698 |
| **2011** | 16838.31 | 684 |
| **2012** | 16306.56 | 670 |
| **2013** | 15335.86 | 629 |
| **2014** | 15101.08 | 626 |
| **2015** | 15354.64 | 630 |

(a) Reliable national GDP data is available, courtesy of the Statistical Service of Cyprus (CYSTAT), starting from 1960 – marked by the establishment of the Republic of Cyprus, and using constant market prices of 2005.

GDP data between the years of 1950-59 was extrapolated exponentially to allow for the waste activity to be fitted to that period as well, as shown in Figure; not much growth was to be expected during those years due to the British rule and Cyprus Emergency, and the fitted model is shown to be in accord. The GDP data appear to effectively gauge the socio-political economics of the time period, as they factor in any fluctuations in the market that may economically influence waste activity, as well as by modelling the situation in the aftermath of a war, such as the Turkish invasion of 1974.

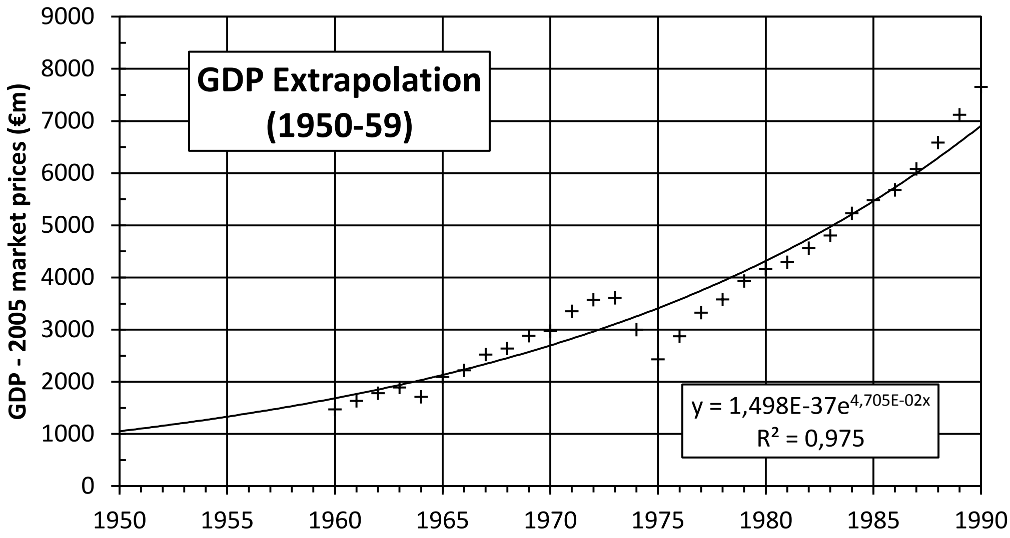


**Figure 7.6. GDP data 1960-2014 (CYSTAT) extrapolated for the years of 1950-59.**

(b) As illustrated in Figure, the waste activity data showing a linear trend between the years 1996-2009 was used to fit waste per capita to GDP exponentially, and, by association, correlate waste activity with each corresponding year.

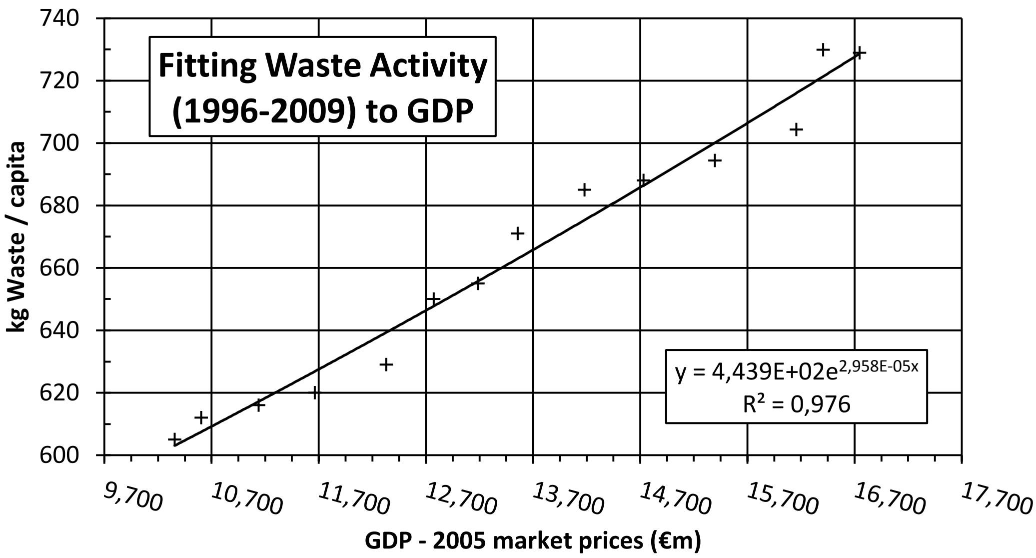


**Figure 7.7. Plotting the linear period of waste activity data from 1996-2009 against their corresponding annual GDP, and fitting to an exponential model.**

(c) The GDP data from 1950-2014 could now be normalized to waste activity data by relation to the exponential fit determined from plotting waste activity to GDP for 1996-

2009 in Figure. Hence, the waste activity data can be hind cast for each year going back to 1950 through a correlation to the annual GDP, as in Figure 7.8.

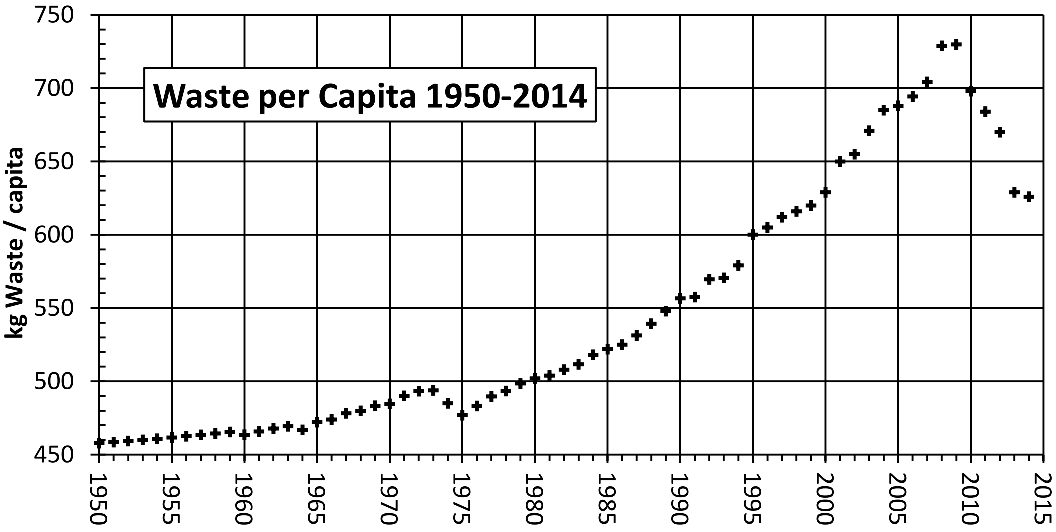


**Figure 7.8. Waste per capita derived from annual GDP data and hind casts.**

### Fraction of MSW disposed at SWDS ($MSW_F$)

Data on MSW disposed at SWDS is available for the period 1996-2013 from the National Statistical Service. For the period 1990-1995 it was assumed that the fraction of waste disposed to SWDS is the same as 1996. The $MSW_F$ and the corresponding mass of MSW disposed to disposal sites are presented in Table 7.7. In Table 7.7 data on other waste management practices are also presented for years that data is available. MSW to disposal sites in 2010 – 2014 has been revised according to revised data provided by the Statistical Service. Amount of compost in 2010-2014 has been revised according to revised data provided by the Statistical Service. MSW to disposal sites for 1950-1989 is assumed 100%.

**Table 7.7. Fraction of MSW disposed at SWDS ($MSW_F$), mass of MSW disposed to disposal sites (1000t) and other practices**

| | Composting (1000t) | Recycling (1000t) | MSW to disposal sites (1000t) | MSW to disposal sites |
|---|---|---|---|---|
| **1990** | | | 305.97 | 97.2% |
| **1991** | | | 320.29 | 97.2% |
| **1992** | | | 334.98 | 97.2% |
| **1993** | | | 348.66 | 97.2% |
| **1994** | | | 361.94 | 97.2% |
| **1995** | | | 387.00 | 97.2% |
| **1996** | | 11.12 | 389.00 | 97.2% |
| **1997** | | 12.54 | 398.00 | 96.9% |
| **1998** | | 12.17 | 406.00 | 97.1% |
| **1999** | | 12.76 | 413.00 | 97.0% |
| **2000** | | 13.11 | 423.00 | 97.0% |
| **2001** | | 14.10 | 442.00 | 96.9% |
| **2002** | | 14.61 | 450.00 | 96.9% |
| **2003** | | 14.73 | 466.63 | 96.9% |

| | Composting (1000t) | Recycling (1000t) | MSW to disposal sites (1000t) | MSW to disposal sites |
|---|---|---|---|---|
| **2004** | | 16.48 | 481.59 | 96.7% |
| **2005** | | 18.61 | 489.30 | 96.3% |
| **2006** | | 21.50 | 499.49 | 95.9% |
| **2007** | | 27.59 | 512.19 | 94.9% |
| **2008** | | 42.09 | 530.59 | 92.7% |
| **2009** | | 49.39 | 539.67 | 91.6% |
| **2010** | 7.89 | 61.09 | 489.97 | 85.7% |
| **2011** | 14.95 | 72.22 | 460.96 | 80.6 |
| **2012** | 16.2 | 69.65 | 451.28 | 79.5% |
| **2013** | 11.67 | 69.78 | 422.82 | 79.3% |
| **2014** | 29.58 | 71.17 | 397.85 | 75.9% |
| **2015** | 43.86 | 72.11 | 403.00 | 74.5% |

Allocation of solid waste to types of waste disposal sites is based on the information that follows.

(a) Assumptions for allocation

Assumptions for allocation have been based on the information provided by the Solid Waste Management Unit of the Department of Environment[26], presented below (Table 7.8). The categorisation is based on the disposal of the waste according to their origin; i.e. urban or rural. Based on this categorisation, the amount of waste disposed per type of disposal site was estimated using the urban and rural population of each district at the end of the year (Table 7.9) and the waste generation per capita (Table 7.5). The resulting amount of waste generated per district and type of waste disposal site is presented in Table 7.10. The resulting total quantities of municipal solid waste disposed per type of waste disposal site and the population served per technology are presented in Table 7.11.

**Table 7.8. Allocation of waste to types waste disposal sites**

| | **Nicosia** | **Ammochostos** | **Larnaca** | **Limassol** | **Pafos** |
|---|---|---|---|---|---|
| Deep unmanaged | all urban until 2011; all from 2012 | all urban until 2009 | all urban until 2009 | all urban until 2011; all from 2012 | all urban until 2005 |
| Shallow unmanaged | all rural until 2011 | all rural until 2009 | all rural until 2009 | all rural until 2011 | all rural until 2005 |
| Managed-semi-aerobic | | | | | |
| Managed-anaerobic | | all from 2010 | all from 2010 | | all from 2006 |

**Table 7.9. Urban and Rural population of Cyprus per district at the end of the year (1000s)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| Regional Population | | | | | | | | | |
| Nicosia | 238.6 | 244.9 | 251.3 | 256.3 | 260.8 | 264.6 | 268 | 271 | 273.4 |
| Ammochostos | 30.3 | 31.0 | 31.7 | 32.7 | 33.6 | 34.4 | 35.1 | 35.8 | 36.5 |
| Larnaca | 98.0 | 100.8 | 103.5 | 105.8 | 107.8 | 109.6 | 111.2 | 112.6 | 113.9 |
| Limassol | 168.7 | 173.6 | 178.6 | 182.4 | 185.8 | 188.8 | 191.5 | 193.9 | 195.8 |
| Pafos | 51.5 | 52.8 | 54.1 | 55.7 | 57.4 | 58.9 | 60.5 | 61.9 | 63.3 |
| TOTAL | 587.1 | 603.1 | 619.2 | 632.9 | 645.4 | 656.3 | 666.3 | 675.2 | 682.9 |

[26] Mrs. Elena Christodoulidou, Environment Officer, Solid Waste Management Unit, Department of Environment, tel. +357 22866248, email echristodoulidou@environment.moa.gov.cy

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Urban Population | | | | | | | | | |
| Nicosia | 171.6 | 177.0 | 182.5 | 186.4 | 189.9 | 193 | 195.7 | 198.2 | 200.2 |
| Ammochostos | 0.0 | 0.0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 |
| Larnaca | 58.3 | 60.5 | 62.6 | 64.1 | 65.4 | 66.6 | 67.6 | 68.6 | 69.5 |
| Limassol | 130.6 | 135.4 | 140.3 | 143.6 | 146.6 | 149.2 | 151.7 | 153.8 | 155.7 |
| Pafos | 30.2 | 31.8 | 33.5 | 35.0 | 36.6 | 38.1 | 39.7 | 41.2 | 42.7 |
| TOTAL | 390.7 | 404.7 | 418.9 | 429.1 | 438.5 | 446.9 | 454.7 | 461.8 | 468.1 |
| Rural Population | | | | | | | | | |
| Nicosia | 67.0 | 67.9 | 68.8 | 69.9 | 70.9 | 71.6 | 72.3 | 72.8 | 73.2 |
| Ammochostos | 30.3 | 31.0 | 31.7 | 32.7 | 33.6 | 34.4 | 35.1 | 35.8 | 36.5 |
| Larnaca | 39.7 | 40.3 | 40.9 | 41.7 | 42.4 | 43.0 | 43.6 | 44.0 | 44.4 |
| Limassol | 38.1 | 38.2 | 38.3 | 38.8 | 39.2 | 39.6 | 39.8 | 40.1 | 40.1 |
| Pafos | 21.3 | 21.0 | 20.6 | 20.7 | 20.8 | 20.8 | 20.8 | 20.7 | 20.6 |
| TOTAL | 196.4 | 198.4 | 200.3 | 203.8 | 206.9 | 209.4 | 211.6 | 213.4 | 214.8 |
| | | | | | | | | | |
| | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** |
| Regional Population | | | | | | | | | |
| Nicosia | 275.8 | 277.9 | 280.3 | 283.5 | 286.2 | 289.7 | 293.5 | 298.4 | 305.1 |
| Ammochostos | 37.1 | 37.8 | 38.5 | 39.1 | 39.6 | 40.1 | 40.8 | 41.6 | 42.7 |
| Larnaca | 115.1 | 116.2 | 117.5 | 119.3 | 120.8 | 122.8 | 124.8 | 127.4 | 130.8 |
| Limassol | 197.8 | 199.5 | 201.6 | 204.6 | 205.7 | 208.1 | 210.8 | 214.3 | 219 |
| Pafos | 64.7 | 66.1 | 67.6 | 68.6 | 70.6 | 72.3 | 74.1 | 76.2 | 78.8 |
| TOTAL | 690.5 | 697.5 | 705.5 | 715.1 | 722.9 | 733.0 | 744.0 | 757.9 | 776.4 |
| Urban Population | | | | | | | | | |
| Nicosia | 202.3 | 204.1 | 206.2 | 208.9 | 210.3 | 212.8 | 215.4 | 219 | 223.7 |
| Ammochostos | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Larnaca | 70.3 | 71.1 | 72.0 | 73.2 | 73.5 | 74.4 | 75.4 | 76.6 | 78.4 |
| Limassol | 157.5 | 159.2 | 161.2 | 163.9 | 163.1 | 164.3 | 165.7 | 167.7 | 170.7 |
| Pafos | 44.2 | 45.7 | 47.3 | 48.3 | 49.5 | 50.7 | 52 | 53.5 | 55.3 |
| TOTAL | 474.3 | 480.1 | 486.7 | 494.3 | 496.4 | 502.2 | 508.5 | 516.8 | 528.1 |
| Rural Population | | | | | | | | | |
| Nicosia | 73.5 | 73.8 | 74.1 | 74.6 | 75.9 | 76.9 | 78.1 | 79.4 | 81.4 |
| Ammochostos | 37.1 | 37.8 | 38.5 | 39.1 | 39.6 | 40.1 | 40.8 | 41.6 | 42.7 |
| Larnaca | 44.8 | 45.1 | 45.5 | 46.1 | 47.3 | 48.4 | 49.4 | 50.8 | 52.4 |
| Limassol | 40.3 | 40.3 | 40.4 | 40.7 | 42.6 | 43.8 | 45.1 | 46.6 | 48.3 |
| Pafos | 20.5 | 20.4 | 20.3 | 20.3 | 21.1 | 21.6 | 22.1 | 22.7 | 23.5 |
| TOTAL | 216.2 | 217.4 | 218.8 | 220.8 | 226.5 | 230.8 | 235.5 | 241.1 | 248.3 |
| | | | | | | | | | |
| | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | |
| Regional Population | | | | | | | | | |
| Nicosia | 312.6 | 320.6 | 328 | 336.0 | 336.9 | 333.8 | 329.5 | 330 | |
| Ammochostos | 43.8 | 45.1 | 46.3 | 47.6 | 47.9 | 47.4 | 46.8 | 46.9 | |
| Larnaca | 134.5 | 138.5 | 142.3 | 146.3 | 147.2 | 145.9 | 144 | 144.2 | |
| Limassol | 224.4 | 230.2 | 235.5 | 241.3 | 241.9 | 239.7 | 236.6 | 237 | |
| Pafos | 81.6 | 84.7 | 87.7 | 90.8 | 92 | 91.2 | 90.1 | 90.2 | |
| TOTAL | 796.9 | 819.1 | 839.8 | 862.0 | 865.9 | 858 | 847 | 848.3 | |
| Urban Population | | | | | | | | | |
| Nicosia | 229.1 | 234.9 | 240.2 | 245.9 | 246.4 | 244.1 | 241 | 241.4 | |
| Ammochostos | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| Larnaca | 80.3 | 82.4 | 84.3 | 86.4 | 86.7 | 85.9 | 84.8 | 84.9 | |
| Limassol | 174.1 | 177.8 | 181.1 | 184.6 | 184.1 | 182.4 | 180 | 180.3 | |
| Pafos | 57.3 | 59.5 | 61.6 | 63.9 | 64.9 | 64.3 | 63.5 | 63.6 | |
| TOTAL | 540.8 | 554.6 | 567.2 | 580.8 | 582.1 | 576.7 | 569.3 | 570.2 | |
| Rural Population | | | | | | | | | |
| Nicosia | 83.5 | 85.7 | 87.8 | 90.1 | 90.5 | 89.7 | 88.5 | 88.6 | |
| Ammochostos | 43.8 | 45.1 | 46.3 | 47.6 | 47.9 | 47.4 | 46.8 | 46.9 | |
| Larnaca | 54.2 | 56.1 | 58.0 | 59.9 | 60.5 | 60 | 59.2 | 59.3 | |
| Limassol | 50.3 | 52.4 | 54.4 | 56.7 | 57.8 | 57.3 | 56.6 | 56.7 | |
| Pafos | 24.3 | 25.2 | 26.1 | 26.9 | 27.1 | 26.9 | 26.6 | 26.6 | |
| TOTAL | 256.1 | 264.5 | 272.6 | 281.2 | 283.8 | 281.3 | 277.7 | 278.1 | |

**Table 7.10. Amount of waste generated per district and type of waste disposal site (kt)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| Nicosia | | | | | | | |
| deep unmanaged | 89.4 | 94.0 | 98.7 | 102.7 | 106.5 | 113.8 | 114.3 |
| shallow unmanaged | 34.9 | 36.1 | 37.2 | 38.5 | 39.8 | 42.2 | 42.2 |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ammochostos | | | | | | | |
| deep unmanaged | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| shallow unmanaged | 15.8 | 16.5 | 17.1 | 18.0 | 18.8 | 20.3 | 20.5 |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Larnaca | | | | | | | |
| deep unmanaged | 30.4 | 32.1 | 33.9 | 35.3 | 36.7 | 39.3 | 39.5 |
| shallow unmanaged | 20.7 | 21.4 | 22.1 | 23.0 | 23.8 | 25.4 | 25.5 |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Limassol | | | | | | | |
| deep unmanaged | 68.1 | 71.9 | 75.9 | 79.1 | 82.2 | 88.0 | 88.6 |
| shallow unmanaged | 19.9 | 20.3 | 20.7 | 21.4 | 22.0 | 23.4 | 23.2 |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pafos | | | | | | | |
| deep unmanaged | 15.7 | 16.9 | 18.1 | 19.3 | 20.5 | 22.5 | 23.2 |
| shallow unmanaged | 11.1 | 11.2 | 11.1 | 11.4 | 11.7 | 12.3 | 12.1 |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | |
| | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** |
| Nicosia | | | | | | | |
| deep unmanaged | 116.8 | 119.0 | 121.0 | 123.8 | 129.2 | 131.7 | 135.7 |
| shallow unmanaged | 42.9 | 43.5 | 44.0 | 44.8 | 46.4 | 47.0 | 49.0 |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ammochostos | | | | | | | |
| deep unmanaged | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| shallow unmanaged | 21.1 | 21.7 | 22.2 | 22.9 | 24.1 | 24.7 | 25.6 |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Larnaca | | | | | | | |
| deep unmanaged | 40.4 | 41.3 | 42.0 | 43.1 | 45.1 | 46.2 | 47.4 |
| shallow unmanaged | 25.9 | 26.4 | 26.8 | 27.4 | 28.5 | 29.1 | 30.5 |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Limassol | | | | | | | |
| deep unmanaged | 90.7 | 92.6 | 94.2 | 96.5 | 101.0 | 103.3 | 105.3 |
| shallow unmanaged | 23.6 | 23.8 | 24.1 | 24.4 | 25.3 | 25.7 | 27.5 |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pafos | | | | | | | |
| deep unmanaged | 24.3 | 25.4 | 26.4 | 27.7 | 29.6 | 30.5 | 32.0 |
| shallow unmanaged | 12.2 | 12.2 | 12.3 | 12.4 | 12.7 | 12.8 | 13.6 |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | |
| | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
| Nicosia | | | | | | | |
| deep unmanaged | 139.8 | 141.7 | 144.3 | 147.6 | 152.5 | 154.8 | 140.1 |
| shallow unmanaged | 50.5 | 51.4 | 52.3 | 53.7 | 55.6 | 56.5 | 51.2 |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ammochostos | | | | | | | |
| deep unmanaged | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| shallow unmanaged | 26.3 | 26.8 | 27.4 | 28.2 | 29.2 | 29.7 | 0 |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 27.0 |
| Larnaca | | | | | | | |
| deep unmanaged | 48.9 | 49.6 | 50.5 | 51.7 | 53.5 | 54.3 | 0 |
| shallow unmanaged | 31.8 | 32.5 | 33.5 | 34.6 | 36.1 | 37.0 | 0 |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 83.0 |
| Limassol | | | | | | | |
| deep unmanaged | 107.9 | 109.0 | 110.5 | 112.6 | 115.9 | 117.1 | 105.7 |
| shallow unmanaged | 28.8 | 29.7 | 30.7 | 31.9 | 33.5 | 34.5 | 31.7 |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pafos | | | | | | | |
| deep unmanaged | 33.3 | 34.2 | 0 | 0 | 0 | 0 | 0 |
| shallow unmanaged | 14.2 | 14.5 | 0 | 0 | 0 | 0 | 0 |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| managed-anaerobic | 0 | 0 | 50.2 | 52.0 | 54.3 | 55.8 | 51.2 |
| | | | | | | | |
| | **2011** | **2012** | **2013** | **2014** | **2015** | | |
| Nicosia | | | | | | | |
| deep unmanaged | 131.5 | 175.6 | 164.5 | 154.8 | 156.8 | | |
| shallow unmanaged | 48.2 | 0.0 | 0.0 | 0.0 | 0 | | |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | | |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | | |
| Ammochostos | | | | | | | |
| deep unmanaged | 0 | 0 | 0 | 0 | 0 | | |
| shallow unmanaged | 0 | 0 | 0 | 0 | 0 | | |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | | |
| managed-anaerobic | 25.5 | 25.0 | 23.4 | 22.0 | 22.3 | | |
| Larnaca | | | | | | | |
| deep unmanaged | 0 | 0 | 0 | 0 | 0 | | |
| shallow unmanaged | 0 | 0 | 0 | 0 | 0 | | |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | | |
| managed-anaerobic | 78.2 | 76.7 | 71.9 | 67.6 | 68.5 | | |
| Limassol | | | | | | | |
| deep unmanaged | 98.7 | 126.1 | 118.1 | 111.1 | 112.6 | | |
| shallow unmanaged | 30.3 | 0 | 0 | 0 | 0 | | |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | | |
| managed-anaerobic | 0 | 0 | 0 | 0 | 0 | | |
| Pafos | | | | | | | |
| deep unmanaged | 0 | 0 | 0 | 0 | 0 | | |
| shallow unmanaged | 0 | 0 | 0 | 0 | 0 | | |
| managed-semi-aerobic | 0 | 0 | 0 | 0 | 0 | | |
| managed-anaerobic | 48.6 | 47.9 | 44.9 | 42.3 | 42.9 | | |

**Table 7.11. Allocation of population and waste to types waste disposal sites**

| | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** |
|---|---|---|---|---|---|---|---|
| Population ($10^6$) | | | | | | | |
| Un-managed, deep | 0.391 | 0.405 | 0.419 | 0.429 | 0.439 | 0.447 | 0.455 |
| Un-managed, shallow | 0.196 | 0.198 | 0.200 | 0.204 | 0.207 | 0.209 | 0.212 |
| Managed, anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 0.587 | 0.603 | 0.619 | 0.633 | 0.645 | 0.656 | 0.666 |
| Waste production (Gg) | | | | | | | |
| Un-managed, deep | 203.6 | 214.9 | 226.6 | 236.4 | 245.9 | 263.5 | 265.5 |
| Un-managed, shallow | 102.4 | 105.4 | 108.4 | 112.3 | 116.0 | 123.5 | 123.5 |
| Managed, anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 611.9 | 640.6 | 670.0 | 697.3 | 723.9 | 774.0 | 778.0 |
| | | | | | | | |
| | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** |
| Population ($10^6$) | | | | | | | |
| Un-managed, deep | 0.462 | 0.468 | 0.474 | 0.480 | 0.487 | 0.494 | 0.496 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Un-managed, shallow | 0.213 | 0.215 | 0.216 | 0.217 | 0.219 | 0.221 | 0.227 |
| Managed, anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 0.675 | 0.683 | 0.691 | 0.698 | 0.706 | 0.715 | 0.723 |
| Waste production (Gg) | | | | | | | |
| Un-managed, deep | 272.2 | 278.3 | 283.7 | 291.2 | 304.9 | 311.7 | 320.4 |
| Un-managed, shallow | 125.8 | 127.7 | 129.3 | 131.8 | 137.1 | 139.2 | 146.2 |
| Managed, anaerobic | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 796.0 | 812.0 | 826.0 | 846.0 | 884.0 | 901.8 | 933.3 |
| | | | | | | | |
| | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
| Population ($10^6$) | | | | | | | |
| Un-managed, deep | 0.502 | 0.509 | 0.463 | 0.473 | 0.484 | 0.495 | 0.421 |
| Un-managed, shallow | 0.231 | 0.236 | 0.218 | 0.225 | 0.232 | 0.239 | 0.142 |
| Managed, anaerobic | 0 | 0 | 0.076 | 0.079 | 0.082 | 0.085 | 0.276 |
| TOTAL | 0.733 | 0.744 | 0.758 | 0.776 | 0.797 | 0.819 | 0.840 |
| Waste production (Gg) | | | | | | | |
| Un-managed, deep | 330.0 | 334.4 | 305.3 | 311.9 | 321.9 | 326.2 | 245.8 |
| Un-managed, shallow | 151.6 | 154.9 | 143.9 | 148.3 | 154.3 | 157.7 | 83.0 |
| Managed, anaerobic | 0.0 | 0.0 | 50.2 | 52.0 | 54.3 | 55.8 | 161.2 |
| TOTAL | 963.2 | 978.6 | 948.8 | 972.4 | 1006.8 | 1023.5 | 818.7 |
| | | | | | | | |
| | **2011** | **2012** | **2013** | **2014** | **2015** | | |
| Population ($10^6$) | | | | | | | |
| Un-managed, deep | 0.431 | 0.579 | 0.574 | 0.566 | 0.567 | | |
| Un-managed, shallow | 0.147 | 0 | 0 | 0 | 0 | | |
| Managed, anaerobic | 0.285 | 0.287 | 0.285 | 0.281 | 0.281 | | |
| TOTAL | 0.862 | 0.866 | 0.858 | 0.847 | 0.848 | | |
| Waste production (Gg) | | | | | | | |
| Un-managed, deep | 230.2 | 301.7 | 282.6 | 265.9 | 269.4 | | |
| Un-managed, shallow | 78.5 | 0 | 0 | 0 | 0 | | |
| Managed, anaerobic | 152.2 | 149.6 | 140.2 | 131.9 | 133.6 | | |
| TOTAL | 769.7 | 752.9 | 705.4 | 663.8 | 672.4 | | |

**Composition of MSW disposed at SWDS**

Data on the composition of waste to disposal sites is available for the period 1996 to 2015. For the period 1990-1995 it is assumed that the composition is the same as 1996. The breakdown on the organic matter to food waste and non-food/garden waste has been provided from the Statistical service and is assumed constant for all the years: 86% of organic matter is food waste and the remaining 14% is non-food/garden waste. The resulting composition of MSW disposed at SWDS is presented in Table 7.12. Composition of waste for 2010-2014 has been revised according to new data from the Statistical Service. Composition of waste for 1950-1989 is assumed the same as 1990.

**Table 7.12. Composition of MSW disposed at SWDS**

| | Paper | Textiles | Wood | Food waste | Garden | Plastics, other inert |
|---|---|---|---|---|---|---|
| **1990** | 28% | 6% | 2% | 39% | 6 % | 19% |
| **1991** | 28% | 6% | 2% | 39% | 6 % | 19% |
| **1992** | 28% | 6% | 2% | 39% | 6 % | 19% |
| **1993** | 28% | 6% | 2% | 39% | 6 % | 19% |
| **1994** | 28% | 6% | 2% | 39% | 6 % | 19% |
| **1995** | 28% | 6% | 2% | 39% | 6 % | 19% |
| **1996** | 28% | 6% | 2% | 39% | 6 % | 19% |
| **1997** | 28% | 6% | 2% | 39% | 6 % | 19% |
| **1998** | 27% | 6% | 2% | 39% | 6 % | 19% |
| **1999** | 27% | 6% | 2% | 39% | 6 % | 19% |
| **2000** | 27% | 6% | 2% | 39% | 6 % | 19% |

| | Paper | Textiles | Wood | Food waste | Garden | Plastics, other inert |
|---|---|---|---|---|---|---|
| **2001** | 27% | 6% | 2% | 39% | 6 % | 19% |
| **2002** | 27% | 6% | 2% | 39% | 6 % | 19% |
| **2003** | 27% | 6% | 2% | 38% | 6 % | 20% |
| **2004** | 27% | 6% | 2% | 38% | 6 % | 20% |
| **2005** | 27% | 6% | 2% | 38% | 6 % | 20% |
| **2006** | 26% | 6% | 2% | 38% | 6 % | 21% |
| **2007** | 24% | 7% | 2% | 39% | 6 % | 21% |
| **2008** | 23% | 7% | 2% | 41% | 7% | 20% |
| **2009** | 23% | 7% | 2% | 42% | 7% | 19% |
| **2010** | 26% | 8% | 3% | 43% | 7% | 13% |
| **2011** | 27% | 9% | 3% | 45% | 7% | 8% |
| **2012** | 28% | 9% | 3% | 44% | 7% | 8% |
| **2013** | 25% | 10% | 3% | 46% | 7% | 8% |
| **2014** | 27% | 11% | 3% | 48% | 8% | 4% |
| **2015** | 27% | 11% | 3% | 49% | 8% | 2% |

### Degradable organic carbon (DOC)

Degradable organic carbon is the organic carbon that is accessible to biochemical decomposition, and should be expressed as Gg C per Gg waste. It is based on the composition of waste and can be calculated from a weighted average of the carbon content of various components of the waste stream. The following equation, as presented in the IPCC Guidelines, estimates DOC using default carbon content values (equation 3.7, volume 5, pg. 3.13):

$$DOC = \Sigma_i \, (DOC_i * W_i)$$

where $DOC_i$ is the fraction of degradable organic carbon in waste type and $W_i$ is the fraction of waste type *i* by waste category. The defaults used by the IPCC waste model for DOC are presented in Table 7.13.

**Table 7.13. DOCi used for the calculation of DOC (weight fraction, wet basis)**

| Waste stream | Range | Default |
|---|---|---|
| Food waste | 0.08-0.20 | 0.15 |
| Garden | 0.18-0.22 | 0.2 |
| Paper | 0.36-0.45 | 0.4 |
| Wood and straw | 0.39-0.46 | 0.43 |
| Textiles | 0.20-0.40 | 0.24 |

### Fraction of degradable organic carbon which decomposes ($DOC_F$)

$DOC_F$ is an estimate of the fraction of carbon that is ultimately degraded and released from SWDS, and reflects the fact that some organic carbon does not degrade, or degrades very slowly, when deposited in SWDS. The IPCC Guidelines (pg. 3.13, volume 5) provide a default value of 0.5 for $DOC_F$.

### Estimation of $CH_4$ from waste disposal on land

Landfill gas consists mainly of $CH_4$ and carbon dioxide ($CO_2$). The $CH_4$ fraction F value used is according to the default proposed by the IPCC guidelines, i.e. 0.5. The oxidation factor

(OX) reflects the amount of $CH_4$ from SWDS that is oxidised in the soil or other material covering the waste. The oxidation factor used is according to the defaults proposed by the IPCC guidelines for managed, unmanaged and uncategorised SWDS (Table 3.2, pg. 3.15, vol. 5, 2006 IPCC guidelines); i.e. 0. This means that no $CH_4$ is oxidised. No methane is recovered from SWDS in Cyprus therefore recovery (R) is assumed 0.

The portion of the waste disposed at disposal sites is presented in Table 7.7. The defaults used by the IPCC waste model for Methane generation rate constant (k) are presented in Table 7.14 and are according to dry temperate climate.

**Table 7.14. Methane generation rate constant (k)**

| Waste stream (per year) | Range | Default |
|---|---|---|
| Food waste | 0.05–0.08 | 0.06 |
| Garden | 0.04–0.06 | 0.05 |
| Paper | 0.03–0.05 | 0.04 |
| Wood and straw | 0.01–0.03 | 0.02 |
| Textiles | 0.03–0.05 | 0.04 |

According to the consultations with the Waste Management Unit of the Department of Environment, and according to the 2006 IPCC Guidelines, all SWDS not meeting the criteria of managed SWDS and which have depth smaller than 5m classified as unmanaged disposal sites, and therefore be assumed shallow. The value for the methane correction factor for shallow unmanaged disposal sites is assumed to be 0.4, and is according to the default IPCC2006 guidelines (pg. 3.14, volume 5).

Moreover, all SWDS not meeting the criteria of managed SWDS and which have depth greater than or equal to 5m classified as unmanaged disposal sites, and assumed deep. The value for the methane conversion factor for deep unmanaged disposal sites is assumed to be 0.8, and is according to the default IPCC2006 guidelines (pg. 3.14, volume 5).

The portion of solid waste disposed to managed and unmanaged disposal sites is presented in Table 7.15.

**Table 7.15. Waste disposed at (a) managed, (b) deep unmanaged and (c) swallow unmanaged disposal sites**

| | % of waste to managed disposal sites | % of waste to deep unmanaged disposal sites | % of waste to shallow unmanaged disposal sites |
|---|---|---|---|
| **1990** | 0.0% | 66.5% | 33.5% |
| **1991** | 0.0% | 67.1% | 32.9% |
| **1992** | 0.0% | 67.7% | 32.3% |
| **1993** | 0.0% | 67.8% | 32.2% |
| **1994** | 0.0% | 67.9% | 32.1% |
| **1995** | 0.0% | 68.1% | 31.9% |
| **1996** | 0.0% | 68.2% | 31.8% |
| **1997** | 0.0% | 68.4% | 31.6% |
| **1998** | 0.0% | 68.5% | 31.5% |
| **1999** | 0.0% | 68.7% | 31.3% |
| **2000** | 0.0% | 68.8% | 31.2% |
| **2001** | 0.0% | 69.0% | 31.0% |
| **2002** | 0.0% | 69.1% | 30.9% |

| | % of waste to managed disposal sites | % of waste to deep unmanaged disposal sites | % of waste to shallow unmanaged disposal sites |
|---|---|---|---|
| **2003** | 0.0% | 68.7% | 31.3% |
| **2004** | 0.0% | 68.5% | 31.5% |
| **2005** | 0.0% | 68.3% | 31.7% |
| **2006** | 10.1% | 61.1% | 28.8% |
| **2007** | 10.1% | 60.9% | 29.0% |
| **2008** | 10.2% | 60.7% | 29.1% |
| **2009** | 10.3% | 60.4% | 29.2% |
| **2010** | 32.9% | 50.2% | 16.9% |
| **2011** | 33.0% | 49.9% | 17.0% |
| **2012** | 33.2% | 66.8% | 0.0% |
| **2013** | 33.2% | 66.8% | 0.0% |
| **2014** | 33.2% | 66.8% | 0.0% |
| **2015** | 33.2% | 66.8% | 0.0% |

Other parameters used for the calculation of methane emissions by the IPCC waste model are presented in Table 7.16.

**Table 7.16. Other parameters used for methane calculation**

| | |
|---|---|
| Delay time (months) | 6 |
| Fraction of methane (F) in developed gas | 0.5 |
| Conversion factor, C to CH4 | 1.33 |

## 7.2.2. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

## 7.2.3. Source-specific QA / QC and verification

QA/QC and verification activities are presented in Section 1.6.

## 7.2.4. Source-specific recalculations

The emissions from this source have been recalculated due to the following changes: a) change in the solid waste production data for the years 2010 - 2014, b) change of the methane generation rate constant, c) change on the time series on waste disposal data and d) change of methane oxidation factor.

During the in-country review of the 2016 submission a recommendation was made by the ERT to report the emissions per waste disposal technology instead of all under unclassified. After the guidance from the IPCC experts, the IPCC WasteModel excel spreadsheet has been applied for each type of waste disposal technology separately and the emissions previously reported under unclassified as a total have now been desegregated into the appropriate technology and properly reported in the CRF tables. Additionally, information on waste disposal has been presented with greater detail in the present report.

**(a) Waste generation**

Total municipal solid waste production, the amount of municipal solid waste to disposal sites and the composition of municipal solid waste have been revised for 2010 - 2014.

**(b) Methane generation rate constant**

A different methane generation rate value was chosen for this submission in order to be more applicable for Cyprus. Dry temperature constant was chosen in this submission according to the IPCC Guidelines, volume 5, pg. 3.18, Table 3.3. The Technical Expert Review Team (TERT) during the Emission Review procedure has also identified the methane generation rate that was used (wet temperature) in NIR2014 incorrect.

**(c) Time series of waste disposal data**

In NIR2015 data on waste disposal had been taken into consideration from 1990 onwards. Methane generation and emissions were therefore underestimated. The Technical Expert Review Team (TERT) during the Emission Review procedure has identified this issue. In this submission Cyprus uses data on waste disposal data for the last 50 years according to the IPCC guidelines (volume 5, pg. 3.6, Section 3.2.1).

**(d) Oxidation factor**

In NIR2015 the default value for oxidation factor was zero for all landfills. In NIR2016 the oxidation factor was changed to 0.1 for covered, well-managed landfills, according to IPCC guidelines (volume 5, pg. 3.15, table 3.2).

### 7.2.5. Source-specific planned improvement

There are no planned improvements for managed waste disposal sites.

## 7.3. Biological Treatment of solid waste (CRF 5B)

### 7.3.1. Composting - Municipal solid waste (5B1a)

Composting is an aerobic process and a large fraction of the degradable organic carbon (DOC) in the waste material is converted into carbon dioxide (CO2). CH4 is formed in anaerobic Sections of the compost, but it is oxidised to a large extent in the aerobic Sections of the compost. Composting can also produce emissions of $N_2O$.

$CH_4$ emissions from biological treatment of solid waste in 2015 accounted for 0.8% of total GHG emissions from Waste, 0.05% of total national emissions without LULUCF. The emissions from composting are presented in Table 7.17 and Figure 7.9.

**Table 7.17. Emissions from Composting 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| $CH_4$ (t) | NO | NO | NO | NO | 31.6 | 78.5 | 118.3 | 175.4 |
| $N_2O$ (t) | NO | NO | NO | NO | 1.90 | 4.71 | 7.10 | 10.53 |
| Total (Gg CO2 eq.) | NO | NO | NO | NO | 1.36 | 3.37 | 5.07 | 7.52 |

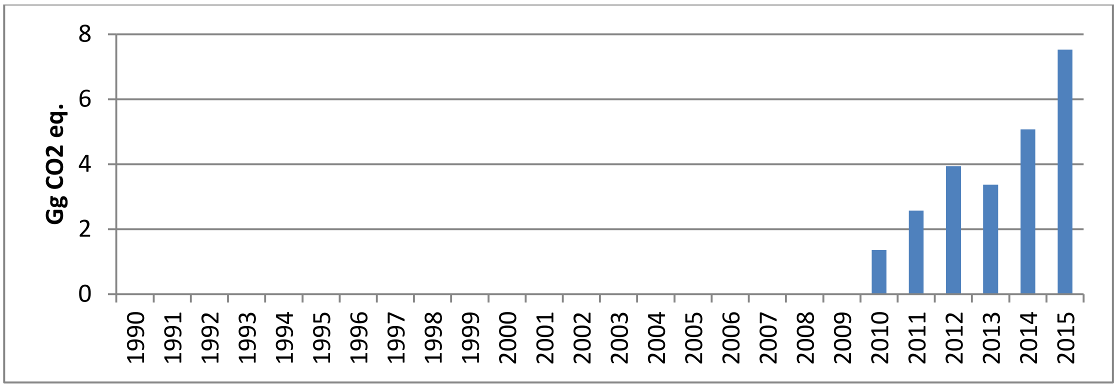


**Figure 7.9. Emissions from Composting 1990-2015**

#### 7.3.1.1. Methodological issues

The $CH_4$ and $N_2O$ emissions of the biological treatment have been estimated using the default method in equation 4.1 and 4.2 of 2006 IPCC guidelines, volume 5, page 4.5:

$$CH_4\ Emissions = \Sigma\ (M*EF)*10^{-3} - R$$

$$N_2O\ Emissions = \Sigma\ (M*EF)*10^{-3}$$

The activity data used is presented in Table 7.18. The emission factor for N2O emissions is assumed 0.24 g/kg as proposed in the corrigendum of the 2006 guidelines dated July 2015, compared to 0.3 g/kg in previous submissions.

**Table 7.18. Amount of municipal solid waste composted (M), 1000 t wet waste**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| M composted, 1000 t wet waste | NO | NO | NO | NO | 7.89 | 19.62 | 29.58 | 43.86 |

### 7.3.2. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

### 7.3.3. Source-specific QA / QC and verification

QA/QC and verification activities are presented in Section 1.6.

### 7.3.4. Source-specific recalculations

(a) Revised data for the years 2010 - 2014.
(b) The emission factor for N2O emissions is assumed 0.24 g/kg as proposed in the corrigendum of the 2006 guidelines dated July 2015, compared to 0.3 g/kg in previous submissions.

## 7.4. Incineration and Open Burning of Waste (CRF 5C)

Not occurring.

## 7.5. Wastewater treatment and discharge (CRF 5D)

Handling of domestic and industrial wastewater under anaerobic conditions produces $CH_4$. The issues concerning emissions from wastewater handling systems are considered separately because the types of activity data and emission factors needed for each are different.

Emissions from Wastewater treatment and discharge accounted for 10% of the total GHG emissions from Waste and 0.6% of total national emissions without LULUCF. The emissions from Wastewater treatment and discharge between 1990 and 2015 decreased by 61%. The emissions from these sources are presented in Table 7.19 and Figure 7.10.

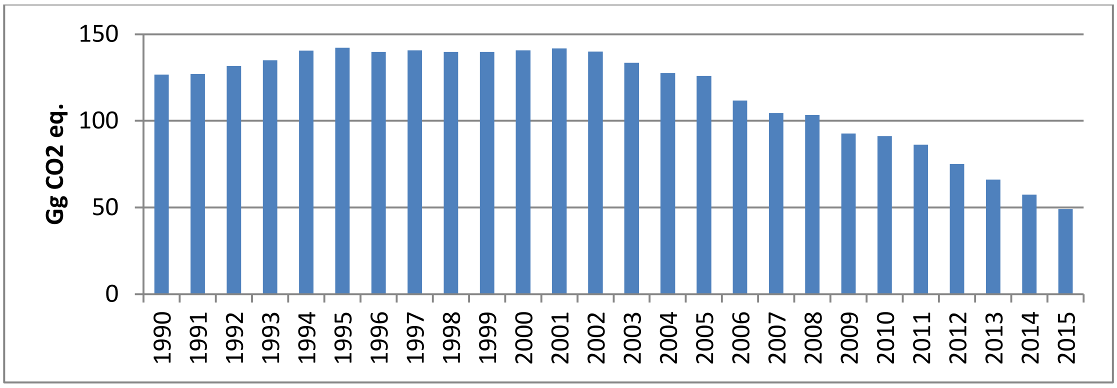


**Figure 7.10. Total emissions from Wastewater treatment and discharge (5D) 1990-2015**

**Table 7.19. Emissions from Wastewater treatment and discharge (5D) 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| CH4 (kt) | 4.58 | 5.12 | 5.04 | 4.46 | 2.99 | 1.98 | 1.64 | 1.31 |
| N2O (kt) | 0.041 | 0.048 | 0.049 | 0.048 | 0.055 | 0.055 | 0.055 | 0.055 |
| Total (Gg CO2 eq.) | 126.72 | 142.24 | 140.62 | 125.88 | 91.15 | 66.07 | 57.31 | 49.09 |

### 7.5.1. Domestic Wastewater (5D1)

In the field of urban waste water, in Cyprus during 2014, 89%[27] was served by a sewer and aerobic treatment systems or addressed by IAS (Individual Appropriate Systems). The majority of the plants apply tertiary or more stringent treatment including activated sludge – sand filtration – chlorination or Membrane bioreactor – UV disinfection. Further information on additional wastewater treatment stations will be provided in later submissions.

Table 7.20 shows the load entering the UWWTPs currently in operation in population equivalent. Table 7.21 includes information on UWWTPs currently in operation, their capacity and type of treatment. Additional information for smaller stations shall be provided in later submissions.

**Table 7.20. Load entering the Urban Waste Water Treatment Plants (UWWTP) (p.e.)**

| UWW Name or IAS | Load Entering UWWTP or | Load Entering UWWTP or | Load Entering UWWTP or | Load Entering UWWTP or |
|---|---|---|---|---|

[27] 75.5% of the population equivalent (p.e.) under the provisions of the Urban Waste Water Treatment Directive 91/271/EEC

| | addressed by IAS 2007 | addressed by IAS 2009 | addressed by IAS 2011 | addressed by IAS 2014 |
|---|---|---|---|---|
| Kakopetria | 1200 | 1200 | 1200 | 1200 |
| Paralimni | 68487 | 62700 | 52665 | 53500 |
| Ayia Napa | | | 37500 | 37500 |
| Livadhia Refugee Camp | 2000 | 2000 | 2000 | 2000 |
| Larnaca | 39090 | 68000 | 70000 | 70000 |
| Kyperounda | 2068 | 2068 | 2200 | 2200 |
| Platres | 1820 | 1820 | 2000 | 2000 |
| Agros | 2400 | 2400 | 2500 | 2500 |
| Limassol | 131178 | 130000 | 182926 | 193417 |
| Paphos | 50000 | 85300 | 123925 | 119611 |
| Dhali | 4710 | 4710 | 5000 | Not operated |
| Mia Milia | 140000 | 140000 | 140000 | Not operated |
| Central Vathia Gonia | 9240 | 13900 | 20068 | 1230 |
| Anthoupolis-A | 4800 | Not operated | Not operated | Not operated |
| Anthoupolis-B | Not operated | 26500 | 37706 | 34132 |
| Vathia-Gonia-A | Not operated | Not operated | 39781 | 57252 |
| Pelendri | Not operated | 2200 | 2200 | 2200 |
| Lythrodontas | Not operated | 2100 | 3500 | 3500 |
| Mia Milia B | Not operated | Not operated | Not operated | 157116 |
| IAS (including Central Vathia Gonia) | 9240 | 13900 | 26328 | 16219 |

**Table 7.21. Type of Treatment**

| UWW Name | Capacity | Primary | Secondary | Tertiary | Nitrogen Removal | Phosphorus Removal | UV | Chlorination | Ozonation | Sand Filtration | MBR Technology |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Kakopetria | 2200 | √ | √ | | | | | | | | |
| Paralimni | 68750 | √ | √ | √ | √ | √ | | √ | | √ | |
| Ayia Napa | 56250 | √ | √ | √ | √ | √ | | √ | | √ | |
| Livadhia Refugee Camp | 2000 | √ | √ | √ | | | | √ | | √ | |
| Larnaca | 70000 | √ | √ | √ | √ | | | √ | | √ | |
| Kyperounda | 3500 | √ | √ | √ | | | | √ | | √ | |
| Platres | 3500 | √ | √ | √ | | | | √ | | √ | |
| Agros | 5250 | √ | √ | √ | | | | √ | | √ | |
| Limassol | 272000 | √ | √ | √ | √ | √ | | √ | | √ | |
| Paphos | 162500 | √ | √ | √ | √ | √ | | √ | | √ | |
| Dhali | 5000 | √ | √ | √ | | | | √ | | √ | |
| Mia Milia | 160000 | √ | √ | | | | | | | | |
| Central Vathia Gonia | 45765 | √ | √ | √ | | | | √ | | √ | |
| Anthoupolis-A | 7200 | √ | √ | √ | | | | √ | | | |
| Anthoupolis-B | 130000 | √ | √ | √ | √ | √ | | | | | √ |
| Vathia-Gonia-A | 201667 | √ | √ | √ | √ | √ | √ | | | | √ |
| Pelendri | 3000 | √ | √ | √ | | | | √ | | √ | |
| Lythrodontas | 3500 | √ | √ | √ | | | | √ | | √ | |
| Mia Milia B | 269117 | √ | √ | √ | √ | √ | | | | | √ |

The wastewater produced by the remaining population is collected in septic tanks where anaerobic conditions are dominant. 10% of this wastewater is collected by authorised wastewater collectors and transported to aerobic wastewater treatment plants. Some industrial wastewater may be discharged into municipal sewer lines where it combines with domestic wastewater provided that the organic load of the wastewater is reduced to the limits set in the wastewater disposal permit issued by the Department of Environment. The CH4 emissions and N2O emissions from this source are presented in Table 7.22 and Figure 7.11.

**Table 7.22. Total emissions from Domestic wastewater 1990-2015**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| CH4 (Gg) | 3.6092 | 3.9639 | 3.9273 | 3.4305 | 1.8991 | 0.9341 | 0.5899 | 0.2603 |
| N2O (Gg) | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| **Total (Gg CO2 eq.)** | **102.21** | **113.06** | **112.39** | **99.74** | **63.60** | **39.55** | **30.74** | **22.53** |

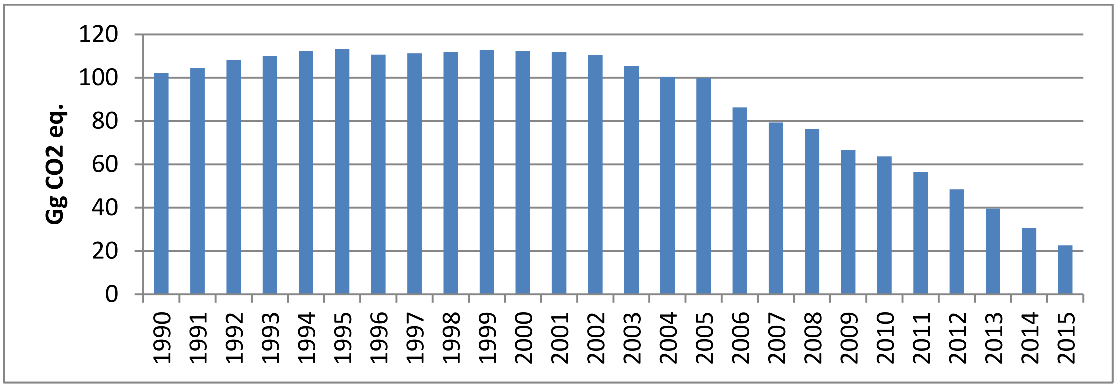


**Figure 7.11. Total emissions from Domestic wastewater (5D1) 1990-2015**

### 7.5.1.1. Methodological issues

**Methane Emissions from Domestic wastewater**

The IPCC Guidelines describe a single method for calculating CH4 emissions from domestic wastewater handling. Emissions are a function of the amount of waste generated and an emission factor that characterises the extent to which this waste generates CH4. The general equation is as follows (equation 6.1, pg. 6.11, volume 5, 2006 IPCC).

$$CH4\ Emissions = [\Sigma(U_i * T_{i,j} * EF_j)](TOW - S) - R$$

Where $U_i$ is the fraction of population in income group i in inventory year, $T_{i,j}$ is the degree of utilisation of treatment/discharge pathway or system for each income group fraction i in inventory year, *EF* is the emission factor, *TOW* is the total organics in wastewater, *S* is the organic component removed as sludge , *R* is the amount of CH4 recovered.

No CH4 is recovered and flared or used for energy therefore methane recovery is assumed 0.

<u>Total organic waste (TOW)</u>

The activity data for this source category is the amount of organic waste in a country. Total Organic Waste (TOW) is a function of human population and waste generation per person, and is expressed in terms of biochemical oxygen demand (equation 6.3, pg. 6.13, volume 5, 2006 IPCC):

*TOW = P * BOD*0.001*I*365*

where TOW is the total organic waste (kg BOD/yr), P is the country population (person) and BOD is the country specific per capita BOD in the inventory year (g/person/day), 0.001 is the conversion from grams BOD to kg BOD and I is the correction factor for additional industrial BOD discharged into sewers (for collected the default is 1.25, for uncollected the default is 1.00). Wastewater disposed in septic tanks is considered as uncollected and 1 is used as a correction factor (compared to 1.25 in previous submissions).

The population used and the estimated TOW are presented in Table 7.23.

**Table 7.23. Human population and total organic waste**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| Human population (1000s) | 587.1 | 603.1 | 619.2 | 632.9 | 645.4 | 656.3 | 666.3 | 675.2 | 682.9 |
| TOW (Gg BOD/yr) | 13.06 | 13.42 | 13.78 | 14.10 | 14.37 | 14.66 | 15.00 | 15.23 | 15.43 |

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| Human population (1000s) | 690.5 | 697.5 | 705.5 | 713.7 | 722.9 | 733 | 744 | 757.9 | 776.4 |
| TOW (Gg BOD/yr) | 15.62 | 15.82 | 16.06 | 16.34 | 16.74 | 17.19 | 17.51 | 18.33 | 19.11 |

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Human population (1000s) | 796.9 | 819.1 | 839.8 | 862.0 | 865.9 | 858.0 | 847.0 | 848.3 |
| TOW (Gg BOD/yr) | 19.79 | 20.72 | 21.41 | 22.25 | 22.64 | 22.71 | 22.70 | 23.01 |

Emission factor

The emission factor for each waste type is a function of the maximum methane producing potential of each waste type ($B_o$) and the weighted average of the methane conversion factors (MCFs) for the different wastewater treatment systems used in the country, as shown in the equation below (equation 6.2, pg. 6.12, volume 5, IPCC guidelines). The MCF indicates the extent to which the methane producing potential ($B_o$) is realised in each type of treatment method.

$$Emission\ Factor = Bo \bullet MCF_j$$

where Bo is the maximum methane producing capacity (kg CH4/kg BOD) and $MCF_j$ is the methane conversion factor (fraction).

The value used for the maximum methane producing capacity ($B_o$) is the value proposed as default by the IPCC guidelines, i.e. 0.6 kg CH4/kg BOD (table 6.2, pg. 6.12, volume 5). The values used for the methane correction factor ($MCF_j$) for septic system is 0.5 (table 6.3, pg. 6.13, volume 5, 2006 IPCC guidelines). Following a recommendation of the ERT during the in-country review of the 2016 submission, the methane correction factor ($MCF_j$) has been changed from 0 which is the default for centralised, aerobic treatment plant to 0.3 which is the default for not well managed, centralised, overloaded aerobic treatment (table 6.3, pg. 6.13, volume 5, 2006 IPCC guidelines), until sufficient information is available for the wastewater treatment plants in Cyprus to justify the use of 0.

According to further investigation from TERT during the 2017 annual review of the issue it was found that the European Commission published a database on all waste water treatment plants which shows the status of compliance of those plants with EU legislation. This source also contains information on the Cypriot plants (http://uwwtd.oieau.fr/Cyprus/uwwtps/compliance ). According to this website, all but one of the Cypriot waste water treatment plants are fully compliant with UWWTD (Urban Waste Water Treatment Directive)-standards. Most important is the compliance on DOC5. DOC5 is the biodegradable part of the organic load into the waste water treatment plant. All experts in the TERT agree that when a plant is overloaded or not well managed, an increase in DOC5 is expected, before an increased methane emissions becomes apparent. The single plant that is not compliant with legislation in Cyprus still does comply with the DOC5-criterion. For the TERT the information provided on this website seems to prove that all Cypriot waste water treatment plants are well-managed and therefore a MCF=0 for collected waste water is justified. As there is an independent EU information that demonstrates compliance of wastewater treatment plants in Cyprus, CH4 emissions based on an MCF of 0.3 are not justified. The calculation for 2015 recalculated with an MCF of 0

Amount of waste treated aerobically

All the sewage treatment plants in Cyprus are using aerobic treatment. The wastewater Information on the percentage of national population connected to wastewater collection and treatment systems is available for 1992-2005, 2007 and 2009. For the years 1990 and 1991, it has been assumed that value is the same as 1992, since not many changes have taken place regarding wastewater treatment during 1990 and 1992. The percentage of national population connected to wastewater collection and treatment systems for the years 2006, 2008 and 2010-2012, were estimated using the linear trend that is created between 2001 and 2009, which has the equation y=0.0595x-0.5937 (see Figure 7.12).

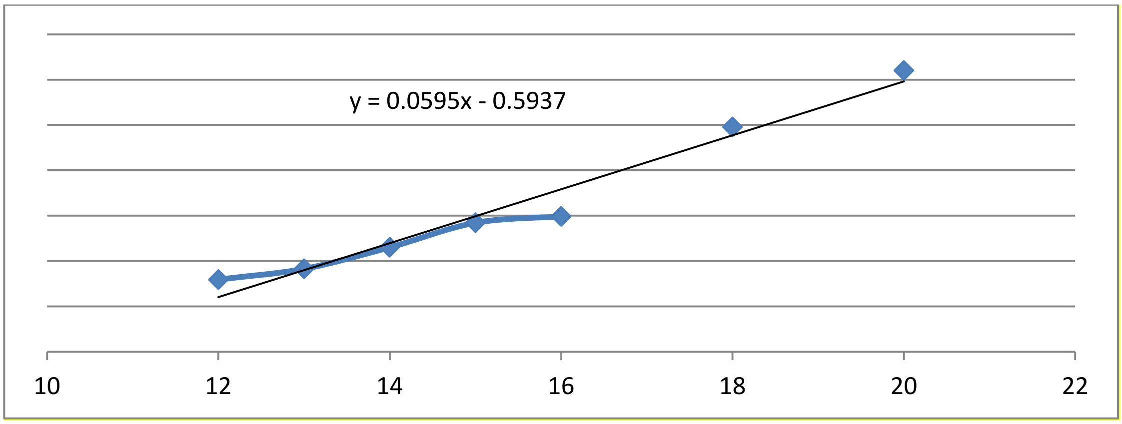


**Figure 7.12. Linear trend that is created between percentage of national population connected to wastewater collection and treatment systems for the years 2001 and 2009 and time (where 1990=1)**

Amount of waste treated anaerobically

The amount of waste treated anaerobically is the remaining when the amount of waste treated aerobically is subtracted from 100%. The percentage of national population served by anaerobic treatment is presented in Table 7.24.

**Table 7.24. Percentages of national population served by aerobic and anaerobic treatment**

| | Percentage of national population connected to wastewater collection and treatment systems | Percentage of population served by septic tanks |
|---|---|---|
| **1990** | 6.4% | 93.6% |
| **1991** | 6.4% | 93.6% |
| **1992** | 6.4% | 93.6% |
| **1993** | 6.8% | 93.2% |
| **1994** | 6.7% | 93.3% |
| **1995** | 8.1% | 91.9% |
| **1996** | 11.2% | 88.8% |
| **1997** | 12.0% | 88.0% |
| **1998** | 12.8% | 87.2% |
| **1999** | 13.3% | 86.7% |
| **2000** | 14.3% | 85.7% |
| **2001** | 15.9% | 84.1% |
| **2002** | 18.3% | 81.7% |
| **2003** | 23.0% | 77.0% |
| **2004** | 28.5% | 71.5% |
| **2005** | 29.8% | 70.2% |
| **2006** | 41.8% | 58.2% |
| **2007** | 49.6% | 50.4% |
| **2008** | 53.7% | 46.3% |
| **2009** | 62.0% | 38.0% |
| **2010** | 65.6% | 34.4% |
| **2011** | 71.5% | 28.5% |
| **2012** | 77.5% | 22.5% |
| **2013** | 83.4% | 16.6% |
| **2014** | 89.4% | 10.6% |
| **2015** | 95.3% | 4.7% |

<u>% BOD reduction</u>

BOD reduction coefficient is assumed 50%.

For category waste water treatment and discharge for domestic waste water and the gas CH4, the TERT noted during the NIR2015 review that the IEF for CH4 emissions from domestic wastewater was very low in comparison to other Member States. The TERT identified a large amount of sludge (90% of total TOW), which was assumed to be removed from the waste water. As a result the fraction of TOW that was assumed to be converted to CH4 after waste water treatment was low and this resulted in low CH4 emissions. The TERT considered the amounts of sludge removed as not realistic and too high. Also for wastewater treatment in septic tanks Cyprus assumed that 90% of the organic material is removed as sludge. In the IPCC Guidelines (Table 6.3) an MCF for septic tanks is given as 0.5 and a remark is added, that 50% of the organic material settles in the tank as sludge. This seems to imply that sludge removal is already accounted for in the MCF. So this MCF should be applied to total TOW, treated in septic tanks and not to TOW subtracted by organic material removed in sludge.

<u>Sludge</u>

The IPCC Guidelines propose a separate calculation for wastewater and for sludge removed from the wastewater. The distinction however is inappropriate for Cyprus, because sludge is not collected separately. Nevertheless, the total organic product of sludge is 0 for all years, since according to the revised IPCC1996 guidelines (workbook, pg. 6.21) the fraction of degradable organic component remove in sludge is 0.

**Nitrous oxide Emissions from domestic wastewater**

The emissions of $N_2O$ from wastewater effluent according to the IPCC2006 guidelines (volume 5, pg. 6.25) are calculated using the following equation:

$$N_2O\ emissions = N_{EFFLUENT} * EF_{EFFLUENT} * 44/28$$

where $N_2O_{(s)}$ is the $N_2O$ emissions from wastewater effluent in kg $N_2O$ -N/yr, $N_{EFFLUENT}$ is the nitrogen in the effluent discharged to aquatic environments, $EF_{EFFLUENT}$ is the emissions factor for N2O emissions from discharged to wastewater (default 0.005 kg $N_2O$-N/kg, page 6.25, volume 5). The factor 44/28 is the conversion of kg N2O-N into kg N2O.

The $N_{EFFLUENT}$ is estimated using the following equation (equation 6.8, pg. 6.25, volume 5):

$$N_{EFFLUENT} = (P * Protein * F_{NPR} * F_{NON\text{-}CON} * F_{IND\text{-}COM}) - N_{SLUDGE}$$

Where P is the human population, Protein is the annual per capita protein consumption in kg/person/yr, $F_{NPR}$ is the fraction on nitrogen in protein (default value = 0.16 in kg N/kg protein), $F_{NON\text{-}CON}$ is the factor for non-consumed protein added to the wastewater, $F_{IND\text{-}COM}$ is factor for industrial and commercial co-discharged protein into the sewer system and $N_{SLUDGE}$ is the nitrogen removed with sludge (default = zero) in kg N/yr.

The population and the annual protein intake per capita used are presented in Table 7.25.

The protein supply quantity (g/capita/day) is according to FAO information[28]. For 2012-2015, the protein intake was assumed that same as 2011.

**Table 7.25. Human population and annual protein intake per capita**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| Human population (1000s) | 587.1 | 603.1 | 619.2 | 632.9 | 645.4 | 656.3 | 666.3 | 675.2 | 682.9 |
| Protein intake (kg/person/yr) | 31.1 | 29.7 | 32.4 | 31.6 | 31.4 | 32.4 | 30.9 | 30.8 | 31.6 |

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| Human population (1000s) | 690.5 | 697.5 | 705.5 | 713.7 | 722.9 | 733 | 744 | 757.9 | 776.4 |
| Protein intake (kg/person/yr) | 31.8 | 31.1 | 31.1 | 30.9 | 29.3 | 29.4 | 28.7 | 27.8 | 29.5 |

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Human population (1000s) | 796.9 | 819.1 | 839.8 | 862.0 | 865.9 | 858.0 | 847.0 | 848.3 |
| Protein intake (kg/person/yr) | 29.8 | 28.9 | 29.3 | 28.8 | 28.8 | 28.8 | 28.8 | 28.8 |

### 7.5.1.2. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

[28]http://faostat3.fao.org/download/FB/FBS/E

### 7.5.1.3. Source-specific QA / QC and verification

QA/QC and verification activities are presented in Section 1.6.

### 7.5.1.4. Source-specific recalculations

The emissions from this source have been recalculated due to the change of (a) the protein supply quantity, (b) the % BOD reduction following the TERT's recommendation in trial review and (c) Wastewater disposed in septic tanks is considered as uncollected and 1 is used as a correction factor (compared to 1.25 in previous submissions).

Following a recommendation of the ERT during the in-country review of the 2016 submission, the methane correction factor ($MCF_j$) has been changed from 0 which is the default for centralised, aerobic treatment plant to 0.3 which is the default for not well managed, centralised, overloaded aerobic treatment (table 6.3, pg. 6.13, volume 5, 2006 IPCC guidelines), until sufficient information is available for the wastewater treatment plants in Cyprus to justify the use of 0.

According to further investigation from TERT during the 2017 annual review of the issue it was found that the European Commission published a database on all waste water treatment plants which shows the status of compliance of those plants with EU legislation. This source also contains information on the Cypriot plants (http://uwwtd.oieau.fr/Cyprus/uwwtps/compliance ). According to this website, all but one of the Cypriot waste water treatment plants are fully compliant with UWWTD (Urban Waste Water Treatment Directive)-standards. Most important is the compliance on DOC5. DOC5 is the biodegradable part of the organic load into the waste water treatment plant. All experts in the TERT agree that when a plant is overloaded or not well managed, an increase in DOC5 is expected, before an increased methane emissions becomes apparent. The single plant that is not compliant with legislation in Cyprus still does comply with the DOC5-criterion. For the TERT the information provided on this website seems to prove that all Cypriot waste water treatment plants are well-managed and therefore a MCF=0 for collected waste water is justified. As there is an independent EU information that demonstrates compliance of wastewater treatment plants in Cyprus, CH4 emissions based on an MCF of 0.3 are not justified. The calculation for 2015 recalculated with an MCF of 0

The impact of the MCF change to the emissions of 4D1 is presented in Table 7.26 and decreases from -1.8% in 1990 to -63.9% in 2015.

**Table 7.26. Changes in emissions from domestic wastewater treatment caused by changes in MCF (1990-2014)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| After ERT recommendation (2016 review) | | | | | | | |
| CH4 (kt) | 3.68 | 3.78 | 3.89 | 3.96 | 4.04 | 4.07 | 4.03 |
| N2O (kt) | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 |
| Total (Gg CO2 eq.) | 104.1 | 106.3 | 110.3 | 112.1 | 114.3 | 115.7 | 114.4 |
| After TERT2017 recommendation | | | | | | | |
| CH4 (kt) | 3.61 | 3.71 | 3.81 | 3.87 | 3.96 | 3.96 | 3.89 |
| N2O (kt) | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 |
| Total (Gg CO2 eq.) | 102.21 | 104.42 | 108.32 | 109.95 | 112.19 | 113.06 | 110.69 |
| Change | | | | | | | |
| *% change to initial submission* | *-1.8%* | *-1.8%* | *-1.8%* | *-1.9%* | *-1.8%* | *-2.3%* | *-3.2%* |

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| After ERT recommendation (2016 review) | | | | | | | |
| CH4 (kt) | 4.06 | 4.08 | 4.11 | 4.12 | 4.12 | 4.09 | 3.98 |
| N2O (kt) | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Total (Gg CO2 eq.) | 115.2 | 116.2 | 117.2 | 117.3 | 117.4 | 116.7 | 113.5 |
| AfterTERT2017recommendation | | | | | | | |
| CH4 (kt) | 3.90 | 3.91 | 3.93 | 3.93 | 3.90 | 3.83 | 3.66 |
| N2O (kt) | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Total (Gg CO2 eq.) | 111.21 | 111.94 | 112.72 | 112.39 | 111.85 | 110.28 | 105.27 |
| Change | | | | | | | |
| *% change to initial submission* | *-3.5%* | *-3.6%* | *-3.8%* | *-4.1%* | *-4.7%* | *-5.5%* | *-7.2%* |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| After ERT recommendation (2016 review) | | | | | | | |
| CH4 (kt) | 3.86 | 3.87 | 3.52 | 3.33 | 3.27 | 3.05 | 2.98 |
| N2O (kt) | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Total (Gg CO2 eq.) | 110.5 | 110.7 | 101.9 | 98.3 | 97.3 | 91.7 | 90.7 |
| AfterTERT2017recommendation | | | | | | | |
| CH4 (kt) | 3.45 | 3.43 | 2.90 | 2.57 | 2.43 | 2.04 | 1.90 |
| N2O (kt) | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Total (Gg CO2 eq.) | 100.26 | 99.74 | 86.31 | 79.36 | 76.22 | 66.64 | 63.60 |
| Change | | | | | | | |
| *% change to initial submission* | *-9.3%* | *-9.9%* | *-15.3%* | *-19.3%* | *-22.2%* | *-27.3%* | *-29.8%* |

| | 2011 | 2012 | 2013 | 2014 | 2015 | | |
|---|---|---|---|---|---|---|---|
| After ERT recommendation (2016 review) | | | | | | | |
| CH4 (kt) | 2.83 | 2.60 | 2.34 | 2.08 | 1.85 | | |
| N2O (kt) | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | | |
| Total (Gg CO2 eq.) | 87.0 | 81.4 | 74.8 | 68.1 | 62.38 | | |
| AfterTERT2017recommendation | | | | | | | |
| CH4 (kt) | 1.61 | 1.28 | 0.93 | 0.59 | 0.26 | | |
| N2O (kt) | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | | |
| Total (Gg CO2 eq.) | 56.59 | 48.38 | 39.55 | 30.74 | 22.53 | | |
| Change | | | | | | | |
| *% change to initial submission* | *-34.9%* | *-40.6%* | *-47.1%* | *-54.9%* | *-63.9%* | | |

#### 7.5.1.5. Source-specific planned improvement

No source specific improvements are planned.

### 7.5.2. Industrial wastewater (5D2)

The principal factor that determines methane generation potential of wastewater is the amount of organic material in the wastewater stream. For industrial wastewater, this is indicated by the Chemical Oxygen Demand (COD). COD indicates the total amount of carbon, biodegradable and non-biodegradable, that is available for oxidation. According to IPCC guidelines, industrial production should be grouped according to their methane production potential. The main groups are paper and pulp manufacture, slaughterhouses, alcohol, beer, starch, organic chemicals and others (vegetable oil production, textiles, rubber, petroleum refineries, fruits and vegetables). The industrial activities taking place in Cyprus are predominately food and drink industries.

Regarding the treatment of wastewaters produced by the manufacturing processes implemented, the following apply:

- Alcohol - Cyprus has one (1) installation producing alcohol and its wastewater is treated by anaerobic digestion, subsequently by further aerobic treatment and the final effluent is discharged into the local municipal sewerage system.
- Beer - Wastewater derived by two (2) brewery installations, are also treated by anaerobic digestion and subsequently by further aerobic treatment. One is discharging the final effluent into the local municipal sewerage system and the other is using the effluent for irrigation.
- Dairy products - Wastewater derived by one (1) dairy installation are treated by anaerobic digestion and subsequently by further aerobic treatment and the final effluent is discharged into the local municipal sewerage system.
- Meat and Poultry - Wastewater derived by meat and poultry installations are treated by anaerobic digestion plans treating mainly pig slurry and subsequently by further aerobic treatment and their final disposal to evaporation lagoons.
- Vegetable oils - Cyprus has several olive oil mills. A portion of their wastewater are treated by anaerobic digestion plans treating mainly pig slurry. In addition, during the process of producing biodiesel from used cooking oils, glycerol is produced and it is mainly treated by anaerobic digestion.
- Veg., fruits and juices – soft drinks. Cyprus has one (1) installation that is treating wastewater and other waste deriving from vegetables, fruits, juices and soft drinks production by anaerobic digestion.

Even though the actual industrial production has decreased considerably during 1990-2015, emissions from industrial wastewater increased by 8.4% during the same period (Table 7.27, Figure 7.14). This increase has been caused by the increase in the amount of waste treated by anaerobic digestion and therefore the methane produced. Emission estimates from this source have been revised due to availability of new data for 2014.

**Table 7.27. Total emissions from industrial wastewater 1990-2015**

| | **1990** | **1995** | **2000** | **2005** | **2010** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|
| $CH_4$ (t) | 968 | 1153 | 1115 | 1034 | 1091 | 1050 | 1052 | 1052 |
| $N_2O$ (t) | 1.04 | 1.24 | 1.18 | 0.96 | 0.93 | 0.87 | 0.86 | 0.86 |
| **Total (Gg $CO_2$ eq.)** | **24.51** | **29.18** | **28.23** | **26.13** | **27.55** | **26.52** | **26.56** | **26.56** |

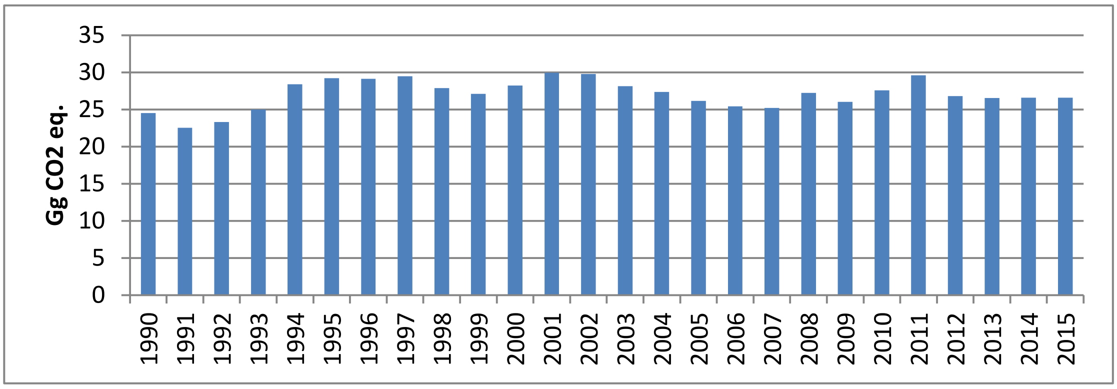

**Figure 7.14. Emissions from industrial wastewater 1990-2015**

### 7.5.2.1. Methodological issues

**Methane emissions**

According to the IPCC guidelines, to estimate total emissions from wastewater, the selected emissions factors are multiplied by the associated organic wastewater production and summed. The amount of $CH_4$ recovered and thus not emitted into the atmosphere for each handling method should be subtracted: no methane recovery takes place in Cyprus therefore recovery is assumed 0. The sum of the emissions for each handling method provides the total $CH_4$ emissions from industrial wastewater. In equation form, the estimate of total CH4 emissions from wastewater handling is as follows (equation 6.4, 2006 IPCC guidelines, volume 5 pg. 6.20):

$$CH4\ Emissions = \Sigma[(TOW_i - S_i) * EF_i - R_i]$$

where CH4 emissions is the total methane emissions from wastewater in kg CH4, TOWi is the total organically degradable material in wastewater from industry i in kg COD/yr, Si is the organic component removed as sludge in inventory year, kg COD/yr, EFi is the emission factor for industry i in kg CH4/kg COD and Ri is the total amount of methane recovered in kg CH4/yr.

To estimate total organic wastewater (TOW) for a particular industry the following equation should be used (equation 6.6, IPCC2006 guidelines, volume 5, pg. 6.22):

$$TOWi = Pi \times Wi \times COD$$

where TOW is the total industrial organically material in wastewater for industry in kg COD/yr, P is the total industrial product for industrial sector W is the wastewater generated in m3/tonne of product, COD is the chemical oxygen demand (industrial degradable organic component in kg COD/m3 wastewater.

To estimate the emission factor for industrial wastewater, the following equation is proposed by the IPCC guidelines (Equation 6.5, IPCC2006 guidelines, volume 5,pg. 6.21):

$$EF_j = B_o \times MCF_j$$

where$EF_j$ is the emission factor (kg CH4 /kg DC) for each treatment (e.g. aerobic treatment, anaerobic digester for sludge, etc.), Bo is the maximum methane producing capacity (kg CH4/kg DC), $MCF_j$ is the methane conversion factor. Since no country specific data is available, Bo is considered 0.25 (2006 IPCC guidelines, volume 5, pg. 6.21).

In words, the methodology applied for the estimation of methane emissions from industrial wastewater is the following:

(a) Collection of data for industrial production (Table 7.29).

(b) Total industrial organic wastewater was estimated by multiplying the industrial production by the wastewater generation coefficients and by COD in Table 7.30 (2006 IPCC guidelines, volume 5, pg. 6.22, Table 6.8).

(c) Organically Degradable material (TOW) in Gg is the sum of the TOW of each industrial product divided by 1,000,000 (Table 7.31).
(d) The wastewater generated was categorised to anaerobic and aerobic treatment according to the assumptions of Table 7.32.
(e) Methane conversion factor was assumed 0.3 for aerobic treatment following a recommendation of the ERT during the in-country review of the 2016 submission. In the initial submission, the MCF used was 0 which is the default for centralised. 0.3, which is currently used is the default for not well managed, centralised, overloaded aerobic treatment (table 6.3, pg. 6.13, volume 5, 2006 IPCC guidelines). This change has been made until sufficient information is available for the wastewater treatment plants in Cyprus to justify the use of 0. 0.8 was used for anaerobic treatment, according to the 2006 IPCC guidelines (pg. 6.21, volume 5). Maximum producing capacity was assumed 0.25 kg CH4 / kg according to the 2006 IPCC guidelines (pg. 6.21, volume 5). The resulting methane emission factor estimated according to waste stream is presented in Table 7.33.
(f) The emission factor for each waste streams was multiplied by the TOW (kg COD/ year) of the respective waste stream to estimate the annual emissions of methane per waste stream. The total CH4 emissions are the sum of the CH4 emitted per waste stream.

Data for industrial production

Detailed statistics on industrial production in Cyprus do not exist. Therefore data on industrial consumption is used instead. Another issue associated with the national statistics on industrial activity, is that the sales of industrial products for the year x-2 (which in this case is 2015) are completed and published in the summer after the inventory has to be submitted (which in this case is summer 2017). Therefore, the 2015 “production" is assumed to be equal to the 2014 “production”. The industrial production data used is presented in Table 7.28.

**Table 7.28. Industrial production 1990-2015**

| **Gg product** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** |
|---|---|---|---|---|---|---|---|
| Alcohol | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 0.9 |
| Beer | 33.1 | 34.8 | 36.6 | 36.1 | 35.6 | 35.2 | 33.1 |
| Soft drinks | 46.6 | 50.5 | 54.7 | 55.4 | 56.2 | 56.9 | 57.5 |
| Dairy products | 60.7 | 64.6 | 68.8 | 71.2 | 73.9 | 76.7 | 81.1 |
| Meat & poultry | 64.4 | 63.1 | 67.7 | 76.0 | 80.9 | 81.0 | 88.0 |
| Refinery | 635.3 | 763.2 | 727.1 | 781.2 | 896.8 | 827.9 | 760.0 |
| Soaps & detergents | 12.1 | 12.9 | 13.8 | 10.9 | 9.8 | 9.5 | 9.0 |
| Vegetable oils | 21.7 | 24.9 | 28.6 | 27.5 | 26.5 | 25.7 | 28.1 |
| Vegetables, fruits & juices | 47.9 | 34.9 | 34.0 | 38.0 | 52.1 | 56.3 | 53.0 |
| Wine | 49.4 | 52.8 | 56.5 | 56.3 | 56.0 | 55.8 | 54.3 |

| **Gg product** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** |
|---|---|---|---|---|---|---|---|
| Alcohol | 1.0 | 1.0 | 2.1 | 2.6 | 3.9 | 3.8 | 2.5 |
| Beer | 33.3 | 36.5 | 40.5 | 40.9 | 40.4 | 38.3 | 36.7 |
| Soft drinks | 58.3 | 59.3 | 60.0 | 60.9 | 62.7 | 62.3 | 62.1 |
| Dairy products | 81.4 | 86.3 | 84.1 | 83.3 | 89.5 | 92.4 | 93.2 |
| Meat & poultry | 97.0 | 93.7 | 69.5 | 80.5 | 87.8 | 90.0 | 92.4 |
| Refinery | 1042.7 | 1082.6 | 1140.4 | 1134.8 | 1115.1 | 1045.5 | 931.9 |
| Soaps & detergents | 7.1 | 7.2 | 7.2 | 7.0 | 7.8 | 8.1 | 6.2 |
| Vegetable oils | 26.3 | 22.7 | 23.2 | 21.8 | 20.1 | 21.3 | 19.4 |
| Vegetables, fruits & juices | 52.5 | 48.0 | 49.0 | 49.9 | 51.6 | 48.7 | 44.2 |
| Wine | 42.0 | 30.9 | 43.2 | 37.4 | 34.5 | 37.5 | 35.5 |

| Gg product | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| Alcohol | 1.9 | 1.3 | 1.2 | 1.0 | 0.9 | 0.7 | 0.7 |
| Beer | 37.1 | 37.7 | 37.4 | 39.8 | 42.7 | 35.7 | 34.3 |
| Soft drinks | 60.5 | 66.6 | 58.3 | 62.5 | 62.9 | 59.4 | 57.9 |
| Dairy products | 93.9 | 96.3 | 99.5 | 97.8 | 112.1 | 104.1 | 106.0 |
| Meat & poultry | 93.4 | 95.5 | 94.0 | 94.5 | 102.1 | 99.1 | 105.6 |
| Refinery | 269.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Soaps & detergents | 7.4 | 6.1 | 6.2 | 6.3 | 6.8 | 6.9 | 7.1 |
| Vegetable oils | 19.6 | 19.3 | 19.1 | 18.1 | 18.2 | 16.3 | 16.9 |
| Vegetables, fruits & juices | 42.1 | 37.6 | 34.4 | 35.4 | 40.6 | 40.4 | 45.5 |
| Wine | 31.7 | 29.8 | 26.5 | 20.2 | 15.9 | 12.4 | 11.1 |

| Gg product | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| Alcohol | 0.6 | 0.7 | 0.7 | 0.6 | 0.6 |
| Beer | 32.2 | 33.0 | 32.9 | 32.8 | 32.8 |
| Soft drinks | 54.6 | 35.6 | 26.0 | 10.8 | 10.8 |
| Dairy products | 109.3 | 106.2 | 100.9 | 99.8 | 99.8 |
| Meat & poultry | 103.6 | 96.0 | 83.6 | 79.7 | 79.7 |
| Refinery | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Soaps & detergents | 6.7 | 7.1 | 6.5 | 7.3 | 7.3 |
| Vegetable oils | 15.7 | 14.3 | 12.2 | 12.6 | 12.6 |
| Vegetables, fruits & juices | 56.5 | 48.0 | 54.5 | 57.9 | 57.9 |
| Wine | 14.2 | 10.9 | 11.5 | 11.0 | 11.0 |

Industrial organic wastewater

Wastewater production was estimated by multiplying the industrial production by the wastewater generation coefficients in Table 7.29 (volume 5, pg. 6.22, Table 6.8).

**Table 7.29. Wastewater generation coefficient ($m^3$ /t product) and COD concentration (kg COD/m3) according to industrial product**

| | Wastewater generation ($m^3$/t) | COD (kg/$m^3$) |
|---|---|---|
| Alcohol | 24 | 11 |
| Beer | 6.3 | 2.9 |
| Soft drinks | 2 [a] | 2 [a] |
| Dairy products | 7 | 2.7 |
| Meat& poultry | 13 | 4.1 |
| Refinery | 0.6 | 1.0 |
| Soaps& detergents | 3.0 [a] | 0.9 [a] |
| Vegetable oils | 3.1 | 0.9 [a] |
| Vegetables, fruits & juices | 20.0 | 5.0 |
| Wine | 23.0 | 1.5 |

[a]IPCC Good Practice Guide 2000, pg. 5.22

Total organic wastewater

Total organically degradable material in wastewater in kg COD/year per industrial product was then estimated by multiplying the industrial production by the wastewater generated and by the COD coefficient of each industrial product (2006 IPCC guidelines, p.6.22). The sum of the TOW of each industrial product divided by $10^6$ is presented in Table 7.30.

**Table 7.30. Total organically degradable material (Gg), 1990-2015**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| Gg DC | 12.61 | 11.55 | 11.96 | 12.85 | 14.64 | 15.07 | 15.04 | 15.22 | 14.40 | 13.98 |

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|
| Gg DC | 14.58 | 15.49 | 15.38 | 14.53 | 13.72 | 13.08 | 12.53 | 12.42 | 13.51 | 12.86 |

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| Gg DC | 13.68 | 14.75 | 13.28 | 13.14 | 13.16 | 13.6 |

Categorisation of wastewater treatment to aerobic and anaerobic

The wastewater generated was categorised to anaerobic and aerobic treatment according to the assumptions of Table 7.31. The assumptions were prepared in collaboration with the Pollution Prevention Unit of the Department of Environment.

Methane emission factor

Methane conversion factor was assumed 0.3 for aerobic treatment and 0.8 for anaerobic treatment, according to the 2006 IPCC guidelines (volume 5, pg. 6.21, Table 6.7). Maximum producing capacity was assumed 0.25 kg CH4 / kg COD according to the 2006 IPCC guidelines (pg. 6.21, volume 5). The resulting methane emission factor estimated according to waste stream is presented in Table 7.32.

The aggregate MCF for all waste streams was multiplied by the total annual organic wastewater generation (kg COD/ year) to estimate the annual emissions of methane.

**Table 7.31. Treatment of waste by anaerobic treatment according to industrial production, 1990-2015**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| alcohol | 2.0% | 2.1% | 2.1% | 2.0% | 1.9% | 1.9% | 2.2% |
| beer | 20% | 19% | 18% | 18% | 19% | 19% | 20% |
| soft drinks | 1.00% | 0.92% | 0.85% | 0.84% | 0.83% | 0.82% | 0.81% |
| dairy products | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| meat & poultry | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| refinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| soaps & detergents | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| vegetable oils | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| veg., fruits & juices | 1.0% | 1.4% | 1.4% | 1.3% | 0.9% | 0.9% | 0.9% |
| wine | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| alcohol | 2.1% | 2.0% | 1.0% | 0.8% | 0.5% | 0.5% | 0.8% |
| beer | 20% | 18% | 16% | 16% | 16% | 17% | 18% |
| soft drinks | 0.80% | 0.79% | 0.78% | 0.76% | 0.74% | 0.75% | 0.75% |
| dairy products | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| meat & poultry | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| refinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| soaps & detergents | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| vegetable oils | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| veg., fruits & juices | 0.9% | 1.0% | 1.0% | 1.0% | 0.9% | 1.0% | 1.1% |
| wine | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| alcohol | 1.1% | 1.5% | 1.8% | 2.1% | 2.3% | 2.8% | 2.8% |
| beer | 18% | 18% | 18% | 17% | 15% | 19% | 19% |
| soft drinks | 0.77% | 0.70% | 0.80% | 0.75% | 0.74% | 0.78% | 0.80% |
| dairy products | 0 | 0 | 5.00% | 5.09% | 4.44% | 4.78% | 4.69% |
| meat & poultry | 5.00% | 4.89% | 4.97% | 4.95% | 4.57% | 4.71% | 4.42% |
| refinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| soaps & detergents | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| vegetable oils | 0 | 0 | 0.5% | 0.5% | 0.5% | 0.6% | 0.5% |
| veg., fruits & juices | 1.1% | 1.3% | 1.4% | 1.4% | 1.2% | 1.2% | 1.1% |
| wine | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| alcohol | 3.5% | 3.1% | 3.1% | 3.2% | 3.2% |
| beer | 21% | 20% | 20% | 20% | 20% |
| soft drinks | 0.85% | 1.31% | 1.79% | 4.31% | 4.31% |
| dairy products | 4.55% | 4.69% | 4.93% | 4.99% | 4.99% |
| meat & poultry | 4.51% | 4.86% | 5.59% | 5.86% | 5.86% |
| refinery | 0 | 0 | 0 | 0 | 0 |
| soaps & detergents | 0 | 0 | 0 | 0 | 0 |
| vegetable oils | 0.6% | 0.6% | 0.7% | 0.7% | 0.7% |
| veg., fruits & juices | 0.8% | 1.0% | 0.9% | 0.8% | 0.8% |
| wine | 0 | 0 | 0 | 0 | 0 |

**Table 7.32. Methane emission factor estimated according to waste stream (kg CH4/kg COD), 1990-2015**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| alcohol | 0.078 | 0.078 | 0.078 | 0.078 | 0.077 | 0.077 | 0.078 |
| beer | 0.100 | 0.099 | 0.098 | 0.098 | 0.098 | 0.099 | 0.100 |
| soft drinks | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 |
| dairy products | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| meat & poultry | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| refinery | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| soaps & detergents | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| vegetable oils | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| veg., fruits & juices | 0.076 | 0.077 | 0.077 | 0.077 | 0.076 | 0.076 | 0.076 |
| wine | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| alcohol | 0.078 | 0.078 | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 |
| beer | 0.100 | 0.098 | 0.095 | 0.095 | 0.095 | 0.097 | 0.098 |
| soft drinks | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 |
| dairy products | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| meat & poultry | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| refinery | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| soaps & detergents | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| vegetable oils | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| veg., fruits & juices | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 |
| wine | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| alcohol | 0.076 | 0.077 | 0.077 | 0.078 | 0.078 | 0.079 | 0.078 |
| beer | 0.097 | 0.097 | 0.097 | 0.096 | 0.094 | 0.098 | 0.099 |
| soft drinks | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 |
| dairy products | 0.075 | 0.075 | 0.081 | 0.081 | 0.081 | 0.081 | 0.081 |
| meat & poultry | 0.081 | 0.081 | 0.081 | 0.081 | 0.081 | 0.081 | 0.081 |
| refinery | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| soaps & detergents | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| vegetable oils | 0.075 | 0.075 | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 |
| veg., fruits & juices | 0.076 | 0.077 | 0.077 | 0.077 | 0.076 | 0.076 | 0.076 |
| wine | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| alcohol | 0.079 | 0.079 | 0.079 | 0.079 | 0.079 |
| beer | 0.101 | 0.100 | 0.100 | 0.100 | 0.100 |
| soft drinks | 0.076 | 0.077 | 0.077 | 0.080 | 0.080 |
| dairy products | 0.081 | 0.081 | 0.081 | 0.081 | 0.081 |
| meat & poultry | 0.081 | 0.081 | 0.082 | 0.082 | 0.082 |
| refinery | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| soaps & detergents | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |
| vegetable oils | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 |
| veg., fruits & juices | 0.076 | 0.076 | 0.076 | 0.076 | 0.076 |
| wine | 0.075 | 0.075 | 0.075 | 0.075 | 0.075 |

**Estimation of $N_2O$ emissions**

The nitrous oxide emissions were estimated by multiplying the total annual industrial wastewater production (Table 7.34) by the default emission factor of 0.25 g N2O/m3 wastewater according to CORINAIR.

**Table 7.34. Total industrial wastewater production (1000 m3/year), 1990-2015**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| Alcohol | 24 | 24 | 23 | 24 | 25 | 26 | 22 |
| Beer | 208 | 219 | 231 | 227 | 225 | 222 | 208 |
| Soft drinks | 93 | 101 | 109 | 111 | 112 | 114 | 115 |
| Dairy products | 425 | 452 | 481 | 499 | 517 | 537 | 568 |
| Meat & poultry | 837 | 820 | 880 | 987 | 1052 | 1052 | 1145 |
| Refinery | 381 | 458 | 436 | 469 | 538 | 497 | 456 |
| Soaps &detergents | 36 | 39 | 41 | 33 | 29 | 29 | 27 |
| Vegetable oils | 67 | 77 | 89 | 85 | 82 | 80 | 87 |
| Veg., fruits & juices | 959 | 698 | 680 | 759 | 1041 | 1127 | 1060 |
| Wine | 1136 | 1215 | 1300 | 1295 | 1289 | 1283 | 1250 |

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| Alcohol | 23 | 24 | 50 | 61 | 94 | 92 | 59 |
| Beer | 210 | 230 | 255 | 257 | 255 | 242 | 231 |
| Soft drinks | 117 | 119 | 120 | 122 | 125 | 125 | 124 |
| Dairy products | 570 | 604 | 589 | 583 | 626 | 647 | 652 |
| Meat & poultry | 1261 | 1218 | 903 | 1047 | 1142 | 1170 | 1202 |
| Refinery | 626 | 650 | 684 | 681 | 669 | 627 | 559 |
| Soaps &detergents | 21 | 22 | 22 | 21 | 23 | 24 | 19 |
| Vegetable oils | 82 | 70 | 72 | 68 | 62 | 66 | 60 |
| Veg., fruits & juices | 1050 | 961 | 980 | 999 | 1031 | 974 | 884 |
| Wine | 965 | 711 | 993 | 860 | 793 | 863 | 817 |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| Alcohol | 46 | 32 | 28 | 24 | 21 | 17 | 18 |
| Beer | 234 | 238 | 236 | 251 | 269 | 225 | 216 |
| Soft drinks | 121 | 133 | 117 | 125 | 126 | 119 | 116 |
| Dairy products | 657 | 674 | 696 | 684 | 785 | 729 | 742 |
| Meat & poultry | 1214 | 1242 | 1222 | 1228 | 1327 | 1289 | 1373 |
| Refinery | 161 | 0 | 0 | 0 | 0 | 0 | 0 |
| Soaps &detergents | 22 | 18 | 19 | 19 | 21 | 21 | 21 |
| Vegetable oils | 61 | 60 | 59 | 56 | 56 | 50 | 52 |
| Veg., fruits & juices | 842 | 751 | 687 | 708 | 812 | 808 | 911 |
| Wine | 730 | 685 | 609 | 465 | 366 | 285 | 254 |

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| Alcohol | 14 | 16 | 16 | 15 | 15 |
| Beer | 203 | 208 | 207 | 206 | 206 |
| Soft drinks | 109 | 71 | 52 | 22 | 22 |
| Dairy products | 765 | 743 | 706 | 698 | 698 |
| Meat & poultry | 1347 | 1248 | 1086 | 1037 | 1037 |
| Refinery | 0 | 0 | 0 | 0 | 0 |
| Soaps &detergents | 20 | 21 | 20 | 22 | 22 |
| Vegetable oils | 49 | 44 | 38 | 39 | 39 |
| Veg., fruits & juices | 1129 | 960 | 1090 | 1157 | 1157 |
| Wine | 327 | 250 | 265 | 253 | 253 |

#### 7.5.2.2. Uncertainties and time-series consistency

Uncertainty analysis is presented in Section 1.7.

#### 7.5.2.3. Sector-specific QA / QC and verification

QA/QC and verification activities are presented in Section 1.6.

#### 7.5.2.4. Sector-specific recalculations

Emissions estimates from this source have been revised due to availability of new data on industrial production for 2014.

Detailed statistics on industrial production in Cyprus do not exist. Therefore data on industrial consumption is used instead. Another issue associated with the national statistics on industrial activity, is that the sales of industrial products for the year x-2 (which in this case is 2015) are completed and published in the summer after the inventory has to be submitted (which in this case is summer 2017). Therefore, the 2015 “production" is assumed to be equal to the 2014 “production”. This assumption was applied for the preparation of the NIR 2016. Since “industrial production” data is now available for 2014, the emissions are re-estimated using the data.

Following a recommendation of the ERT during the in-country review of the 2016 submission, the methane correction factor ($MCF_j$) has been changed from 0 which is the default for centralised, aerobic treatment plant to 0.3 which is the default for not well managed, centralised, overloaded aerobic treatment (table 6.3, pg. 6.13, volume 5, 2006 IPCC guidelines), until sufficient information is available for the wastewater treatment plants in Cyprus to justify the use of 0. The impact of the MCF change to the emissions of 4D2 is presented in Table 7.35 and Figure 7.15 and ranges from 780% to 2317% which corresponds to a maximum of 29 Gg CO2 eq. in actual emissions.

**Table 7.35. Changes in emissions from industrial wastewater treatment caused by changes in MCF (1990-2014)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | | | | | | | |
| CH4 (kt) | 0.03521 | 0.03521 | 0.03521 | 0.03521 | 0.03521 | 0.03521 | 0.03521 |
| N2O (kt) | 0.00104 | 0.00103 | 0.00107 | 0.00112 | 0.00123 | 0.00124 | 0.00123 |
| Total (Gg CO2 eq.) | 1.19084 | 1.18598 | 1.19856 | 1.21476 | 1.24621 | 1.25028 | 1.24823 |
| After ERT recommendation | | | | | | | |
| CH4 (kt) | 0.96794 | 0.88861 | 0.91869 | 0.98604 | 1.11998 | 1.15257 | 1.14986 |
| N2O (kt) | 0.00104 | 0.00103 | 0.00107 | 0.00112 | 0.00123 | 0.00124 | 0.00123 |
| Total (Gg CO2 eq.) | 24.509 | 22.521 | 23.285 | 24.985 | 28.365 | 29.184 | 29.114 |
| Change | 23.318 | 21.335 | 22.087 | 23.771 | 27.119 | 27.934 | 27.866 |
| *% change to initial submission* | *1958%* | *1799%* | *1843%* | *1957%* | *2176%* | *2234%* | *2232%* |

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | | | | | | | |
| CH4 (kt) | 0.03521 | 0.03521 | 0.03521 | 0.03521 | 0.03521 | 0.03521 | 0.03521 |
| N2O (kt) | 0.00123 | 0.00115 | 0.00117 | 0.00117 | 0.00121 | 0.00121 | 0.00115 |
| Total (Gg CO2 eq.) | 1.24716 | 1.22362 | 1.22803 | 1.23038 | 1.23953 | 1.24017 | 1.22350 |
| After ERT recommendation | | | | | | | |
| CH4 (kt) | 1.16371 | 1.10189 | 1.07018 | 1.11517 | 1.18380 | 1.17550 | 1.11178 |
| N2O (kt) | 0.00123 | 0.00115 | 0.00117 | 0.00117 | 0.00121 | 0.00121 | 0.00115 |
| Total (Gg CO2 eq.) | 29.459 | 27.890 | 27.102 | 28.229 | 29.954 | 29.747 | 28.138 |
| Change | 28.212 | 26.667 | 25.874 | 26.999 | 28.715 | 28.507 | 26.914 |
| *% change to initial submission* | *2262%* | *2179%* | *2107%* | *2194%* | *2317%* | *2299%* | *2200%* |

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | | | | | | | |
| CH4 (kt) | 0.08501 | 0.08501 | 0.10386 | 0.10386 | 0.10386 | 0.10386 | 0.10386 |
| N2O (kt) | 0.00102 | 0.00096 | 0.00092 | 0.00089 | 0.00095 | 0.00089 | 0.00093 |
| Total (Gg CO2 eq.) | 2.42970 | 2.41070 | 2.87012 | 2.86168 | 2.87835 | 2.86037 | 2.87232 |
| After ERT recommendation | | | | | | | |
| CH4 (kt) | 1.08189 | 1.03375 | 1.00477 | 0.99669 | 1.07785 | 1.02944 | 1.09109 |
| N2O (kt) | 0.00102 | 0.00096 | 0.00092 | 0.00089 | 0.00095 | 0.00089 | 0.00093 |
| Total (Gg CO2 eq.) | 27.352 | 26.129 | 25.393 | 25.182 | 27.228 | 26.000 | 27.553 |
| Change | 24.922 | 23.719 | 22.523 | 22.321 | 24.350 | 23.140 | 24.681 |
| *% change to initial submission* | *1026%* | *984%* | *785%* | *780%* | *846%* | *809%* | *859%* |

| | 2011 | 2012 | 2013 | 2014 | | | |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | | | | | | | |
| CH4 (kt) | 0.10386 | 0.10386 | 0.10386 | 0.10386 | | | |
| N2O (kt) | 0.00099 | 0.00089 | 0.00087 | 0.00087 | | | |
| Total (Gg CO2 eq.) | 2.89178 | 2.86183 | 2.85575 | 2.85575 | | | |
| After ERT recommendation | | | | | | | |
| CH4 (kt) | 1.17121 | 1.06069 | 1.05028 | 1.05028 | | | |
| N2O (kt) | 0.00099 | 0.00089 | 0.00087 | 0.00087 | | | |
| Total (Gg CO2 eq.) | 29.576 | 26.783 | 26.516 | 26.516 | | | |
| Change | 26.684 | 23.921 | 23.661 | 23.661 | | | |
| *% change to initial submission* | *923%* | *836%* | *829%* | *829%* | | | |

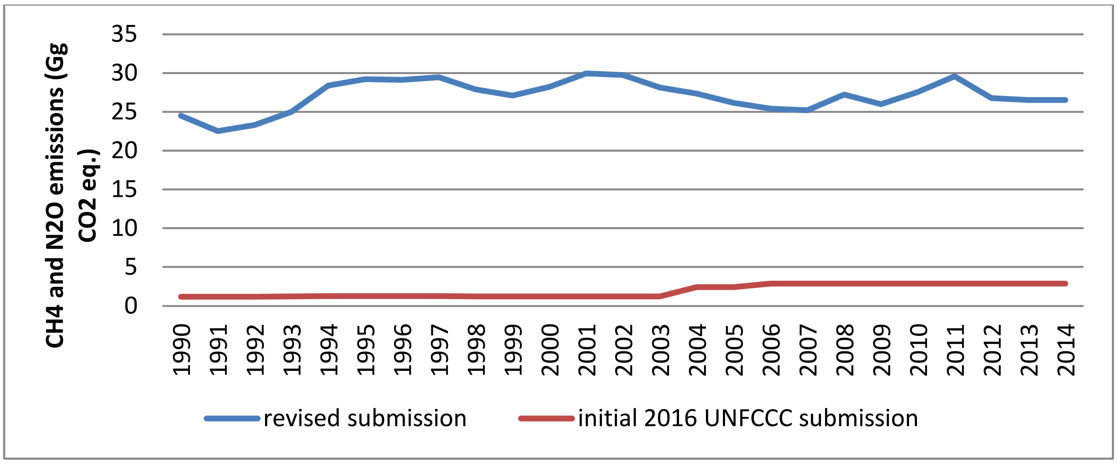


**Figure 7.15. Changes in emissions from industrial wastewater treatment 4D2 caused by changes in MCF (1990-2014)**

### 7.5.2.5. Sector-specific planned improvement

Improvement of activity data for wastewater production and management – the inventory team is in communication with the statistical service and other involved authorities to improve the industrial production and management data for the whole time series. The necessary resources and methods are investigated by the statistical service to collect the necessary data and information.

# Chapter 8: Other (CRF source category sector 6)

Not occurring.

# Chapter 9: KP-LULUCF

## 9.1. General information

Accounting of LULUCF activities under the Kyoto Protocol states that unlike the Convention, which includes all emissions and removals from LULUCF in a Party's total emissions, the accounting of the LULUCF sector is restricted to emissions and removals from specific activities that are defined under Article 3, paragraphs 3 and 4, of the Protocol. Article 3, paragraph 3, covers direct, human-induced, afforestation, reforestation and deforestation activities. Accounting of these is mandatory: each Annex I Party must account for emissions and removals in the commitment period on lands on which these activities have occurred. Article 3, paragraph 4, activities are restricted to forest land management, cropland management, grazing land management and/or revegetation. In the second commitment period article 3, paragraph 4, activities include also wetland drainage and rewetting. Accounting of these activities differs between the first and the second commitment period. For activities that are elective each Party must choose whether to account for emissions and removals from each such activity during the commitment period.

Cyprus did not have any obligations during the first commitment period regarding KP-LULUCF and the inventory section on LULUCF and the KP-LULUCF is still under development. The calculations of emissions and removals for afforestation/reforestation, deforestation and forest management are still under way.

### 9.1.1. Definition of forest and any other criteria

The forest definition adopted by Cyprus is in line with the Forest National Law of 2012 (25 (I)/2012) and in accordance with the definitions of the Food and Agriculture Organization of the United Nations for its Global Forest Resource assessment (FAO FRA 2015). This definition is consistent with the definition given in Decision 16/CMP.1.

For Cyprus, forest comprises of land covered by forest trees which covers at least 0.3 hectares, where the tree crown cover is at least 10 per cent and the minimum tree height is of 5 meters (at maturity). It includes forest roads, cleared tracts, firebreaks and other small open areas within the forest as well as reforested areas or burnt areas or other areas that temporarily have low plant cover due to human intervention or natural causes, but does not include municipal parks and gardens.

### 9.1.2. Elected activities under Article 3, paragraph 4, of the Kyoto Protocol

Cyprus has not elected any additional activities under Article 3, paragraph 4 of the Kyoto Protocol. As of the Decision 2/CMP.7, forest management (FM) is a mandatory activity to be reported under Article 3.4.

### 9.1.3. Description of how the definitions of each activity under Article 3.3 and each elected activity under Article 3.4 have been implemented and applied consistently over time

Non-applicable.

### 9.1.4. Description of precedence conditions and/or hierarchy among Article 3.4 activities, and how they have been consistently applied in determining how land was classified.

Non-applicable.

## 9.2. Land-related information

As mentioned in Chapter 6, the proposal of the LULUCF inventory expert was to use the available land cover and land change information from the CORINE Land Cover Maps that are prepared from the nature protection sector of the Department of the Environment, in order to categorise the land into the LULUCF categories.

Preliminary analysis of land change data from the CORINE datasets show land change from one category to the other as illustrated in the Table 9.1 below.

**Table 9.1. Land change 1990-2015**

| **Year** | **1990** | **1995** | **2000** | **2005** | **2010** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|
| Forest Land remaining Forest Land | 186990 | 189305 | 191620 | 193936 | 194469 | 194508 | 194518 |
| Cropland remaining Cropland | 449581 | 447614 | 445647 | 443680 | 443199 | 441820 | 441476 |
| Grassland remaining Grassland | 219963 | 211870 | 203777 | 195684 | 195325 | 195019 | 194942 |
| Wetland remaining Wetland | 3208 | 3613 | 4019 | 4425 | 4558 | 4627 | 4645 |
| Settlements remaining Settlements | 50670 | 59402 | 68133 | 76865 | 79993 | 81574 | 81969 |
| Other Land remaining Other Land | 9233 | 7841 | 6448 | 5055 | 5977 | 5972 | 5970 |
| Land to Forest Land | 515 | 515 | 515 | 515 | 21 | 21 | 21 |
| Land to Cropland | 899 | 899 | 899 | 899 | 4 | 4 | 4 |
| Land to Grassland | 0 | 0 | 0 | 0 | 53 | 53 | 53 |
| Land to Wetlands | 81 | 81 | 81 | 81 | 17 | 17 | 17 |
| Land to Settlements | 2021 | 2021 | 2021 | 2021 | 474 | 474 | 474 |
| Land to Other Land | 984 | 984 | 984 | 984 | 55 | 55 | 55 |
| **Total Area in ha** | **924145** | **924145** | **924145** | **924145** | **924145** | **924145** | **924145** |

### 9.2.1. Spatial assessment unit used for determining the area of the units of land under Article 3.3

The minimum mapping unit (MMU) for CORINE land cover is 25 hectares, the minimum width of linear elements is 100 meters and the MMU for Land Cover Changes is 5 hectares.

### 9.2.2. Methodology used to develop the land transition matrix

As mentioned in Chapter 6 the CORINE Land Cover maps and CORINE Land Change data was utilized to categorize land into the 6 LULUCF categories for years 2000, 2006 and 2012.

Then it was assumed that land change was linear and it was extrapolated back to 1990 and forward to 2014, thus establishing land transition matrices.

**Table 9.2. Land transition matrices - Areas and changes in areas in 1990-1991 and in 2013-2014 (ha)**

| | **Ha** | Forest | Annual CL | Woody CL | Grass GL | Woody GL | Wetland | Settlements | Other Land | **Total end 1990** |
|---|---|---|---|---|---|---|---|---|---|---|
| | Forest | 159719 | | 39 | | 225 | | 9 | 129 | 160120 |
| | Annual CL | 5 | 303616 | 159 | | 116 | 4 | 552 | 401 | 304854 |
| | Woody CL | | | 145156 | | 123 | | 740 | | 146019 |
| | Grass GL | | 130 | 7 | 48154 | 8 | | 140 | 293 | 48732 |
| | Woody GL | | | 277 | | 199118 | | 325 | 51 | 199771 |
| | Wetland | | | | | | 3208 | | | 3208 |
| | Settlements | | | 36 | | | | 50909 | | 50945 |
| | Other Land | | | 1059 | | | 77 | 17 | 9342 | 10495 |
| **FROM** | **Total end 1991** | 159724 | 303745 | 146734 | 48154 | 199591 | 3289 | 52692 | 10217 | **924145** |
| | | **TO** | | | | | | | | |

| | **Ha** | Forest | Annual CL | Woody CL | Grass GL | Woody GL | Wetland | Settlements | Other Land | **Total end 2013** |
|---|---|---|---|---|---|---|---|---|---|---|
| | Forest | 154792 | | | | | 6 | | | 154798 |
| | Annual CL | | 285689 | 29 | | | | 184 | | 285902 |
| | Woody CL | | 14 | 156063 | | | | 163 | 26 | 156266 |
| | Grass GL | | | | 38993 | 45 | | 26 | | 39063 |
| | Woody GL | 150 | | 3 | | 195551 | | 101 | | 195806 |
| | Wetland | | | | | | 4627 | | | 4627 |
| | Settlements | | 1 | | | 31 | 9 | 81574 | 38 | 81653 |
| | Other Land | 2 | 23 | | 10 | 26 | 3 | | 5965 | 6030 |
| **FROM** | **Total end 2014** | 154945 | 285727 | 156095 | 39003 | 195653 | 4645 | 82048 | 6029 | **924145** |
| | | **TO** | | | | | | | | |

### 9.2.3. Maps and/or database to identify the geographical locations, and the system of identification codes for the geographical locations

CORINE Land Use Maps covering the whole of Cyprus were used. The maps were obtained for years 2000, 2006 and 2012.

## 9.3. Activity-specific information

The development of this sector is not complete yet.

### 9.3.1. Methods for carbon stock change and GHG emission and removal estimates

Not reported. The methodology used for LULUCF is the 2006 IPCC Guidelines for National Greenhouse Inventories.

#### 9.3.1.1. Description of the methodologies and the underlying assumptions used

Tier 1 methodologies will be applied.

#### 9.3.1.2. Justification when omitting any carbon pool or GHG emissions/removals from activities under Article 3.3 and elected activities under Article 3.4

Non-applicable.

#### 9.3.1.3. Information on whether or not indirect and natural GHG emissions and removals have been factored out

Non-applicable.

#### 9.3.1.4. Changes in data and methods since the previous submission (recalculations)

Non-applicable.

#### 9.3.1.5. Uncertainty estimates

Non-applicable.

#### 9.3.1.6. Information on other methodological issues

Non-applicable.

#### 9.3.1.7. The year of the onset of an activity, if after 2008

Non-applicable.

## 9.4. Article 3.3

Calculations of these activities are not as yet complete.

### 9.4.1. Information that demonstrates that activities under Article 3.3 began on or after 1 January 1990 and before 31 December 2012 and are direct human-induced

In Cyprus all land use categories are to be considered managed and consequently activities under Article 3.3 are directly human induced.

### 9.4.2. Information on how harvesting or forest disturbance that is followed by the re-establishment of forest is distinguished from deforestation

This information is not yet available. The Forest Department is conducting a full inventory of forested areas which should be complete by 2020. This should give us the additional information needed to distinguish between forest disturbance and deforestation. Harvesting is not taking place extensively in Cyprus and no areas are clear-cut of forest as the common practice is the thinning of trees.

### 9.4.3. Information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested

Not reported.

## 9.5. Article 3.4

Not reported.

### 9.5.1. Information that demonstrates that activities under Article 3.4 have occurred since 1 January 1990 and are human-induced

In Cyprus all land use categories are to be considered managed and consequently activities under Article 3.4 are directly human induced.

### 9.5.2. Information relating to Cropland Management, Grazing Land Management and Revegetation, if elected, for the base year

Cyprus has not elected Cropland Management, Grazing Land Management and Revegetation for the current commitment period.

### 9.5.3. Information relating to Forest Management

All forested areas that are not reported as Afforestation/Reforestation or Deforestation are to be considered as Forest Management.

### 9.5.4. Information related to the natural disturbances provision under article 3.4

Cyprus intends to apply the provisions under article 3.4 to exclude emissions from natural disturbances for the accounting for forest management (FM) during the second commitment period in accordance with decision 2/CMP.7.

## 9.6. Other information

### 9.6.1. Key category analysis for Article 3.3 activities and any elected activities under Article 3.4

Not reported.

### 9.6.2. KP-LULUCF accounting

Cyprus will account for Article 3.3 and 3.4 LULUCF activities at the end of the commitment period.

## 9.7. Information relating to Article 6

Cyprus has not elected any activities under Article 6.

# Chapter 10: Recalculations and improvements

The recalculations and improvements that have been performed have been presented in detail in the appropriate chapter.

The previous submission (NIR2016 v.1.4 (CYP_2016_12_Inventory)) was made following the recommendations in the report “Potential Problems formulated in the course of the review of the 2015 and 2016 annual submissions of Cyprus and of the report to facilitate the calculation of the assigned amount for the second commitment period” prepared by the ERT during the in-country review for the 2016 submission. The 2016 submission (NIR2016 v.1.5 (CYP_2016_14_Inventory) includes additionally two pending issues identified by ERT in response to the explanations/documents provided by Cyprus to the Saturday Paper issues.

The changes to the estimates of emissions compared to the submission (NIR2016 v.1.3 (CYP_2016_12_Inventory) submitted 15th of June 2016) are presented in Table 10.1 below.

**Table 10.1. Recalculations caused by the recommendations received in the Saturday Paper for the 2016 submission**

| Sector | Recommendation | Implemented | Change in report | Change in CRF |
|---|---|---|---|---|
| Industrial Processes and product Use, Cement Production (2.A.1) | Use the emissions data from the National Allocation Plan for 1997–2004 to calculate emissions in the period 1997–2004 and the annual IEF for 1997 to calculate emissions in the period 1990–1996, as it was already recognized by the Party itself and by the previous ERT in the ARR 2013, as being more realistic and more consistent for being used for the 1990–1996 inventory years. | ✓ | ✓ | x |
| | Provide revised estimates for the category 2.A.1 Cement production for the entire time-series. | ✓ | ✓ | ✓ |
| Industrial Processes and product Use, Other Processes Uses of Carbonates (ceramics production) (2.A.4.a) | Use the 2001 IEF (the earliest available IEF value coming from the ETS verified emissions report) for calculating the CO2 emissions from ceramic production for the period 1990-2000; | ✓ | ✓ | x |
| | Provide revised estimates for the category 2.A.4.a Other Processes Uses of Carbonates (ceramics production) for the entire time-series | ✓ | ✓ | ✓ |
| Industrial Processes and product Use, Other Processes Uses of Carbonates (Other uses of soda ash) (2.A.4.b) | Collect the AD on soda ash (Common Nomenclature code 2836 20 00) imports and exports from the Custom Service of Cyprus and identify the soda ash consumption in the country; | ✓ | ✓ | x |
| | Provide estimates of CO2 emissions from category 2.A.4.b Other Processes Uses of Carbonates (other uses of soda ash) for the entire time-series rounded at the level of 4 figures after decimal point (ERT latest comment). | ✓ | ✓ | ✓ |
| Industrial Processes and product Use, Paraffin wax use (2.D.2) | Collect the AD on paraffin waxes (Common Nomenclature code 2712 20) import, export and consumption for the period 2004-2014; | ✓ | ✓ | x |
| | Use one of the splicing techniques (i.e., overlap and/or surrogate data) available in the 2006 IPCC Guidelines to fill the gap in the AD for the period 1990-2003 | Not necessary – data was obtained for 1990-2014 | | |

| Sector | Recommendation | Implemented | Change in report | Change in CRF |
|---|---|---|---|---|
| | Provide estimates of $CO_2$ emissions from category 2.D.2 Paraffin wax use for the entire time-series based on one of two methodologies available in the 2006 IPCC Guidelines (Volume 3, Chapter 5.3 Paraffin Wax Use), based on the amount of paraffin waxes consumed in a country provided in energy units (TJ), and default, or country-specific emission factors. | ✓ | ✓ | ✓ |
| Industrial Processes and product Use, Refrigeration and air conditioning (2.F.1) | If country-specific information is still not available, recalculate the HFCs emissions from category 2.F.1 Refrigeration and air conditioning in 1995, by using the annual per capita emissions average value of three countries (Spain, Italy and Greece) (4.08 kg $CO_2$ eq/capita), instead of average value of four countries (Malta, Spain, Italy and Greece) (13.60 kg $CO_2$ eq/capita); | ✓ | ✓ | x |
| | Alternatively, check if in the latest available (2016) inventory submission of Malta, the value of per capita HFCs emissions for category 2.F.1 Refrigeration and air conditioning in 1995 year is still outstandingly high, if not, use the average value of four countries (Malta, Spain, Italy and Greece) for that particular year, as reported in the Section 4.2.2 of the NIR of 2016 submission; | Not implemented – first option was applied | | |
| | Provide revised estimates of HFCs emissions from category 2.F.1 Refrigeration and air conditioning for the entire time series. | ✓ | ✓ | ✓ |
| Industrial Processes and product Use, Aerosols (2.F.4) | If country-specific information is still not available, recalculate the HFCs emissions from category 2.F.4 Aerosols (MDI) using the annual per capita emissions average value of the 4 countries (Malta, Spain, Italy and Greece) from their latest available (2016) inventory submission, for the entire time series, as reported in the Section 4.2.2 of the NIR of 2016 submission; | Partly | ✓ | x |
| | Provide revised estimates of HFCs emissions from category 2.F.4 Aerosols for the entire time series. | ✓ | ✓ | ✓ |
| Industrial Processes and product Use, Electrical equipment (2.G.1) | If country-specific information is still not available, recalculate the $SF_6$ emissions from category 2.G.1Electrical equipment using the average value of per capita $SF_6$ emissions of Malta for 1995, 2003, 2011, 2012 and 2013 from the latest available 2016 inventory submission; | Malta excluded from the calculations for all years | ✓ | x |
| | Report the annual per capita emissions average of Cyprus based on corresponding average values of 4 countries (Malta, Spain, Italy and Greece), as per information reported in section 4.5.2 of the NIR; | | ✓ | x |
| | Provide revised estimates of $SF_6$ emissions for the entire time-series. | | x | x |
| 3.A Enteric fermentation 3.B Manure management 3.D. agricultural soils | Extract the data for horses, mules and asses from the 1985, 1994 and 2010 livestock census reports. | ✓ | ✓ | x |
| | Use the extracted data to do linear interpolation to gap-fill the entire time series. | ✓ | ✓ | ✓ |
| | Recalculate the emissions for the base year and the entire time-series. | ✓ | ✓ | ✓ |
| | Conduct category-specific documentation of the recalculations indicating the percentage differences between previous and latest data and the reason for recalculation. | ✓ | ✓ | x |
| | Identify the possible need to recalculate other | ✓ | ✓ | ✓ |

| Sector | Recommendation | Implemented | Change in report | Change in CRF |
|---|---|---|---|---|
| | estimates (e.g. N2O emissions from agricultural soils) as a consequence of using new data for horses, mules and assess. | | | |
| 5.A - Solid Waste Disposal | The ERT recommends that activity data for waste management system be reported in a segregated manner, taking into account the types of landfill operation (managed shallow / managed deep and unmanaged) over time as well as their respective status of operation (active or inactive). An adequate assessment of the volume of waste handled to each type of landfill has also to be presented in a transparent manner. For consistency, the data presented in the NIR shall adequately represent the information in CRF, therefore it would be appropriate that municipal solid waste disposal activity on landfill be adequately segregated into the appropriate categories. The ERT recommends that Cyprus use the country specific data for solid waste disposal (already presented in the NIR) and apply the available approach to calculate national emissions of the sector. If country-specific data is not available for key parameters, the ERT recommends that the Party estimate emissions using IPCC FOD method with default parameters and country-specific AD. | ✓ | ✓ | ✓ |
| 5.D - Wastewater treatment and discharge | The ERT recommends that Cyprus further enhance the use of country-specific data to support the choice of MCFs in order to better represent the types of activities that have been implemented by the industrial sector to process and dispose all the wastewater generated, as well as in domestic municipal wastewater treatment plants. In that sense, the ERT recommends that Cyprus implement a higher tier approach and estimate emissions based on country-specific activity data and emission factors. | Partly | ✓ | ✓ |
| 4.A Forest Land | Develop its own estimates for the annual biomass growth to be applied to coniferous and broadleaf stands or plantations, taking into account existing country-specific forest data, and/or expert judgement from the Department of Forests, and/or data from other countries with similar characteristics (climate, soil) that can support the default data presently used, as appropriate. | ✓ | ✓ | ✓ |
| 4.A Forest Land | In case Cyprus does not have country specific data to provide estimates for (2) and (3) to replace the default values used, the ERT recommends that the corresponding default values be changed to the default values in the IPCC 2006 Guidelines equal to 0.28 and 0.47, respectively. | ✓ | ✓ | ✓ |
| 4. LULUCF | Provide estimates for deforestation in 1990 using the CORINE land-cover transition matrices for 2000-2006 and 2006-2012 and applies extrapolations and interpolations, as appropriate. In case that country-specific data is not available, Cyprus can use deforestation data contained in the Forest Resources Assessment – FRA, published by FAO. | Partly | x | x |
| 4. LULUCF | Complete the CRF tables 4(I) to 4(V) associated with deforestation, based on actual data estimates or expert judgement. | x | x | x |

| Sector | Recommendation | Implemented | Change in report | Change in CRF |
|---|---|---|---|---|
| KP LULUCF | Improve the completeness of the LULUCF inventory, so that the ERT is provided with concrete elements to justify that LULUCF in the base year was a source or not. | x | x | x |
| KP LULUCF | The ERT recommends that Cyprus provide revised estimates for the different sources of losses (wood removal, fuelwood removal, and disturbances) by using equations 2.12, 2.13 and 2.14 in the 2006 IPCC guidelines and country specific or default data (or expert judgment), as appropriate, in the suitable KP LULUCF CRF tables. The ERT notes the importance to avoid double counting, including, *inter alia*: Harvest of wood and fuelwood: to avoid this, the Party should check how fuelwood data are represented in the country and use the equation that is most appropriate for national conditions. | ✓ Partly included in LULUCF chapter | ✓ included in LULUCF chapter | ✓ included in LULUCF chapter |
| KP LULUCF | Forest fires: in case the $CO_2$ emissions from carbon stock change are reported in tables 4 A-F, then they should not be reported in table 4(V). In case of salvage logging, the ERT recommends that Cyprus indicate how the biomass in the affected areas is being treated | Partly salvage logging was subtracted from roundwood and fuelwood removals | ✓ | ✓ |
| KP LULUCF | The ERT recommends that Cyprus apply the same values of root-to-shoot and carbon fraction of dry matter in the calculation of the emissions as used to estimate the annual removals from growth (biomass gain). | ✓ | x | x |
| KP LULUCF | Provide revised estimates of the background level and the margin based on the following steps:<br>1. use of the greenhouse gas emissions estimates provided in Table 4(V) (biomass burning) for at least the period from 1990 to 2009, inclusive, ensuring that the emissions have been estimated using the IPCC 2006 Guidelines and that they refer only to forest management areas;<br>2. clear indication of the methodology used to estimate these emissions, including of the parameters used and respective sources;<br>3. if not using the default method, a clear description of the method used and information on how it avoids the expectation of net credits and net debits;<br>4. provide the ERT with the worksheets that include the calculation of the background level and margin.<br><br>For the identification of the forest management areas affected by fires, the ERT recommends that Cyprus apply, as a proxy, and in consultation with the experts from the Forest Department, the following approach:<br>1. Estimate, for each year, the area of forest land under afforestation and reforestation using, for example, the data reported to the FAO Forest Resources Assessment - FRA;<br>2. Exclude the area of afforestation and reforestation calculated in (1) from the total area reported under forest land;<br>3. Divide the result in (2) by the total area under forest land; | Partly | ✓ | ✓ |

| Sector | Recommendation | Implemented | Change in report | Change in CRF |
|---|---|---|---|---|
| | 4. Multiply the ratio in (3) by the area affected by fires. | | | |
| KP LULUCF | The 2013 KP Supplement provides two reporting methods in Chapter 2, section 2.2.2, page 2.15 (*Reporting Methods for Lands Subject to Article 3.3 and Article 3.4 activities*) to address information on geographical location of boundaries of the areas:<br>• The first one delineates the geographic boundaries that contain multiple land units subject to Article 3.3 or 3.4 activities that can be identified using sampling techniques using remote sensing or ground-based data or administrative statistics;<br>• The second one is based on spatially explicit and complete geographical identification of all land units subject to Article 3 paragraph 3 and elected paragraph 4 activities.<br><br>The ERT recommends that Cyprus apply one of these methods that are presented in detail in section 2.2.2 (Reporting Methods for Lands Subject to Article 3.3 and Article 3.4 activities) of the 2013 KP Supplement. Considering the size of the country, the ERT recommends that Cyprus explore the possibility to apply reporting method 2, using satellite imagery of adequate spatial resolution to the size of the forest stands under ARD and FM. Consultation with experts from the Forest Department is essential to define the best type of remotely sensed data to be used. | Partly | x | x |

The total impact of these changes on total national emissions excluding LULUCF is presented in Table 10.2 and Figure 10.1. Detailed presentation on the impact on each source affected is given in the respective section of the document.

**Table 10.2. The impact of recalculations on total national emissions excluding LULUCF**

| Total (Gg CO2 eq.) | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 5638.0 | 6135.2 | 6573.6 | 6876.3 | 7117.8 | 7065.7 | 7357.2 |
| Resubmission 31/10/16 | 5624.7 | 6121.5 | 6559.3 | 6858.7 | 7103.1 | 7046.9 | 7343.5 |
| Change | -13.36 | -13.72 | -14.32 | -17.56 | -14.71 | -18.74 | -13.63 |
| *% change to initial submission* | *-0.24%* | *-0.22%* | *-0.22%* | *-0.26%* | *-0.21%* | *-0.27%* | *-0.19%* |

| Total (Gg CO2 eq.) | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 7484.4 | 7809.2 | 8070.0 | 8338.8 | 8281.2 | 8517.6 | 8913.1 |
| Resubmission 31/10/16 | 7473.1 | 7799.6 | 8059.1 | 8326.9 | 8282.6 | 8519.1 | 8914.6 |
| Change | -11.31 | -9.62 | -10.97 | -11.89 | 1.34 | 1.46 | 1.44 |
| *% change to initial submission* | *-0.15%* | *-0.12%* | *-0.14%* | *-0.14%* | *0.02%* | *0.02%* | *0.02%* |

| Total (Gg CO2 eq.) | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 9142.9 | 9272.6 | 9528.8 | 9871.4 | 10046.4 | 9824.6 | 9520.6 |
| Resubmission 31/10/16 | 9144.4 | 9308.0 | 9567.6 | 9913.2 | 10093.3 | 9872.2 | 9571.7 |
| Change | 1.47 | 35.41 | 38.75 | 41.80 | 46.89 | 47.57 | 51.01 |
| *% change to initial submission* | *0.02%* | *0.38%* | *0.41%* | *0.42%* | *0.47%* | *0.48%* | *0.54%* |

| Total (Gg CO2 eq.) | **2011** | **2012** | **2013** | **2014** | | | |
|---|---|---|---|---|---|---|---|
| Initial 2016 submission | 9239.7 | 8713.0 | 7962.7 | 8394.3 | | | |
| Resubmission 31/10/16 | 9269.5 | 8769.4 | 8020.1 | 8453.8 | | | |
| Change | 29.80 | 56.40 | 57.39 | 59.45 | | | |
| *% change to initial submission* | *0.32%* | *0.65%* | *0.72%* | *0.71%* | | | |

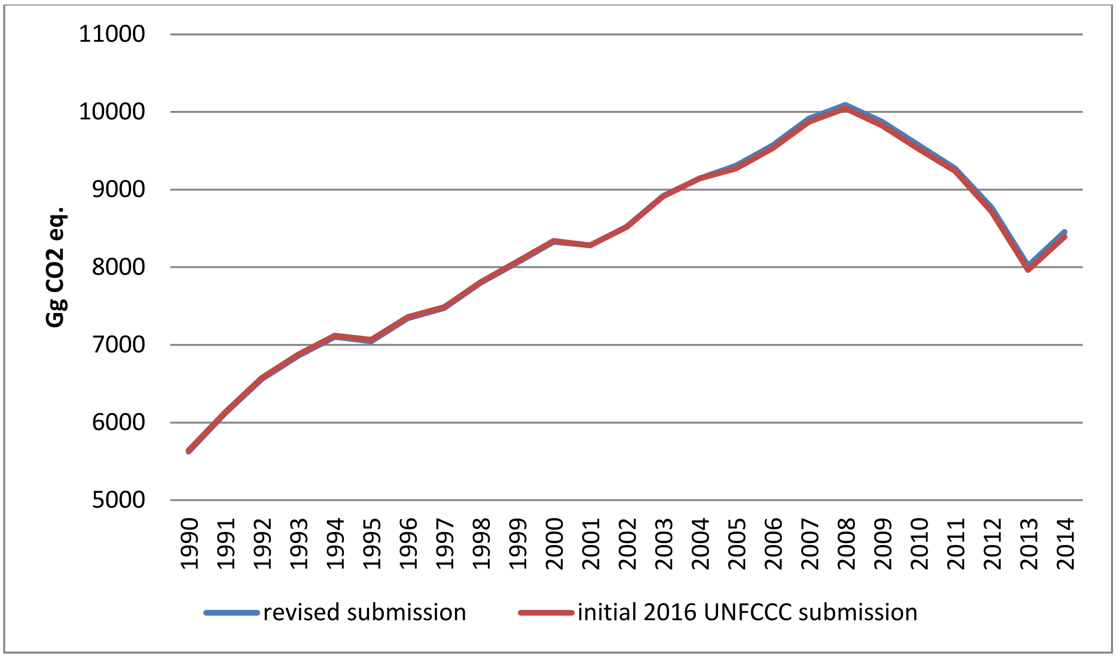


**Figure 10.1. The impact of recalculations on total national emissions excluding LULUCF**

Several of the improvements and recalculations that have been implemented for the initial 2016 submission because of comments received for the submission of 2015 by the EU TERT. Cyprus has not undergone a detailed review by the UNFCCC for the NIR2015 submission.

The comments made and mistakes identified with the resulting changes that have taken place are presented in the Table 10.3.

**Table 10.3. Reporting on implementation of recommendations and adjustments**

| CRF category / issue | Review recommendation | Review report / paragraph | MS response / status of implementation | Chapter/section in the NIR |
|---|---|---|---|---|
| Public Electricity and Heat Production CH4, CO2, N2O emissions, biomass Activity data | Cyprus cross check the biomass activity data and CO2 emissions reported as memo items in the reporting tables | When comparing the CRF sectoral approach with the sectoral approach calculated on basis of Eurostat energy balance data, the TERT noted that the CRF does not include activity data for biomass for the category 1A1a whereas the Eurostat energy balance includes 118 TJ for this specific category. Cyprus responded that necessary changes will be made in the 2016 submission. The TERT recommends that when making these changes that Cyprus cross check the biomass activity data and $CO_2$ emissions reported as memo items in the reporting tables. This item is linked with item CY-1A2g-2015-0002. | All biogas consumed by Main activity producer CHP plants and Autoproducer CHP plants has been allocated to agriculture since the biogas is produced and consumed the CHP generators installed at the anaerobic digesters treating animal waste. | section 3.2.2 |
| 1A2g Other CH4, CO2, N2O emissions, Activity data | Cyprus checks whether biomass consumption exists in this category and reports emissions in its next submission, if relevant | For the category 1A2g Other and CH4, CO2, N2O emissions from biomass for the year 2013, step 1 of the review identified a notable difference between CRF and Eurostat energy balance data. Cyprus responded that CH4 and N2O emissions from biomass were not estimated because biomass consumption is not indicated in the national energy balance. However, Eurostat energy data includes biomass consumption. In its reply to the TERT Bulgaria indicated that the national energy balance may have been updated and that it will check in the next inventory submission whether biomass consumption is available from national sources or Eurostat data and complete the estimation. The TERT recommends that Cyprus checks whether biomass consumption exists in this category and reports emissions in its next submission, if relevant. This item is linked with item CY-1A1a-2015-0002. | Biomass consumption exists in this category and emissions have been estimated and reported. | section 3.2.6 |
| 2A1 Mineral industry - Cement Production CO2 emissions, Activity data | Cyprus investigates whether there is no CKD exported from the process for the period before 2005 and to check whether the same production technologies and CKD recycling were used in that period and to clearly document this in its NIR | For CO2 emissions from category 2A1 and the years before 2005, the TERT noted that it is not clear whether and how cement kiln dust (CKD) was included in the calculation of emissions from cement production. In response to the review Cyprus explained that from 2005 onwards emissions reported under the EU ETS are used in the inventory. Based on information received from the cement company all the CKD is bound and recycled into the production process and that therefore emissions from CKD are not included in the EU ETS reports since no CKD is being exported from the system. Cyprus used the implied emission factor from the two operating installations from 2005 onwards also for the period 1990-2004. The TERT recommends that Cyprus investigates whether there is no CKD exported from the process for the period before 2005 and to check whether the same production technologies and CKD recycling were used in that period and to clearly document this in its NIR. | Confirmed with the ETS inspectors that there is no CKD exported from the process for the period before 2005 and the same production technologies and CKD recycling were used during 1990-2004. This is clearly documented in the NIR. | Section 4.2.1 |
| 2D Non-Energy Products from Fuels and Solvent Use CO2 Emission | Cyprus recommended to report these emissions in its next submission and document the | The TERT notes that this issue is outside the agreed scope for the 2015 ESD trial review.<br>For CO2 emissions from non-energy use of fuels, the TERT noted that Cyprus stated in its NIR that these emissions are calculated according to the methodology proposed by the IPCC 2006 guidelines. In the NIR in Table 3.38 only the consumption of feedstocks and the carbon stored is reported (also for lubricants). However, in the CRF in Table 2(I).A-Hs2 lubricant emissions are reported as 'NO'. In response to a question raised during the review Cyprus acknowledges that | The emissions have been estimated and reported. | section 4.3 |

| CRF category / issue | Review recommendation | Review report / paragraph | MS response / status of implementation | Chapter/section in the NIR |
|---|---|---|---|---|
| | estimates transparently | emissions from lubricants do exist in Cyprus. However, due to problems encountered while applying the IPCC 2006 guidelines, the emissions have not been estimated and therefore the respective cells in the CRF reporter have been left blank. Cyprus stated during the review that these problems have not yet been resolved and cannot provide estimates. However, Cyprus aims to correct this problem in the 2016 inventory submission. The TERT welcomes this effort and recommends Cyprus to report these emissions in its next submission and document the estimates transparently. | | |
| 2D Non-Energy Products from Fuels and Solvent Use CO2 Emission | Cyprus considers the method provided in the 2006 IPCC Guidelines and provides estimates or provides a justification in the NIR why the method cannot be implemented. | The TERT noted that Cyprus does not report CO2 emissions from urea-based catalytic converters. These emissions should be reported under category 2D3 according to footnote 6 in CRF table 2(I).A-Hs2. It is unlikely that these emissions do not occur in view of compliance with European emission standards. Upon a question raised during the review, Cyprus stated that no data is available to report CO2 emissions from this source. The TERT recommends that Cyprus considers the method provided in the 2006 IPCC Guidelines (Chapter 3 of Volume 2) and provides estimates or provides a justification in the NIR why the method cannot be implemented. | The emissions have been estimated and reported. | section 3.2.5 |
| 2F4 Product Uses as Substitutes for Ozone Depleting Substances – Aerosols HFCs emissions, Activity data | Cyprus include MDI emission estimates in its next submission. | For category Aerosols/Metered dose inhalers and HFCs the TERT noted that no information was provided for emissions in the CRF tables although some data was included in the draft NIR. In addition, emissions from MDI were presented in the NIR 2014. In response to the questions raised during the review, Cyprus explained that the emissions have not been estimated by mistake. Cyprus notified the TERT that it plans to estimate emissions from MDI based on population data (applying average of MDI emissions per capita based on the submissions by Malta and Greece) for the 2016 submission. The TERT noted that the issue is below the threshold of significance for technical correction. The TERT recommends that Cyprus include MDI emission estimates in its next submission. | The emissions have been estimated and reported. | section 4.4 |
| 2F1 Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning HFCs emissions, Activity data, | Cyprus (a) improves its F-gas reporting and reports emissions from newly filled/ manufactured products and from stocks separately (and accounts for the entire stock in 2000-2013) (b) to include a more | For the category 2F1 Refrigeration and air conditioning and HFCs for years 2000-2013 the TERT noted that the product life factors reported for CRF 2F1 subcategories show unexpectedly high values (between 41-1.050% in 2013). In the NIR (page 83) a formula is provided for calculating the emissions from 2.F.1. However, it was not very clear from the NIR which values were used in the formula and which activity data were available. The TERT asked Cyprus to explain the calculation method in more detail and to provide an explanation for the high IEFs reported in the CRF tables. In response to the review, Cyprus provided an Excel file with 2F1 emission calculations. Based on the file and the information received during review week, the TERT believes that the method is not in line with the 2006 IPCC Guidelines. The TERT recommends that Cyprus improves its F-gas reporting and reports emissions from newly filled/manufactured products and from stocks separately (and accounts for the entire stock in 2000-2013). Furthermore, the TERT recommends Cyprus to include a more detailed description of the | The methodology for the estimation of emissions from 2F1 has been revised and clearly reported in the NIR. | section 4.4 |

| CRF category / issue | Review recommendation | Review report / paragraph | MS response / status of implementation | Chapter/section in the NIR |
|---|---|---|---|---|
| Emission factor | detailed description of the methods and activity data used in its NIR to increase the transparency of the inventory | methods and activity data used in its NIR to increase the transparency of the inventory. | | |
| 3A Enteric Fermentation CH4 emissions, Emission factor | Cyprus include revised estimates in its next submission. | For category 3A1 Dairy Cattle Enteric Fermentation for CH4 emissions for the entire time series, the TERT noted that the EF used by Cyprus was identified as an outlier. The TERT identified that the EF was too high due to the assumed daily weight gain used and the fat content of milk used in the estimation. In response to a question and solutions suggested by the TERT during the review, Cyprus explained that 'We shall discuss your comments with the Department of Agriculture that have provided the data that we used and revise the methodology/estimates accordingly'. The TERT partly agreed with the explanation provided by Cyprus. However, the TERT decided to calculate a technical correction because the issue had already been identified in step 1 as a significant issue and the trial review was meant to simulate a regular review year. The TERT recommends that Cyprus include revised estimates in its next submission. | The daily weight gain has been revised to 0 (from 1.15) according to the IPCC2006 guidelines (pg.10.12, vol. 4) and the percentage of fat in milk to 3.5% (from 0.4%) according to the recommendation of the TERT expert (3-4%). Revised estimates on the animal weight are expected from the Department of Agriculture, to further improve the EF. | section 5.2.2 |
| 3B Manure Management CH4, N2O emissions, Activity data | Cyprus to (a) include in the NIR information about the source of the manure management systems, as well as an explanation of the lack of 'pasture' in the country. (b) gather statistical information about the use of the different manure management systems. | For category 3B manure management for CH4 and N2O emissions, the TERT noted that Cyprus has not provided in the NIR information about the source of the manure management systems used. In addition, the TERT pointed out that "pasture" system is reported as "NO" for all animal species. In response to a question raised during the review, Cyprus explained that 'No other written references are available for Cyprus. The source for the information is oral discussion s with Mr. Andreas Athanasiades, an officer at the Department of Environment who is an expert on animal waste management. Pasture is not practiced in Cyprus even for sheep and goats'. The TERT partly agreed with the explanation of Cyprus. Even though, the TERT considered that the information should be strengthen based on statistical studies. The TERT recommends Cyprus to include in the NIR information about the source of the manure management systems, as well as an explanation of the lack of 'pasture' in the country. Additionally, the TERT encourages Cyprus to gather statistical information about the use of the different manure management systems. | Work in progress in collaboration with the pollution prevention control Unit of the Department of Environment. | section 5.3.6 |
| 3B Manure Management N2O Emissions | recommends reporting the notation key "NE" and including a comment about the lack of a Tier 1 | For category 3B5 Indirect N2O emissions due to leaching and run-off for the whole period the TERT noted that Cyprus has neither estimated this activity nor reported a notation key.<br>In response to a question raised during the review, Cyprus explained that 'The emissions have not been estimated by error. Emissions' estimates will be provided in next submission'.<br>The TERT agreed with the commitment of Cyprus. The TERT also acknowledged the lack of a default value for FracLEACHMS in the 2006 IPCC Guidelines. Additionally, the TERT | Information for FracLEACHMS is not available. "NE" reportedincluding a comment about the lack of a Tier 1 methodology in the 2006 IPCC Guidelines | section 5.3.2 |

| CRF category / issue | Review recommendation | Review report / paragraph | MS response / status of implementation | Chapter/section in the NIR |
|---|---|---|---|---|
| | methodology in the 2006 IPCC Guidelines | recognize the lack of a Tier 1 methodology in the 2006 IPCC Guidelines. Nevertheless, the TERT also points out that for every cell a value or notation key should be reported. The TERT recommends estimating this activity, if information for parameter FracLEACHMS is available. If this is not the case, the TERT recommends reporting the notation key "NE" and including a comment about the lack of a Tier 1 methodology in the 2006 IPCC Guidelines. | | |
| 3B Manure Management N2O emissions, Activity data | include the explanation provided in the agriculture sector of NIR | For category 3B manure management for cattle for CH4 and N2O emissions and for the whole time series of emissions, the TERT noted that Cyprus has used a Western Europe default value for N excretion and an Eastern Europe value for the CH4 emissions due to manure management. In response to a question raised during the review, Cyprus explained that 'Manure management practices for cattle waste used in Cyprus are more appropriate to be categorised under Eastern Europe. However, for the calculation of the N2O emissions from manure management, the factor has been changed to Western Europe, due to the high milk production, based on the comment received by the UNFCCC review team in 2013'. The TERT agreed with the explanation of Cyprus. The TERT recommends Cyprus to include the explanation provided in the agriculture sector of NIR. | The necessary explanation has been included in the report. | section 5.3.2 |
| 3B Manure Management, CH4, CO2 emissions | include the explanation provided in the agriculture sector of NIR | For category 3B manure management for CH4 and N2O emissions and for the whole time series of emissions, the TERT noted that Cyprus has not provided in the NIR information in energy sector about the inclusion of emissions from the use of CH4 captured in digesters. In response to a question raised during the review, Cyprus explained that 'The electrical energy used on and offsite has been taken into account in the energy sector according to the national energy balance'. The TERT agreed with the explanation of Cyprus. The TERT recommends Cyprus to include the explanation provided in the agriculture sector of NIR. | The necessary explanation has been included in the report. | section 5.3.1 |
| 3B Manure Management N2O emissions, Activity data | include the revised estimate in its next submission | For category 3B manure management for N2O emissions from sheep, swine and goats for the whole time series of emissions, the TERT noted that the sum of manure excretion over the different manure management systems did not match the total N excreted by the animals. In response to a question and solutions suggested by the TERT during the review, Cyprus explained that they found the mistake in the calculations. In addition, Cyprus committed to use the corrected calculations for the next submission. The TERT agreed with the commitment of Cyprus. The TERT recommends that Cyprus include the revised estimate in its next submission. | The mistake has been identified and the necessary correction has been made to the estimates. | section 5.3.5 |
| Direct N2O from managed soils N2O emissions, Activity data | Cyprus estimates N2O emissions from source category 3.D.1.2 Organic N fertilizers in its next submission | For source category 3D1.2 Organic N fertilizers and N2O emissions Cyprus reported 'not estimated' (NE). However, N excretions of animal livestock are reported in CRF table 3.B(b) and N2O emissions were reported in previous submission. In addition, N2O emissions from sewage sludge spreading were reported in previous submission in this category. In its answer to a question raised within step 1 of the ESD trial Review 2015, Cyprus explained that it will try to provide emissions in the final inventory submission. However, the final submission still includes the notation key NE and Cyprus explained in an answer to a question raised by the TERT during step 2 of the ESD review that emissions were not estimated. This causes significant underestimation of N2O emissions from agricultural soils and the TERT strongly recommends that Cyprus estimates N2O emissions from source category 3.D.1.2 Organic N fertilizers in its next submission. | The emissions have been estimated and reported. | section 5.5.2 |

| CRF category / issue | Review recommendation | Review report / paragraph | MS response / status of implementation | Chapter/section in the NIR |
|---|---|---|---|---|
| Direct N2O from managed soils N2O emissions, Activity data | Cyprus reports the notation key 'not occurring' (NO) also for source category 3D1.3. | Cyprus reports for source category 3D1.3 Urine and dung deposited by grazing animals and N2O emissions the notation key 'not estimated' (NE). For the source category 3B(b) N excretions from pasture, range, paddock Cyprus explained that grazing does not occur in the country. Assuming that the statement for 3.D.1.3 is correct, the TERT recommends that Cyprus reports the notation key 'not occurring' (NO) also for source category 3D1.3. | "NE" revised to "NO" as proposed | NA |
| Solid Waste Disposal CH4 emissions | Cyprus recalculate emissions in its next submission | The category solid waste disposal and the gas CH4 for year 2013 was identified in the first step as a potential significant issue. In response to questions raised during the review, Cyprus provided details on the calculation of methane emissions. The TERT identified two errors in the calculation: (i) in the IPCC-calculation sheet wet temperate conditions are chosen for the rate of biodegradation (k), where dry temperate seem to be more applicable and (ii) in the calculation for Cyprus only waste landfilled after 1990 is taken in consideration. Good practice according to the 2006 guidelines (volume 5, page 3.6) is to use data for 3 to 5 half-lives in order to achieve an acceptably accurate result. In addition, Cyprus assumes zero methane oxidation for all landfills, where the 2006 IPCC guidelines allow 10% methane oxidation for well-managed landfills. In a response to this recommendation, Cyprus indicated that recalculated emissions cannot be provided during this review. The TERT recommends that Cyprus will recalculate emissions in its next submission. | (i) in the IPCC-calculation sheet wet temperate conditions for the rate of biodegradation (k), were changed to dry temperate<br>(ii) in the calculation waste landfilled since 1950 is taken in consideration<br>(iii) in the IPCC-calculation sheet there is no differentiation of landfills therefore zero methane oxidation is maintained | section 7.2.1 |
| Wastewater Treatment and Discharge CH4 emissions | take these recommendations into consideration in its next submission | For category waste water treatment and discharge for domestic waste water and the gas CH4 for year 2013, the TERT noted that the IEF for CH4 emissions from domestic wastewater was very low in comparison to other Member States. In response to the review, Cyprus provided details on the way emissions are calculated. The TERT identified a large amount of sludge (90% of total TOW), which was assumed to be removed from the waste water. As a result the fraction of TOW that is assumed to be converted to CH4 after waste water treatment is low which results in low CH4 emissions. The TERT considered the amounts of sludge removed as not realistic and too high. Also for wastewater treatment in septic tanks Cyprus assumed that 90% of the organic material is removed as sludge. In the IPCC Guidelines (Table 6.3) an MCF for septic tanks is given as 0.5 and a remark is added, that 50% of the organic material settles in the tank as sludge. This seems to imply that sludge removal is already accounted for in the MCF. So this MCF should be applied to total TOW, treated in septic tanks and not to the TOW subtracted by organic material removed in sludge. In a response to this recommendation, Cyprus indicated that they internally will discuss this recommendation. The TERT recommends that Cyprus will take these recommendations into consideration in its next submission. | MCF was applied to total TOW, treated in septic tanks and not to the TOW subtracted by organic material removed in sludge | section 7.5.1 |

Additional recalculations that have been performed during the EU QA/QC procedures for the 2016 submission are presented in Tables 10.3 to 10.5 that follow.

**Table 10.4. The differences between NIR2016 v.1.1 submitted on 16th of March 2016 and NIR2016 v.1.0 are presented in the Table below.**

| Sector | Comment | Change | TERT ref. number | Change in report | Change in CRF |
|---|---|---|---|---|---|
| 1 Energy | Verified emissions: reported in Annex V: 1,528 kt CO2eq, reported in EUTL: 4,469 kt CO2eq. | Corrected - The emissions from 1A1a. Public electricity and heat production were not entered. | | Template MMR-IRArticle10 revised & resubmitted | |
| 1A3a Fuel Combustion Activities - Transport - Civil Aviation | Pick IEF value 1990 | Correction of fuel consumption (from 230.991 to 272.31 TJ) | CY-1A3a-2016-0001 | ✓ | ✓ |
| 1A3a Fuel Combustion Activities - Transport - Civil Aviation | Trend of kerosene consumption | Data source changed from CYSTAT to EUROCONTROL for both international and domestic flights | CY-1A3a-2016-0002 | ✓ | ✓ |
| 1A3b Fuel Combustion Activities - Transport - Road transportation | IE notation key without explanation | Explanation included in the CRF. | CY-1A3b-2016-0001 | | |
| 2F Product uses as substitutes for Ozone Depleting Substances | Recovery should be “amount remaining in products at decommissioning” minus “disposal emissions”. | NO changed to NE | CY-2F-2016-0004 | | |
| 3.D.1.2.a Animal Manure Applied to Soils | Implied emission factor (IEF): Data has been identified as an outlier. | Change of EF1 from 0.0125 (IPCC1996) to 0.01 as proposed by the IPCC2006 guidelines | CY-3D1-2016-0004 | ✓ | ✓ |
| 3.D.1.2.c Other organic fertilizers applied to soil. | There is a notation key "NE" used in the category | NE has been replaced by NO. | CY-3D1-2016-0001 | | |
| 3.D.1.5 Mineralization of soil organic matters | There is a notation key "NE" used in the category | NE has been replaced by NO. | CY-3D1-2016-0002 | | |
| 3B Manure Management - 3.B.1.3 (Swine) | Allocation over all climate regions and MMS (Tier 2) sums up to 100). Years: 1999-2002 | Corrected | CY-3B-2016-0005 | | ✓ |
| 3B Manure Management - 3.B.1.4.6 (Mules and Asses) | Allocation over all climate regions and MMS (Tier 2) sums up to 100). Years: 1999 | Corrected | CY-3B-2016-0006 | | ✓ |
| 3B Manure Management - 3.B.2.1 (Cattle) | Sum of manure excreted over the MMS per animal type versus the N-excretion rate multiplied by the animal population (heads)). Years: 1996 | Mistake during the transfer of data from the excel file to CRF reporter – corrected | CY-3B-2016-0008 | | ✓ |
| 5B Biological Treatment of Solid Waste | Emission factors applied for calculating CH4 and N2O emissions from | Emissions corrected | CY-5B-2016-0001 | ✓ | ✓ |

| Sector | Comment | Change | TERT ref. number | Change in report | Change in CRF |
|---|---|---|---|---|---|
| | composting are very low. Check if the right units are used | | | | |
| 5.C Incineration and Open Burning of Waste | No emissions are reported | The correct notation key (NO) has been used to complete the empty cells | CY-5C-2016-0001 | | |
| 5.E Other | Blank cells | Blank cells have been completed | CY-5E-2016-0001 | | |

**Table 10.5. The differences between NIR2016 v.1.2 submitted on 7th of April 2016 and NIR2016 v.1.0 submitted on 16th of March 2016 are presented in the Table below.**

| Sector | Comment | Change | TERT ref. number | Change in report | Change in CRF |
|---|---|---|---|---|---|
| 2D1 Lubricant Use, CO2, 1993 | Mistake identified 23/3/16 | CO2 emissions entered in CRFreporter | NA | x | ✓ |
| 2G4 Other product use | NOx, SOx, NMVOCs not included by mistake | 2G4 added | | * Change in template for art.7 | ✓ |
| 2G4 Other product use | CO2 emissions estimated from NMVOCs | 2G4 added | CY-2D-2016-0001 | ✓ | ✓ |
| 2D3 | CO2 emissions estimated from NMVOCs | CO2 emissions entered in CRFreporter | CY-2D-2016-0002 | ✓ | ✓ |
| 1A1a | We have detected blank cells for the following fuels: biomass, gaseous fuels, other fossil fuels, peat and solid fuels. | Biomass, gaseous fuels, other fossil fuels, peat and solid fuels have been created and entered NO. | CY-1A1a-2016-0001 | x | ✓ |
| 1D1a | Mistake identified 31/3/16 from TERT comment CY-1A3a-2016-0002 (Numbers have considerably been revised for nearly the whole time-series (*only 1999 and 2000 for international consumption has not changed*) | Jet kerosene 1999-2000 revised – not correctly entered in CRFreporter | NA | x | ✓ |
| 3.D.1.5 - Mineralization of soil organic matters | NE instead of NO | NO | CY-3D1-2016-0002 | x | ✓ |
| 3.B.1.3 | Distribution of MMS over climates | Corrected to sum up to 100 | CY-3B-2016-0004 CY-3B-2016-0005 | x | ✓ |
| 5A | Wrong oxidation factor in report | Corrected | CY-5A-2016-0002 | ✓ | x |
| 3.B.2.5 | "NE" used in the category 3.B.2.5 | Emissions estimated | CY-3B-2016-0001 | ✓ | ✓ |

**Table 10.6. The differences between NIR2016 v.1.3 submitted on 13h of June 2016 (CYP_2016_12_Inventory) and NIR2016 v.1.2 (CYP_2016_5_Inventory) submitted on 7th of April 2016 are presented in the Table below.**

| Sector | Comment | Change | TERT ref. number | Change in report | Change in CRF |
|---|---|---|---|---|---|
| 1A3b Fuel Combustion Activities - Transport - Road transportation | Large differences in Biomass fuel consumption between data in CRF and data reported to the Eurostat for road transportation. There seems to be a systematic difference of 27% lower consumption in CRF each year (2008-2014). | The difference is due to the NCV used: in the CRF, 27 was used according to the IPCC2006 guidelines, whereas in the energy balance reported to EUROSTAT, 37 was used. | CY-1A3b-2016-0003 | ✓ | ✓ |
| 1A3b Fuel Combustion Activities - Transport - Road transportation | CO2 from urea-based catalysts are reported under 1.A.3.b instead of 2.D.3 as in line with the UNFCCC | Relocation of emissions from urea-based catalyst | CY-1A3b-2016-0004 | ✓ | ✓ |
| 2D Non-Energy Products from Fuels and Solvent Use | Carbon content of NMVOCs not according to IPCC2006 guidelines | Revised from 85% to 60% | CY-2D-2016-0001 | ✓ | ✓ |
| 3A Enteric fermentation | Overestimation of emissions caused by 60% digestibility for dairy cattle. | Adopted 68% proposed by the TERT. | CY-3A-2016-0002 | ✓ | ✓ |
| 3A Enteric fermentation | Mistake identified during calculations in equation (constant milk production used and not varying by year) | Formula corrected | NA | ✓ | ✓ |
| 3B Manure management | For estimating CH4 emission from Manure Management Systems (MMS) for cattle is assumed Eastern European conditions and using the default value for CH4 from MMS for Eastern Europe. Proposal to develop T2 | Proposal adopted. T2 applied for cattle (dairy and other) | CY-3B-2016-0010 | ✓ | ✓ |
| Biological Treatment of Solid Waste | Emissions of N2O from composting are calculated assuming an EF of 0.3 g/kg of waste and not 0.24 as indicated in corrigendum, dated July 2015. | EF revised from 0.3 to 0.24 g/kg | CY-5B-2016-0002 | ✓ | ✓ |
| Wastewater Treatment and Discharge | I=1 should be used for septic tanks | Calculations revised to use I=1 for septic tanks | CY-5D-2016-0002 | ✓ | ✓ |

# Chapter 11: Minimisation of Adverse Impacts under Article 3, paragraph 14

## 11.1. Introduction

Article 3, paragraph 14, of the Kyoto Protocol requires that Annex I Parties shall strive to meet their commitments under Article 3, paragraph 1 of the Kyoto Protocol in such a way as to minimize adverse social environmental and economic impacts on developing country Parties, particularly those Parties identified in Article 4, paragraphs 8 and 9, of the Convention. Information on how commitments under Article 3, paragraph 14, are being implemented is to be prioritised under a number of actions as set down in section H of the annex to guidelines for the preparation of supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol (Decision 15/CMP.1). These requirements are addressed in this chapter.

## 11.2. Context

As a Member State of the European Union, Cyprus commitments under the Kyoto Protocol are being implemented under Decision 2005/166/EC, governing joint fulfilment under Article 4, and Decision 280/2004/EC, which covers specific emissions monitoring and reporting requirements. In this context, the minimization of adverse impacts on developing countries is also largely dictated by the European Commission's policy on climate change and by its policies and programmes affecting developing countries. Regulation at the European level also controls or influences market conditions, fiscal incentives, tax and duty exemptions and subsidies in all economic sectors in Member States.

The impact assessment of new policy initiatives has been established in the European Union, which allows their potential adverse social, environmental and economic impacts on various stakeholders, including developing country Parties, to be identified and limited at an early stage within the legislative process. Impact Assessment Guidelines specifically address impacts on third countries and also issues related to international relations. This provides a framework in which Member States like Cyprus can also ensure a high level of protection of the environment and contribute to the integration of environmental considerations into the preparation and adoption of specified plans and programmes with a view to promoting sustainable development.

## 11.3. Specific Elements

<u>a) The progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse-gas-emitting sectors, taking into account the need for energy price reforms to reflect market prices and externalities</u>

The current paragraph includes information on the means used by the country in order to enhance the progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies that run counter to the objectives of the Convention and on the application of market instruments.

Cyprus, as a Member of the EU, supports and makes the necessary steps to implement the EU Common Agricultural Policy. In the specific policy environmental concerns have been gradually incorporated. Such examples are the including "decoupled" direct payments which have replaced price support; environmental cross compliance; a substantial increase in budget for rural development. As part of 2008 Common Agriculture Policy Health Check, additional part of direct aid has been shifted to climate change, renewable energy, water management, biodiversity, innovation; - transparency of agricultural subsidies has improved. It is important to note that in the other areas most subsidies are within the competence of the country.

The energy market liberisation (National Laws 122(I)/2003 and 183(I)/2004) has been an important step to create an original internal energy market and can be considered as a mean to address market imperfections and to reflect externalities. The existence of a competitive internal energy market is a strategic instrument both in terms of giving local consumers a choice between different companies supplying gas and electricity at reasonable prices, but also in terms of making the market accessible for all suppliers, especially the smallest and those investing in renewable forms of energy.

At the same time, Cyprus participates in the EU Emissions Trading Scheme, which constitutes an important market instrument to implement the objectives of the Convention and Article 3, paragraph 1 of the Kyoto Protocol which aims at creating the right incentives for forward looking low carbon investment decisions by reinforcing a clear, undistorted and long-term carbon price signal.

Finally, the taxation on energy products and electricity, as defined by the Directive 2003/96/EC, contribute to establishment of rules for the taxation of energy products used as motor or heating fuel, taxes on energy consumption, and common minimum levels of taxation. The Directive has been transposed into Cyprus legislation with Law 91(I)/2004.

(b) Cooperating in the development, diffusion, and transfer of less-greenhouse-gas emitting advanced fossil-fuel technologies, and/or technologies, relating to fossil fuels, that capture and store greenhouse gases, and encouraging their wider use; and facilitating the participation of the least developed countries and other non-Annex I Parties in this effort

Cyprus considers important that EU remains committed to the climate change mitigation, through the international funding. Therefore, Cyprus has already contributed through the direct funding of the EU, with the amount of 1.2 million € for two projects in Nepal and eastern Caribbean. In the fulfilment of the requirements of Article 16 of Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC, Cyprus submits reports including information regarding funding provided by the Republic of Cyprus to developing countries. No private funding, technology and capacity building have been provided to developing countries since 2013 due to the fact that Cyprus is implementing a macroeconomic adjustment program in order to improve key sectors of the economy as well as its public finances, pursuant to the provisions of the Memorandum of Understanding.

# Annex I. Uncertainty analysis

This Annex contains the uncertainty analysis tables. The tables have also been submitted in excel format.

**Uncertainty analysis has not been updated**

| Reporting year: | 1990 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IPCC category/Group | Gas | Base year emissions or removals | Year x emissions or removals | Activity data uncertainty (1) | Emission factor / estimation parameter uncertainty (1) | Combined uncertainty | Contribution to variance by category in year x | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2) | Uncertainty in trend in national emissions introduced by activity data uncertainty (3) | Uncertainty introduced into the trend in total national emissions | Comments (optional) |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert\frac{D}{\sum C}\right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 1761.4882 | 5 | 5 | 7.0711 | 4.8807 | 0.0000 | 0.3124 | 0.0000 | 2.2092 | 4.880654673 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 512.1969 | 5 | 5 | 7.0711 | 0.6424 | 0.0000 | 0.0908 | 0.0000 | 0.6424 | 0.412660078 | |
| 1A3. Transport | CO2 | 1180.5150 | 1180.5150 | 5 | 5 | 7.0711 | 1.4806 | 0.0000 | 0.2094 | 0.0000 | 1.4806 | 2.192106367 | |
| 1A4. Other sectors | CO2 | 430.4000 | 430.4000 | 2 | 2 | 2.8284 | 0.2159 | 0.0000 | 0.0763 | 0.0000 | 0.2159 | 0.046621164 | |
| 1A5. Other | CO2 | 10.9950 | 10.9950 | 5 | 5 | 7.0711 | 0.0138 | 0.0000 | 0.0020 | 0.0000 | 0.0138 | 0.000190156 | |
| 2A. Mineral industry | CO2 | 759.1845 | 759.1845 | 5 | 5 | 7.0711 | 0.9522 | 0.0000 | 0.1347 | 0.0000 | 0.9522 | 0.906594895 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 6.2377 | 20 | 400 | 400.4997 | 0.4431 | 0.0000 | 0.0011 | 0.0000 | 0.0313 | 0.000979243 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0584 | 50 | 200 | 206.1553 | 0.0021 | 0.0000 | 0.0000 | 0.0000 | 0.0007 | 5.36101E-07 | |
| 3H. Urea application | CO2 | 1.8150 | 1.8150 | 50 | 200 | 206.1553 | 0.0664 | 0.0000 | 0.0003 | 0.0000 | 0.0228 | 0.00051817 | |
| 1A1. Energy industries | CH4 | 1.7055 | 1.7055 | 5 | 100 | 100.1249 | 0.0303 | 0.0000 | 0.0003 | 0.0000 | 0.0021 | 4.57533E-06 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 0.8831 | 5 | 100 | 100.1249 | 0.0157 | 0.0000 | 0.0002 | 0.0000 | 0.0011 | 1.22656E-06 | |
| 1A3. Transport | CH4 | 5.3955 | 5.3955 | 5 | 50 | 50.2494 | 0.0481 | 0.0000 | 0.0010 | 0.0000 | 0.0068 | 4.57912E-05 | |
| 1A4. Other sectors | CH4 | 2.5278 | 2.5278 | 5 | 20 | 20.6155 | 0.0092 | 0.0000 | 0.0004 | 0.0000 | 0.0032 | 1.00505E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.0370 | 20 | 40 | 44.7214 | 0.0003 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 3.44542E-08 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | 0.0001 | 30 | 100 | 104.4031 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 2.19256E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 199.6575 | 5 | 30 | 30.4138 | 1.0770 | 0.0000 | 0.0354 | 0.0000 | 0.2504 | 0.062703223 | |
| 3B. Manure management | CH4 | 111.4133 | 111.4133 | 5 | 50 | 50.2494 | 0.9930 | 0.0000 | 0.0198 | 0.0000 | 0.1397 | 0.019525056 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.3450 | 50 | 200 | 206.1553 | 0.0126 | 0.0000 | 0.0001 | 0.0000 | 0.0043 | 1.87222E-05 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 251.1627 | 5 | 20 | 20.6155 | 0.9184 | 0.0000 | 0.0445 | 0.0000 | 0.3150 | 0.099226811 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 91.1100 | 20 | 40 | 44.7214 | 0.7227 | 0.0000 | 0.0162 | 0.0000 | 0.4571 | 0.208915508 | |
| 1A1. Energy industries | N2O | 3.9813 | 3.9813 | 5 | 300 | 300.0417 | 0.0449 | 0.0000 | 0.0007 | 0.0000 | 0.0050 | 2.49324E-05 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 1.7230 | 5 | 300 | 300.0417 | 0.0084 | 0.0000 | 0.0003 | 0.0000 | 0.0022 | 4.6699E-06 | |
| 1A3. Transport | N2O | 27.8034 | 27.8034 | 5 | 300 | 300.0417 | 2.1893 | 0.0000 | 0.0049 | 0.0000 | 0.0349 | 0.001215946 | |
| 1A4. Other sectors | N2O | 0.9804 | 0.9804 | 5 | 100 | 100.1249 | 0.0003 | 0.0000 | 0.0002 | 0.0000 | 0.0012 | 1.51197E-06 | |
| 1A5. Other | N2O | 0.0265 | 0.0265 | 20 | 20 | 28.2843 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 1.77032E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 41.3028 | 50 | 200 | 206.1553 | 2.2808 | 0.0000 | 0.0073 | 0.0000 | 0.5180 | 0.268335167 | |
| 3B. Manure management | N2O | 72.5332 | 72.5332 | 5 | 100 | 100.1249 | 1.6592 | 0.0000 | 0.0129 | 0.0000 | 0.0910 | 0.008275463 | |
| 3D. Agricultural soils | N2O | 149.9732 | 149.9732 | 20 | 100 | 101.9804 | 7.3588 | 0.0000 | 0.0266 | 0.0000 | 0.7524 | 0.566064542 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.1073 | 20 | 20 | 28.2843 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0005 | 2.89652E-07 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 12.2776 | 5 | 10 | 11.1803 | 0.0006 | 0.0000 | 0.0022 | 0.0000 | 0.0154 | 0.000237108 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 0.1456 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0018 | 3.33522E-06 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.0258 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0003 | 1.04433E-07 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 5638.0082 | | | | 26.0668 | | | | | 9.6749 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.105569909 | | | | Trend uncertainty %: | 3.110456456 | |

| Reporting year: | 1991 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IPCC category/Group** | **Gas** | **Base year emissions or removals** | **Year x emissions or removals** | **Activity data uncertainty (1)** | **Emission factor / estimation parameter uncertainty (1)** | **Combined uncertainty** | **Contribution to variance by category in year x** | **Type A sensitivity** | **Type B sensitivity** | **Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)** | **Uncertainty in trend in national emissions introduced by activity data uncertainty (3)** | **Uncertainty introduced into the trend in total national emissions** | **Comments (optional)** |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert\frac{D}{\sum C}\right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 1824.0439 | 5 | 5 | 7.0711 | 4.4195 | 0.0164 | 0.3235 | 0.0820 | 2.2877 | 5.240193836 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 938.3774 | 5 | 5 | 7.0711 | 1.0815 | 0.0675 | 0.1664 | 0.3376 | 1.1769 | 1.499040167 | |
| 1A3. Transport | CO2 | 1180.5150 | 1178.5630 | 5 | 5 | 7.0711 | 1.3583 | 0.0188 | 0.2090 | 0.0939 | 1.4781 | 2.193674121 | |
| 1A4. Other sectors | CO2 | 430.4000 | 470.3680 | 2 | 2 | 2.8284 | 0.2168 | 0.0004 | 0.0834 | 0.0007 | 0.2360 | 0.055682417 | |
| 1A5. Other | CO2 | 10.9950 | 12.2290 | 5 | 5 | 7.0711 | 0.0141 | 0.0000 | 0.0022 | 0.0002 | 0.0153 | 0.000235289 | |
| 2A. Mineral industry | CO2 | 759.1845 | 716.2085 | 5 | 5 | 7.0711 | 0.8255 | 0.0195 | 0.1270 | 0.0974 | 0.8983 | 0.816337908 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 5.5092 | 20 | 400 | 400.4997 | 0.3596 | 0.0002 | 0.0010 | 0.0907 | 0.0276 | 0.008992962 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0584 | 50 | 200 | 206.1553 | 0.0020 | 0.0000 | 0.0000 | 0.0002 | 0.0007 | 5.69461E-07 | |
| 3H. Urea application | CO2 | 1.8150 | 1.4667 | 5 | 100 | 100.1249 | 0.0239 | 0.0001 | 0.0003 | 0.0090 | 0.0018 | 8.46875E-05 | |
| 1A1. Energy industries | CH4 | 1.7055 | 1.7575 | 5 | 100 | 100.1249 | 0.0287 | 0.0000 | 0.0003 | 0.0017 | 0.0022 | 7.90559E-06 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 1.2852 | 5 | 100 | 100.1249 | 0.0210 | 0.0001 | 0.0002 | 0.0058 | 0.0016 | 3.56673E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 5.5560 | 5 | 50 | 50.2494 | 0.0455 | 0.0001 | 0.0010 | 0.0028 | 0.0070 | 5.63772E-05 | |
| 1A4. Other sectors | CH4 | 2.5278 | 2.4760 | 5 | 20 | 20.6155 | 0.0083 | 0.0000 | 0.0004 | 0.0010 | 0.0031 | 1.05926E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.0413 | 20 | 40 | 44.7214 | 0.0003 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 4.28729E-08 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | 0.0001 | 30 | 100 | 104.4031 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.30698E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 198.5050 | 5 | 30 | 30.4138 | 0.9840 | 0.0033 | 0.0352 | 0.0998 | 0.2490 | 0.07194015 | |
| 3B. Manure management | CH4 | 111.4133 | 118.0630 | 5 | 50 | 50.2494 | 0.9670 | 0.0006 | 0.0209 | 0.0282 | 0.1481 | 0.022718484 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.3200 | 50 | 200 | 206.1553 | 0.0108 | 0.0000 | 0.0001 | 0.0020 | 0.0040 | 1.99731E-05 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 255.8867 | 5 | 20 | 20.6155 | 0.8598 | 0.0031 | 0.0454 | 0.0618 | 0.3209 | 0.106812845 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 93.5700 | 20 | 40 | 44.7214 | 0.6821 | 0.0010 | 0.0166 | 0.0395 | 0.4694 | 0.221913541 | |
| 1A1. Energy industries | N2O | 3.9813 | 4.2852 | 5 | 300 | 300.0417 | 0.0439 | 0.0000 | 0.0008 | 0.0025 | 0.0054 | 3.51836E-05 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 2.6841 | 5 | 300 | 300.0417 | 0.0172 | 0.0001 | 0.0005 | 0.0431 | 0.0034 | 0.001864777 | |
| 1A3. Transport | N2O | 27.8034 | 28.1908 | 5 | 300 | 300.0417 | 1.9007 | 0.0004 | 0.0050 | 0.1099 | 0.0354 | 0.013318881 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.0490 | 5 | 100 | 100.1249 | 0.0003 | 0.0000 | 0.0002 | 0.0003 | 0.0013 | 1.83187E-06 | |
| 1A5. Other | N2O | 0.0265 | 0.0295 | 20 | 20 | 28.2843 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 2.19101E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 42.4650 | 50 | 200 | 206.1553 | 2.0360 | 0.0004 | 0.0075 | 0.0880 | 0.5326 | 0.291390073 | |
| 3B. Manure management | N2O | 72.5332 | 72.9802 | 5 | 100 | 100.1249 | 1.4185 | 0.0011 | 0.0129 | 0.1055 | 0.0915 | 0.019512374 | |
| 3D. Agricultural soils | N2O | 149.9732 | 146.9664 | 20 | 100 | 101.9804 | 5.9677 | 0.0029 | 0.0261 | 0.2879 | 0.7373 | 0.626454671 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0983 | 20 | 20 | 28.2843 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0005 | 2.47649E-07 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 12.0303 | 5 | 10 | 11.1803 | 0.0005 | 0.0002 | 0.0021 | 0.0024 | 0.0151 | 0.000233216 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 0.1556 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0020 | 3.81847E-06 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.0301 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0004 | 1.47681E-07 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 6135.2492 | | | | 23.2936 | | | | | 11.1906 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 4.826342227 | | | | Trend uncertainty %: | 3.345231349 | |

| Reporting year: | 1992 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IPCC category/Group** | **Gas** | **Base year emissions or removals** | **Year x emissions or removals** | **Activity data uncertainty (1)** | **Emission factor / estimation parameter uncertainty (1)** | **Combined uncertainty** | **Contribution to variance by category in year x** | **Type A sensitivity** | **Type B sensitivity** | **Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)** | **Uncertainty in trend in national emissions introduced by activity data uncertainty (3)** | **Uncertainty introduced into the trend in total national emissions** | **Comments (optional)** |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert\frac{D}{\sum C}\right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 2120.7909 | 5 | 5 | 7.0711 | 5.2042 | 0.0118 | 0.3762 | 0.0592 | 2.6599 | 7.07830867 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 726.5667 | 5 | 5 | 7.0711 | 0.7815 | 0.0229 | 0.1289 | 0.1146 | 0.9112 | 0.84350508 | |
| 1A3. Transport | CO2 | 1180.5150 | 1324.5280 | 5 | 5 | 7.0711 | 1.4248 | 0.0092 | 0.2349 | 0.0459 | 1.6612 | 2.761676009 | |
| 1A4. Other sectors | CO2 | 430.4000 | 561.4490 | 2 | 2 | 2.8284 | 0.2416 | 0.0106 | 0.0996 | 0.0211 | 0.2817 | 0.079780632 | |
| 1A5. Other | CO2 | 10.9950 | 14.8100 | 5 | 5 | 7.0711 | 0.0159 | 0.0004 | 0.0026 | 0.0018 | 0.0186 | 0.000348123 | |
| 2A. Mineral industry | CO2 | 759.1845 | 767.5490 | 5 | 5 | 7.0711 | 0.8256 | 0.0208 | 0.1361 | 0.1042 | 0.9626 | 0.937534263 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 5.9334 | 20 | 400 | 400.4997 | 0.3615 | 0.0002 | 0.0011 | 0.0950 | 0.0298 | 0.009916603 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0635 | 50 | 200 | 206.1553 | 0.0020 | 0.0000 | 0.0000 | 0.0002 | 0.0008 | 6.60435E-07 | |
| 3H. Urea application | CO2 | 1.8150 | 1.9177 | 5 | 100 | 100.1249 | 0.0292 | 0.0000 | 0.0003 | 0.0035 | 0.0024 | 1.81807E-05 | |
| 1A1. Energy industries | CH4 | 1.7055 | 2.0605 | 5 | 100 | 100.1249 | 0.0314 | 0.0000 | 0.0004 | 0.0013 | 0.0026 | 8.30766E-06 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 0.7868 | 5 | 100 | 100.1249 | 0.0120 | 0.0000 | 0.0001 | 0.0043 | 0.0010 | 1.95262E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 5.7960 | 5 | 50 | 50.2494 | 0.0443 | 0.0001 | 0.0010 | 0.0044 | 0.0073 | 7.21039E-05 | |
| 1A4. Other sectors | CH4 | 2.5278 | 2.7525 | 5 | 20 | 20.6155 | 0.0086 | 0.0000 | 0.0005 | 0.0007 | 0.0035 | 1.23944E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.0500 | 20 | 40 | 44.7214 | 0.0003 | 0.0000 | 0.0000 | 0.0000 | 0.0003 | 6.52871E-08 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | 0.0001 | 30 | 100 | 104.4031 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 2.87137E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 203.5275 | 5 | 30 | 30.4138 | 0.9416 | 0.0052 | 0.0361 | 0.1557 | 0.2553 | 0.08938685 | |
| 3B. Manure management | CH4 | 111.4133 | 134.1058 | 5 | 50 | 50.2494 | 1.0251 | 0.0007 | 0.0238 | 0.0373 | 0.1682 | 0.029677644 | |
| 3F. Field burning of agricultural residu | CH4 | 0.3450 | 0.3150 | 50 | 200 | 206.1553 | 0.0099 | 0.0000 | 0.0001 | 0.0031 | 0.0040 | 2.51879E-05 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 260.9192 | 5 | 20 | 20.6155 | 0.8183 | 0.0057 | 0.0463 | 0.1132 | 0.3272 | 0.119899163 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 96.0450 | 20 | 40 | 44.7214 | 0.6534 | 0.0018 | 0.0170 | 0.0722 | 0.4818 | 0.237380066 | |
| 1A1. Energy industries | N2O | 3.9813 | 4.8872 | 5 | 300 | 300.0417 | 0.0498 | 0.0000 | 0.0009 | 0.0130 | 0.0061 | 0.000207819 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 1.7692 | 5 | 300 | 300.0417 | 0.0065 | 0.0000 | 0.0003 | 0.0128 | 0.0022 | 0.000167671 | |
| 1A3. Transport | N2O | 27.8034 | 30.6046 | 5 | 300 | 300.0417 | 1.9513 | 0.0003 | 0.0054 | 0.0965 | 0.0384 | 0.01077728 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.2427 | 5 | 100 | 100.1249 | 0.0004 | 0.0000 | 0.0002 | 0.0018 | 0.0016 | 5.54582E-06 | |
| 1A5. Other | N2O | 0.0265 | 0.0358 | 20 | 20 | 28.2843 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 3.24779E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 43.5676 | 50 | 200 | 206.1553 | 1.8668 | 0.0008 | 0.0077 | 0.1628 | 0.5464 | 0.325071641 | |
| 3B. Manure management | N2O | 72.5332 | 77.0032 | 5 | 100 | 100.1249 | 1.3756 | 0.0013 | 0.0137 | 0.1342 | 0.0966 | 0.02733596 | |
| 3D. Agricultural soils | N2O | 149.9732 | 170.8183 | 20 | 100 | 101.9804 | 7.0225 | 0.0007 | 0.0303 | 0.0717 | 0.8569 | 0.739497681 | |
| 3F. Field burning of agricultural residu | N2O | 0.1073 | 0.0983 | 20 | 20 | 28.2843 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0005 | 2.52388E-07 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 13.4577 | 5 | 10 | 11.1803 | 0.0005 | 0.0002 | 0.0024 | 0.0015 | 0.0169 | 0.000287191 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 0.1642 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 0.0021 | 4.2819E-06 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.0342 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0004 | 2.06724E-07 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 6573.6495 | | | | 24.7046 | | | | | 13.2909 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 4.97037402 | | | | Trend uncertainty %: | 3.645672104 | |

| Reporting year: | 1993 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IPCC category/Group | Gas | Base year emissions or removals | Year x emissions or removals | Activity data uncertainty (1) | Emission factor / estimation parameter uncertainty (1) | Combined uncertainty | Contribution to variance by category in year x | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2) | Uncertainty in trend in national emissions introduced by activity data uncertainty (3) | Uncertainty introduced into the trend in total national emissions | Comments (optional) |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G\bullet D)^2}{(\sum D)^2}$ | Note B | $\left\|\frac{D}{\sum C}\right\|$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 2242.9861 | 5 | 5 | 7.0711 | 5.3200 | 0.0167 | 0.3978 | 0.0836 | 2.8131 | 7.920554864 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 768.4144 | 5 | 5 | 7.0711 | 0.7902 | 0.0255 | 0.1363 | 0.1273 | 0.9637 | 0.94498937 | |
| 1A3. Transport | CO2 | 1180.5150 | 1342.0860 | 5 | 5 | 7.0711 | 1.3801 | 0.0173 | 0.2380 | 0.0865 | 1.6832 | 2.840690585 | |
| 1A4. Other sectors | CO2 | 430.4000 | 558.1340 | 2 | 2 | 2.8284 | 0.2296 | 0.0059 | 0.0990 | 0.0118 | 0.2800 | 0.078538433 | |
| 1A5. Other | CO2 | 10.9950 | 15.3710 | 5 | 5 | 7.0711 | 0.0158 | 0.0003 | 0.0027 | 0.0017 | 0.0193 | 0.000374665 | |
| 2A. Mineral industry | CO2 | 759.1845 | 840.7310 | 5 | 5 | 7.0711 | 0.8645 | 0.0151 | 0.1491 | 0.0755 | 1.0544 | 1.117508594 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 9.5362 | 20 | 400 | 400.4997 | 0.5554 | 0.0003 | 0.0017 | 0.1368 | 0.0478 | 0.021008453 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0175 | 50 | 200 | 206.1553 | 0.0005 | 0.0000 | 0.0000 | 0.0019 | 0.0002 | 3.67462E-06 | |
| 3H. Urea application | CO2 | 1.8150 | 1.6023 | 5 | 100 | 100.1249 | 0.0233 | 0.0001 | 0.0003 | 0.0108 | 0.0020 | 0.00012161 | |
| 1A1. Energy industries | CH4 | 1.7055 | 2.1805 | 5 | 100 | 100.1249 | 0.0317 | 0.0000 | 0.0004 | 0.0018 | 0.0027 | 1.0651E-05 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 0.8421 | 5 | 100 | 100.1249 | 0.0123 | 0.0000 | 0.0001 | 0.0042 | 0.0011 | 1.84807E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 5.7503 | 5 | 50 | 50.2494 | 0.0420 | 0.0001 | 0.0010 | 0.0074 | 0.0072 | 0.000106226 | |
| 1A4. Other sectors | CH4 | 2.5278 | 2.7498 | 5 | 20 | 20.6155 | 0.0082 | 0.0001 | 0.0005 | 0.0012 | 0.0034 | 1.32902E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.0518 | 20 | 40 | 44.7214 | 0.0003 | 0.0000 | 0.0000 | 0.0000 | 0.0003 | 6.96082E-08 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | 0.0001 | 30 | 100 | 104.4031 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.30721E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 212.4800 | 5 | 30 | 30.4138 | 0.9398 | 0.0055 | 0.0377 | 0.1650 | 0.2665 | 0.09825607 | |
| 3B. Manure management | CH4 | 111.4133 | 144.4028 | 5 | 50 | 50.2494 | 1.0552 | 0.0015 | 0.0256 | 0.0755 | 0.1811 | 0.038505911 | |
| 3F. Field burning of agricultural residu | CH4 | 0.3450 | 0.3050 | 50 | 200 | 206.1553 | 0.0091 | 0.0000 | 0.0001 | 0.0041 | 0.0038 | 3.14989E-05 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 266.5955 | 5 | 20 | 20.6155 | 0.7993 | 0.0070 | 0.0473 | 0.1409 | 0.3344 | 0.131641548 | |
| 5D. Waste water treatment and discha | CH4 | 91.1100 | 97.7225 | 20 | 40 | 44.7214 | 0.6356 | 0.0024 | 0.0173 | 0.0950 | 0.4902 | 0.249373703 | |
| 1A1. Energy industries | N2O | 3.9813 | 5.1792 | 5 | 300 | 300.0417 | 0.0511 | 0.0001 | 0.0009 | 0.0172 | 0.0065 | 0.000338572 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 1.8819 | 5 | 300 | 300.0417 | 0.0067 | 0.0000 | 0.0003 | 0.0117 | 0.0024 | 0.000142109 | |
| 1A3. Transport | N2O | 27.8034 | 30.6791 | 5 | 300 | 300.0417 | 1.7920 | 0.0006 | 0.0054 | 0.1719 | 0.0385 | 0.031031713 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.2486 | 5 | 100 | 100.1249 | 0.0003 | 0.0000 | 0.0002 | 0.0009 | 0.0016 | 3.33162E-06 | |
| 1A5. Other | N2O | 0.0265 | 0.0370 | 20 | 20 | 28.2843 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 3.46317E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 44.5510 | 50 | 200 | 206.1553 | 1.7840 | 0.0010 | 0.0079 | 0.2066 | 0.5587 | 0.354865576 | |
| 3B. Manure management | N2O | 72.5332 | 82.2182 | 5 | 100 | 100.1249 | 1.4332 | 0.0011 | 0.0146 | 0.1108 | 0.1031 | 0.022901441 | |
| 3D. Agricultural soils | N2O | 149.9732 | 184.7915 | 20 | 100 | 101.9804 | 7.5108 | 0.0003 | 0.0328 | 0.0333 | 0.9270 | 0.860525086 | |
| 3F. Field burning of agricultural residu | N2O | 0.1073 | 0.0954 | 20 | 20 | 28.2843 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0005 | 2.44703E-07 | |
| 5D. Waste water treatment and discha | N2O | 12.2776 | 13.4011 | 5 | 10 | 11.1803 | 0.0005 | 0.0003 | 0.0024 | 0.0028 | 0.0168 | 0.000290271 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 0.2171 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0014 | 0.0027 | 9.37909E-06 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.0385 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0003 | 0.0005 | 2.96144E-07 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 6876.2972 | | | | 25.2919 | | | | | 14.7119 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.029100599 | | | | Trend uncertainty %: | 3.835603701 | |

| Reporting year: | 1994 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IPCC category/Group | Gas | Base year emissions or removals | Year x emissions or removals | Activity data uncertainty (1) | Emission factor / estimation parameter uncertainty (1) | Combined uncertainty | Contribution to variance by category in year x | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2) | Uncertainty in trend in national emissions introduced by activity data uncertainty (3) | Uncertainty introduced into the trend in total national emissions | Comments (optional) |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert \frac{D}{\sum C} \right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 2370.8962 | 5 | 5 | 7.0711 | 5.5475 | 0.0260 | 0.4205 | 0.1300 | 2.9735 | 8.858764607 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 781.9994 | 5 | 5 | 7.0711 | 0.7769 | 0.0240 | 0.1387 | 0.1199 | 0.9808 | 0.9762882 | |
| 1A3. Transport | CO2 | 1180.5150 | 1395.2540 | 5 | 5 | 7.0711 | 1.3861 | 0.0168 | 0.2475 | 0.0842 | 1.7499 | 3.06922651 | |
| 1A4. Other sectors | CO2 | 430.4000 | 570.2910 | 2 | 2 | 2.8284 | 0.2266 | 0.0048 | 0.1012 | 0.0095 | 0.2861 | 0.081943504 | |
| 1A5. Other | CO2 | 10.9950 | 15.8190 | 5 | 5 | 7.0711 | 0.0157 | 0.0003 | 0.0028 | 0.0017 | 0.0198 | 0.000396574 | |
| 2A. Mineral industry | CO2 | 759.1845 | 873.3840 | 5 | 5 | 7.0711 | 0.8676 | 0.0151 | 0.1549 | 0.0753 | 1.0954 | 1.20553187 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 13.1313 | 10 | 50 | 50.9902 | 0.0941 | 0.0009 | 0.0023 | 0.0466 | 0.0329 | 0.003257799 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0175 | 20 | 400 | 400.4997 | 0.0010 | 0.0000 | 0.0000 | 0.0040 | 0.0001 | 1.58962E-05 | |
| 3H. Urea application | CO2 | 1.8150 | 1.7035 | 50 | 200 | 206.1553 | 0.0493 | 0.0001 | 0.0003 | 0.0209 | 0.0214 | 0.000891371 | |
| 1A1. Energy industries | CH4 | 1.7055 | 2.2720 | 5 | 100 | 100.1249 | 0.0320 | 0.0000 | 0.0004 | 0.0021 | 0.0028 | 1.25632E-05 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 0.8393 | 5 | 100 | 100.1249 | 0.0118 | 0.0000 | 0.0001 | 0.0049 | 0.0011 | 2.49863E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 6.0800 | 5 | 100 | 100.1249 | 0.0855 | 0.0001 | 0.0011 | 0.0130 | 0.0076 | 0.000226564 | |
| 1A4. Other sectors | CH4 | 2.5278 | 2.7035 | 5 | 50 | 50.2494 | 0.0191 | 0.0001 | 0.0005 | 0.0043 | 0.0034 | 3.02046E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.0533 | 5 | 20 | 20.6155 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 4.9982E-09 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | 0.0001 | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 2.02872E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 215.9575 | 30 | 100 | 104.4031 | 3.1676 | 0.0064 | 0.0383 | 0.6402 | 1.6251 | 3.050739928 | |
| 3B. Manure management | CH4 | 111.4133 | 141.3570 | 5 | 30 | 30.4138 | 0.6040 | 0.0001 | 0.0251 | 0.0037 | 0.1773 | 0.031444532 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.1925 | 5 | 50 | 50.2494 | 0.0014 | 0.0000 | 0.0000 | 0.0022 | 0.0002 | 4.70444E-06 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 272.4501 | 50 | 200 | 206.1553 | 7.8910 | 0.0079 | 0.0483 | 1.5827 | 3.4170 | 14.18092981 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 99.7850 | 5 | 20 | 20.6155 | 0.2890 | 0.0027 | 0.0177 | 0.0540 | 0.1251 | 0.018583433 | |
| 1A1. Energy industries | N2O | 3.9813 | 5.5011 | 20 | 40 | 44.7214 | 0.0346 | 0.0001 | 0.0010 | 0.0034 | 0.0276 | 0.000772961 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 1.8896 | 5 | 300 | 300.0417 | 0.0063 | 0.0001 | 0.0003 | 0.0152 | 0.0024 | 0.000236675 | |
| 1A3. Transport | N2O | 27.8034 | 32.1453 | 5 | 300 | 300.0417 | 1.8361 | 0.0005 | 0.0057 | 0.1573 | 0.0403 | 0.02636014 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.2605 | 5 | 300 | 300.0417 | 0.0028 | 0.0000 | 0.0002 | 0.0012 | 0.0016 | 3.96921E-06 | |
| 1A5. Other | N2O | 0.0265 | 0.0381 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0000 | 9.12206E-09 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 45.4152 | 20 | 20 | 28.2843 | 0.0326 | 0.0012 | 0.0081 | 0.0239 | 0.2278 | 0.05247843 | |
| 3B. Manure management | N2O | 72.5332 | 82.0394 | 50 | 200 | 206.1553 | 5.6460 | 0.0017 | 0.0146 | 0.3381 | 1.0289 | 1.172980627 | |
| 3D. Agricultural soils | N2O | 149.9732 | 170.9751 | 5 | 100 | 100.1249 | 5.7843 | 0.0033 | 0.0303 | 0.3256 | 0.2144 | 0.151997515 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0596 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0013 | 0.0003 | 1.89876E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 13.5799 | 20 | 20 | 28.2843 | 0.0029 | 0.0003 | 0.0024 | 0.0068 | 0.0681 | 0.004687589 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 0.7030 | 5 | 10 | 11.1803 | 0.0000 | 0.0001 | 0.0001 | 0.0009 | 0.0009 | 1.62552E-06 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.0503 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0006 | 0.0006 | 7.95966E-07 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 7117.8433 | | | | 34.4120 | | | | | 32.8878 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.866173002 | | | | Trend uncertainty %: | 5.734791653 | |

| Reporting year: | 1995 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IPCC category/Group | Gas | Base year emissions or removals | Year x emissions or removals | Activity data uncertainty (1) | Emission factor / estimation parameter uncertainty (1) | Combined uncertainty | Contribution to variance by category in year x | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2) | Uncertainty in trend in national emissions introduced by activity data uncertainty (3) | Uncertainty introduced into the trend in total national emissions | Comments (optional) |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert\frac{D}{\sum C}\right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 2166.1439 | 5 | 5 | 7.0711 | 4.6994 | 0.0073 | 0.3842 | 0.0366 | 2.7167 | 7.3819652 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 770.8955 | 5 | 5 | 7.0711 | 0.7715 | 0.0229 | 0.1367 | 0.1143 | 0.9668 | 0.947844603 | |
| 1A3. Transport | CO2 | 1180.5150 | 1482.0050 | 5 | 5 | 7.0711 | 1.4831 | 0.0005 | 0.2629 | 0.0023 | 1.8587 | 3.454765599 | |
| 1A4. Other sectors | CO2 | 430.4000 | 602.5390 | 2 | 2 | 2.8284 | 0.2412 | 0.0112 | 0.1069 | 0.0224 | 0.3023 | 0.091872218 | |
| 1A5. Other | CO2 | 10.9950 | 17.1660 | 5 | 5 | 7.0711 | 0.0172 | 0.0006 | 0.0030 | 0.0030 | 0.0215 | 0.000472529 | |
| 2A. Mineral industry | CO2 | 759.1845 | 838.7570 | 5 | 5 | 7.0711 | 0.8394 | 0.0200 | 0.1488 | 0.0998 | 1.0520 | 1.116557641 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 13.0601 | 10 | 50 | 50.9902 | 0.0942 | 0.0009 | 0.0023 | 0.0465 | 0.0328 | 0.003234952 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0175 | 20 | 400 | 400.4997 | 0.0010 | 0.0000 | 0.0000 | 0.0039 | 0.0001 | 1.55921E-05 | |
| 3H. Urea application | CO2 | 1.8150 | 1.5407 | 50 | 200 | 206.1553 | 0.0450 | 0.0001 | 0.0003 | 0.0260 | 0.0193 | 0.001051142 | |
| 1A1. Energy industries | CH4 | 1.7055 | 2.0925 | 5 | 100 | 100.1249 | 0.0297 | 0.0000 | 0.0004 | 0.0008 | 0.0026 | 7.52063E-06 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 0.7966 | 5 | 100 | 100.1249 | 0.0113 | 0.0001 | 0.0001 | 0.0055 | 0.0010 | 3.12367E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 6.2638 | 5 | 100 | 100.1249 | 0.0888 | 0.0001 | 0.0011 | 0.0088 | 0.0079 | 0.000139734 | |
| 1A4. Other sectors | CH4 | 2.5278 | 3.5940 | 5 | 50 | 50.2494 | 0.0256 | 0.0001 | 0.0006 | 0.0038 | 0.0045 | 3.46018E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.0580 | 5 | 20 | 20.6155 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 6.99372E-09 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | 0.0001 | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.65626E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 225.3000 | 30 | 100 | 104.4031 | 3.3291 | 0.0044 | 0.0400 | 0.4418 | 1.6954 | 3.069522361 | |
| 3B. Manure management | CH4 | 111.4133 | 148.0505 | 5 | 30 | 30.4138 | 0.6373 | 0.0015 | 0.0263 | 0.0448 | 0.1857 | 0.036486647 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.1975 | 5 | 50 | 50.2494 | 0.0014 | 0.0000 | 0.0000 | 0.0021 | 0.0002 | 4.39957E-06 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 278.6830 | 50 | 200 | 206.1553 | 8.1311 | 0.0064 | 0.0494 | 1.2793 | 3.4952 | 13.8528899 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 99.9775 | 5 | 20 | 20.6155 | 0.2917 | 0.0025 | 0.0177 | 0.0504 | 0.1254 | 0.018260353 | |
| 1A1. Energy industries | N2O | 3.9813 | 4.9110 | 20 | 40 | 44.7214 | 0.0311 | 0.0000 | 0.0009 | 0.0006 | 0.0246 | 0.000607305 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 1.8148 | 5 | 300 | 300.0417 | 0.0059 | 0.0001 | 0.0003 | 0.0183 | 0.0023 | 0.000341251 | |
| 1A3. Transport | N2O | 27.8034 | 33.6740 | 5 | 300 | 300.0417 | 2.0448 | 0.0002 | 0.0060 | 0.0622 | 0.0422 | 0.005657779 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.3827 | 5 | 300 | 300.0417 | 0.0034 | 0.0000 | 0.0002 | 0.0082 | 0.0017 | 7.01874E-05 | |
| 1A5. Other | N2O | 0.0265 | 0.0414 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0001 | 2.377E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 46.1900 | 20 | 20 | 28.2843 | 0.0342 | 0.0010 | 0.0082 | 0.0198 | 0.2317 | 0.054085649 | |
| 3B. Manure management | N2O | 72.5332 | 85.0194 | 50 | 200 | 206.1553 | 6.1534 | 0.0010 | 0.0151 | 0.2086 | 1.0663 | 1.180491842 | |
| 3D. Agricultural soils | N2O | 149.9732 | 212.1694 | 5 | 100 | 100.1249 | 9.0395 | 0.0043 | 0.0376 | 0.4295 | 0.2661 | 0.255250927 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0596 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0013 | 0.0003 | 1.8517E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 14.2593 | 20 | 20 | 28.2843 | 0.0033 | 0.0002 | 0.0025 | 0.0040 | 0.0715 | 0.00513322 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 8.9521 | 5 | 10 | 11.1803 | 0.0002 | 0.0016 | 0.0016 | 0.0156 | 0.0112 | 0.000367997 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.0581 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0009 | 0.0007 | 1.3733E-06 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 7065.6702 | | | | 38.0538 | | | | | 31.4772 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 6.168774548 | | | | Trend uncertainty %: | 5.610451465 | |

| Reporting year: | 1996 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IPCC category/Group** | **Gas** | **Base year emissions or removals** | **Year x emissions or removals** | **Activity data uncertainty (1)** | **Emission factor / estimation parameter uncertainty (1)** | **Combined uncertainty** | **Contribution to variance by category in year x** | **Type A sensitivity** | **Type B sensitivity** | **Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)** | **Uncertainty in trend in national emissions introduced by activity data uncertainty (3)** | **Uncertainty introduced into the trend in total national emissions** | **Comments (optional)** |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert\frac{D}{\sum C}\right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 2281.1158 | 5 | 5 | 7.0711 | 4.8067 | 0.0031 | 0.4046 | 0.0155 | 2.8609 | 8.185137117 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 829.3021 | 5 | 5 | 7.0711 | 0.7971 | 0.0285 | 0.1471 | 0.1426 | 1.0401 | 1.102123033 | |
| 1A3. Transport | CO2 | 1180.5150 | 1532.1250 | 5 | 5 | 7.0711 | 1.4725 | 0.0015 | 0.2717 | 0.0074 | 1.9216 | 3.692439911 | |
| 1A4. Other sectors | CO2 | 430.4000 | 628.3360 | 2 | 2 | 2.8284 | 0.2416 | 0.0118 | 0.1114 | 0.0236 | 0.3152 | 0.099921417 | |
| 1A5. Other | CO2 | 10.9950 | 18.0630 | 5 | 5 | 7.0711 | 0.0174 | 0.0007 | 0.0032 | 0.0033 | 0.0227 | 0.00052407 | |
| 2A. Mineral industry | CO2 | 759.1845 | 898.6285 | 5 | 5 | 7.0711 | 0.8637 | 0.0163 | 0.1594 | 0.0815 | 1.1270 | 1.276866157 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 13.0723 | 10 | 50 | 50.9902 | 0.0906 | 0.0009 | 0.0023 | 0.0437 | 0.0328 | 0.002988679 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0545 | 20 | 400 | 400.4997 | 0.0030 | 0.0000 | 0.0000 | 0.0015 | 0.0003 | 2.44092E-06 | |
| 3H. Urea application | CO2 | 1.8150 | 1.3779 | 50 | 200 | 206.1553 | 0.0386 | 0.0002 | 0.0002 | 0.0351 | 0.0173 | 0.001533304 | |
| 1A1. Energy industries | CH4 | 1.7055 | 2.2133 | 5 | 100 | 100.1249 | 0.0301 | 0.0000 | 0.0004 | 0.0002 | 0.0028 | 7.7527E-06 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 0.8821 | 5 | 100 | 100.1249 | 0.0120 | 0.0000 | 0.0002 | 0.0048 | 0.0011 | 2.42023E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 6.4013 | 5 | 100 | 100.1249 | 0.0871 | 0.0001 | 0.0011 | 0.0113 | 0.0080 | 0.000193094 | |
| 1A4. Other sectors | CH4 | 2.5278 | 4.0200 | 5 | 50 | 50.2494 | 0.0275 | 0.0001 | 0.0007 | 0.0064 | 0.0050 | 6.63581E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.0610 | 5 | 20 | 20.6155 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 7.88832E-09 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | 0.0001 | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.41508E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 231.7525 | 30 | 100 | 104.4031 | 3.2887 | 0.0051 | 0.0411 | 0.5104 | 1.7440 | 3.301861384 | |
| 3B. Manure management | CH4 | 111.4133 | 156.5620 | 5 | 30 | 30.4138 | 0.6472 | 0.0020 | 0.0278 | 0.0595 | 0.1964 | 0.04209107 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.2000 | 5 | 50 | 50.2494 | 0.0014 | 0.0000 | 0.0000 | 0.0022 | 0.0003 | 4.98624E-06 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 285.6486 | 50 | 200 | 206.1553 | 8.0042 | 0.0075 | 0.0507 | 1.4928 | 3.5825 | 15.06294615 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 98.0725 | 5 | 20 | 20.6155 | 0.2748 | 0.0037 | 0.0174 | 0.0738 | 0.1230 | 0.020581574 | |
| 1A1. Energy industries | N2O | 3.9813 | 5.2001 | 20 | 40 | 44.7214 | 0.0316 | 0.0000 | 0.0009 | 0.0000 | 0.0261 | 0.000680554 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 2.0267 | 5 | 300 | 300.0417 | 0.0068 | 0.0000 | 0.0004 | 0.0118 | 0.0025 | 0.000145664 | |
| 1A3. Transport | N2O | 27.8034 | 34.6783 | 5 | 300 | 300.0417 | 2.0001 | 0.0003 | 0.0062 | 0.0853 | 0.0435 | 0.009166929 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.5019 | 5 | 300 | 300.0417 | 0.0038 | 0.0000 | 0.0003 | 0.0118 | 0.0019 | 0.000143775 | |
| 1A5. Other | N2O | 0.0265 | 0.0435 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 0.0001 | 2.78897E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 46.9052 | 20 | 20 | 28.2843 | 0.0325 | 0.0012 | 0.0083 | 0.0248 | 0.2353 | 0.055985842 | |
| 3B. Manure management | N2O | 72.5332 | 88.7444 | 50 | 200 | 206.1553 | 6.1837 | 0.0010 | 0.0157 | 0.2095 | 1.1130 | 1.28267863 | |
| 3D. Agricultural soils | N2O | 149.9732 | 172.6445 | 5 | 100 | 100.1249 | 5.5204 | 0.0041 | 0.0306 | 0.4089 | 0.2165 | 0.214071493 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0626 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0014 | 0.0003 | 1.98381E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 13.7974 | 20 | 20 | 28.2843 | 0.0028 | 0.0004 | 0.0024 | 0.0079 | 0.0692 | 0.004853311 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 3.6139 | 5 | 10 | 11.1803 | 0.0000 | 0.0006 | 0.0006 | 0.0061 | 0.0045 | 5.74223E-05 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.0660 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0011 | 0.0008 | 2.00015E-06 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 7357.1728 | | | | 34.4859 | | | | | 34.3571 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.872470817 | | | | Trend uncertainty %: | 5.861493013 | |

| Reporting year: | 1997 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IPCC category/Group | Gas | Base year emissions or removals | Year x emissions or removals | Activity data uncertainty (1) | Emission factor / estimation parameter uncertainty (1) | Combined uncertainty | Contribution to variance by category in year x | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2) | Uncertainty in trend in national emissions introduced by activity data uncertainty (3) | Uncertainty introduced into the trend in total national emissions | Comments (optional) |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert\frac{D}{\sum C}\right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 2410.9466 | 5 | 5 | 7.0711 | 5.1884 | 0.0128 | 0.4276 | 0.0642 | 3.0238 | 9.147224643 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 772.5180 | 5 | 5 | 7.0711 | 0.7299 | 0.0164 | 0.1370 | 0.0820 | 0.9689 | 0.945448233 | |
| 1A3. Transport | CO2 | 1180.5150 | 1598.2690 | 5 | 5 | 7.0711 | 1.5100 | 0.0055 | 0.2835 | 0.0276 | 2.0045 | 4.01883766 | |
| 1A4. Other sectors | CO2 | 430.4000 | 652.8240 | 2 | 2 | 2.8284 | 0.2467 | 0.0144 | 0.1158 | 0.0289 | 0.3275 | 0.108092261 | |
| 1A5. Other | CO2 | 10.9950 | 18.9610 | 5 | 5 | 7.0711 | 0.0179 | 0.0008 | 0.0034 | 0.0039 | 0.0238 | 0.000580497 | |
| 2A. Mineral industry | CO2 | 759.1845 | 863.4820 | 5 | 5 | 7.0711 | 0.8158 | 0.0256 | 0.1532 | 0.1278 | 1.0830 | 1.189142368 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 12.8927 | 10 | 50 | 50.9902 | 0.0878 | 0.0008 | 0.0023 | 0.0409 | 0.0323 | 0.002718866 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0608 | 20 | 400 | 400.4997 | 0.0033 | 0.0000 | 0.0000 | 0.0012 | 0.0003 | 1.49005E-06 | |
| 3H. Urea application | CO2 | 1.8150 | 1.1015 | 50 | 200 | 206.1553 | 0.0303 | 0.0002 | 0.0002 | 0.0464 | 0.0138 | 0.002343397 | |
| 1A1. Energy industries | CH4 | 1.7055 | 2.3373 | 5 | 100 | 100.1249 | 0.0313 | 0.0000 | 0.0004 | 0.0013 | 0.0029 | 1.02789E-05 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 0.7887 | 5 | 100 | 100.1249 | 0.0106 | 0.0001 | 0.0001 | 0.0068 | 0.0010 | 4.72621E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 6.6065 | 5 | 100 | 100.1249 | 0.0884 | 0.0001 | 0.0012 | 0.0099 | 0.0083 | 0.000165897 | |
| 1A4. Other sectors | CH4 | 2.5278 | 3.6075 | 5 | 50 | 50.2494 | 0.0242 | 0.0000 | 0.0006 | 0.0022 | 0.0045 | 2.54624E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.0640 | 5 | 20 | 20.6155 | 0.0002 | 0.0000 | 0.0000 | 0.0001 | 0.0001 | 9.23012E-09 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | 0.0001 | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 2.81099E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 226.6125 | 30 | 100 | 104.4031 | 3.1611 | 0.0068 | 0.0402 | 0.6814 | 1.7053 | 3.37227238 | |
| 3B. Manure management | CH4 | 111.4133 | 161.4318 | 5 | 30 | 30.4138 | 0.6560 | 0.0024 | 0.0286 | 0.0720 | 0.2025 | 0.046173999 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.2725 | 5 | 50 | 50.2494 | 0.0018 | 0.0000 | 0.0000 | 0.0016 | 0.0003 | 2.82265E-06 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 292.7766 | 50 | 200 | 206.1553 | 8.0644 | 0.0072 | 0.0519 | 1.4410 | 3.6719 | 15.55961707 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 98.4500 | 5 | 20 | 20.6155 | 0.2712 | 0.0040 | 0.0175 | 0.0798 | 0.1235 | 0.021612967 | |
| 1A1. Energy industries | N2O | 3.9813 | 5.4892 | 20 | 40 | 44.7214 | 0.0328 | 0.0000 | 0.0010 | 0.0014 | 0.0275 | 0.000760412 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 1.8008 | 5 | 300 | 300.0417 | 0.0052 | 0.0001 | 0.0003 | 0.0259 | 0.0023 | 0.000675228 | |
| 1A3. Transport | N2O | 27.8034 | 35.9567 | 5 | 300 | 300.0417 | 2.0778 | 0.0002 | 0.0064 | 0.0507 | 0.0451 | 0.004599987 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.4781 | 5 | 300 | 300.0417 | 0.0035 | 0.0000 | 0.0003 | 0.0094 | 0.0019 | 9.17193E-05 | |
| 1A5. Other | N2O | 0.0265 | 0.0459 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 0.0001 | 3.92247E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 47.5310 | 20 | 20 | 28.2843 | 0.0323 | 0.0013 | 0.0084 | 0.0259 | 0.2384 | 0.057528261 | |
| 3B. Manure management | N2O | 72.5332 | 91.7542 | 50 | 200 | 206.1553 | 6.3874 | 0.0008 | 0.0163 | 0.1608 | 1.1508 | 1.350102199 | |
| 3D. Agricultural soils | N2O | 149.9732 | 156.1645 | 5 | 100 | 100.1249 | 4.3645 | 0.0076 | 0.0277 | 0.7611 | 0.1959 | 0.617670295 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0834 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0010 | 0.0004 | 1.26933E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 13.9375 | 20 | 20 | 28.2843 | 0.0028 | 0.0004 | 0.0025 | 0.0084 | 0.0699 | 0.00495898 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 6.0945 | 5 | 10 | 11.1803 | 0.0001 | 0.0010 | 0.0011 | 0.0105 | 0.0076 | 0.000167976 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.0695 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0013 | 0.0009 | 2.3309E-06 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 7484.4083 | | | | 33.8456 | | | | | 36.4509 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.817696343 | | | | Trend uncertainty %: | 6.037456108 | |

| Reporting year: | 1998 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IPCC category/Group** | **Gas** | **Base year emissions or removals** | **Year x emissions or removals** | **Activity data uncertainty (1)** | **Emission factor / estimation parameter uncertainty (1)** | **Combined uncertainty** | **Contribution to variance by category in year x** | **Type A sensitivity** | **Type B sensitivity** | **Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)** | **Uncertainty in trend in national emissions introduced by activity data uncertainty (3)** | **Uncertainty introduced into the trend in total national emissions** | **Comments (optional)** |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert\frac{D}{\sum C}\right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 2643.2136 | 5 | 5 | 7.0711 | 5.7283 | 0.0360 | 0.4688 | 0.1798 | 3.3151 | 11.02196219 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 776.4865 | 5 | 5 | 7.0711 | 0.7031 | 0.0119 | 0.1377 | 0.0594 | 0.9739 | 0.951917636 | |
| 1A3. Transport | CO2 | 1180.5150 | 1674.8810 | 5 | 5 | 7.0711 | 1.5166 | 0.0070 | 0.2971 | 0.0352 | 2.1006 | 4.413756108 | |
| 1A4. Other sectors | CO2 | 430.4000 | 678.9280 | 2 | 2 | 2.8284 | 0.2459 | 0.0147 | 0.1204 | 0.0293 | 0.3406 | 0.11686854 | |
| 1A5. Other | CO2 | 10.9950 | 20.1950 | 5 | 5 | 7.0711 | 0.0183 | 0.0009 | 0.0036 | 0.0044 | 0.0253 | 0.000660908 | |
| 2A. Mineral industry | CO2 | 759.1845 | 817.9293 | 5 | 5 | 7.0711 | 0.7406 | 0.0414 | 0.1451 | 0.2069 | 1.0258 | 1.095132651 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 8.6151 | 10 | 50 | 50.9902 | 0.0563 | 0.0000 | 0.0015 | 0.0002 | 0.0216 | 0.000467031 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0619 | 20 | 400 | 400.4997 | 0.0032 | 0.0000 | 0.0000 | 0.0013 | 0.0003 | 1.90248E-06 | |
| 3H. Urea application | CO2 | 1.8150 | 0.8360 | 50 | 200 | 206.1553 | 0.0221 | 0.0003 | 0.0001 | 0.0595 | 0.0105 | 0.003652864 | |
| 1A1. Energy industries | CH4 | 1.7055 | 2.5653 | 5 | 100 | 100.1249 | 0.0329 | 0.0000 | 0.0005 | 0.0036 | 0.0032 | 2.33111E-05 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 0.8222 | 5 | 100 | 100.1249 | 0.0105 | 0.0001 | 0.0001 | 0.0071 | 0.0010 | 5.16331E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 6.8013 | 5 | 100 | 100.1249 | 0.0872 | 0.0001 | 0.0012 | 0.0119 | 0.0085 | 0.000214836 | |
| 1A4. Other sectors | CH4 | 2.5278 | 3.8085 | 5 | 50 | 50.2494 | 0.0245 | 0.0001 | 0.0007 | 0.0027 | 0.0048 | 3.02435E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.0683 | 5 | 20 | 20.6155 | 0.0002 | 0.0000 | 0.0000 | 0.0001 | 0.0001 | 1.09643E-08 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | 0.0001 | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.01533E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 219.5500 | 30 | 100 | 104.4031 | 2.9352 | 0.0101 | 0.0389 | 1.0105 | 1.6521 | 3.750725896 | |
| 3B. Manure management | CH4 | 111.4133 | 165.3260 | 5 | 30 | 30.4138 | 0.6439 | 0.0020 | 0.0293 | 0.0586 | 0.2073 | 0.046422893 | |
| 3F. Field burning of agricultural residu | CH4 | 0.3450 | 0.2875 | 5 | 50 | 50.2494 | 0.0018 | 0.0000 | 0.0001 | 0.0017 | 0.0004 | 2.97991E-06 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 300.1188 | 50 | 200 | 206.1553 | 7.9229 | 0.0085 | 0.0532 | 1.6937 | 3.7640 | 17.03635255 | |
| 5D. Waste water treatment and discha | CH4 | 91.1100 | 98.6775 | 5 | 20 | 20.6155 | 0.2605 | 0.0049 | 0.0175 | 0.0976 | 0.1238 | 0.024842501 | |
| 1A1. Energy industries | N2O | 3.9813 | 6.0911 | 20 | 40 | 44.7214 | 0.0349 | 0.0001 | 0.0011 | 0.0041 | 0.0306 | 0.000950493 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 1.8562 | 5 | 300 | 300.0417 | 0.0051 | 0.0001 | 0.0003 | 0.0282 | 0.0023 | 0.000801717 | |
| 1A3. Transport | N2O | 27.8034 | 37.4407 | 5 | 300 | 300.0417 | 2.0694 | 0.0002 | 0.0066 | 0.0569 | 0.0470 | 0.005444038 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.5556 | 5 | 300 | 300.0417 | 0.0036 | 0.0000 | 0.0003 | 0.0105 | 0.0020 | 0.000114341 | |
| 1A5. Other | N2O | 0.0265 | 0.0489 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 0.0001 | 5.00949E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 48.0674 | 20 | 20 | 28.2843 | 0.0303 | 0.0016 | 0.0085 | 0.0324 | 0.2411 | 0.05919997 | |
| 3B. Manure management | N2O | 72.5332 | 91.8436 | 50 | 200 | 206.1553 | 5.8786 | 0.0015 | 0.0163 | 0.3058 | 1.1519 | 1.420350392 | |
| 3D. Agricultural soils | N2O | 149.9732 | 179.1254 | 5 | 100 | 100.1249 | 5.2746 | 0.0051 | 0.0318 | 0.5072 | 0.2247 | 0.307688542 | |
| 3F. Field burning of agricultural residu | N2O | 0.1073 | 0.0894 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0010 | 0.0004 | 1.30342E-06 | |
| 5D. Waste water treatment and discha | N2O | 12.2776 | 14.4351 | 20 | 20 | 28.2843 | 0.0027 | 0.0005 | 0.0026 | 0.0091 | 0.0724 | 0.005327346 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 9.3847 | 5 | 10 | 11.1803 | 0.0002 | 0.0016 | 0.0017 | 0.0163 | 0.0118 | 0.000403828 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.0673 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0011 | 0.0008 | 1.97387E-06 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 7809.1773 | | | | 34.2533 | | | | | 40.2634 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.852628867 | | | | Trend uncertainty %: | 6.34534244 | |

| Reporting year: | 1999 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IPCC category/Group | Gas | Base year emissions or removals | Year x emissions or removals | Activity data uncertainty (1) | Emission factor / estimation parameter uncertainty (1) | Combined uncertainty | Contribution to variance by category in year x | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2) | Uncertainty in trend in national emissions introduced by activity data uncertainty (3) | Uncertainty introduced into the trend in total national emissions | Comments (optional) |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\|\frac{D}{\sum C}\right\|$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 2826.9354 | 5 | 5 | 7.0711 | 6.1355 | 0.0540 | 0.5014 | 0.2702 | 3.5455 | 12.64343184 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 802.0577 | 5 | 5 | 7.0711 | 0.7028 | 0.0122 | 0.1423 | 0.0611 | 1.0059 | 1.015610541 | |
| 1A3. Transport | CO2 | 1180.5150 | 1718.8370 | 5 | 5 | 7.0711 | 1.5061 | 0.0051 | 0.3049 | 0.0257 | 2.1557 | 4.647826634 | |
| 1A4. Other sectors | CO2 | 430.4000 | 686.0850 | 2 | 2 | 2.8284 | 0.2405 | 0.0124 | 0.1217 | 0.0248 | 0.3442 | 0.119082302 | |
| 1A5. Other | CO2 | 10.9950 | 20.7560 | 5 | 5 | 7.0711 | 0.0182 | 0.0009 | 0.0037 | 0.0045 | 0.0260 | 0.000697455 | |
| 2A. Mineral industry | CO2 | 759.1845 | 823.8113 | 5 | 5 | 7.0711 | 0.7218 | 0.0466 | 0.1461 | 0.2328 | 1.0332 | 1.121711046 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 9.5265 | 10 | 50 | 50.9902 | 0.0602 | 0.0001 | 0.0017 | 0.0053 | 0.0239 | 0.00059914 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0867 | 20 | 400 | 400.4997 | 0.0043 | 0.0000 | 0.0000 | 0.0002 | 0.0004 | 2.39071E-07 | |
| 3H. Urea application | CO2 | 1.8150 | 0.9167 | 50 | 200 | 206.1553 | 0.0234 | 0.0003 | 0.0002 | 0.0596 | 0.0115 | 0.003688978 | |
| 1A1. Energy industries | CH4 | 1.7055 | 2.7483 | 5 | 100 | 100.1249 | 0.0341 | 0.0001 | 0.0005 | 0.0054 | 0.0034 | 4.15412E-05 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 0.8763 | 5 | 100 | 100.1249 | 0.0109 | 0.0001 | 0.0002 | 0.0069 | 0.0011 | 4.84926E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 7.0483 | 5 | 100 | 100.1249 | 0.0874 | 0.0001 | 0.0013 | 0.0120 | 0.0088 | 0.00022134 | |
| 1A4. Other sectors | CH4 | 2.5278 | 3.8698 | 5 | 50 | 50.2494 | 0.0241 | 0.0000 | 0.0007 | 0.0022 | 0.0049 | 2.85343E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.0700 | 5 | 20 | 20.6155 | 0.0002 | 0.0000 | 0.0000 | 0.0001 | 0.0001 | 1.13611E-08 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | 0.0001 | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.70486E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 218.0300 | 30 | 100 | 104.4031 | 2.8207 | 0.0120 | 0.0387 | 1.2013 | 1.6407 | 4.134964343 | |
| 3B. Manure management | CH4 | 111.4133 | 160.0293 | 5 | 30 | 30.4138 | 0.6031 | 0.0001 | 0.0284 | 0.0030 | 0.2007 | 0.040291342 | |
| 3F. Field burning of agricultural residu | CH4 | 0.3450 | 0.3125 | 5 | 50 | 50.2494 | 0.0019 | 0.0000 | 0.0001 | 0.0016 | 0.0004 | 2.73935E-06 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 307.4425 | 50 | 200 | 206.1553 | 7.8538 | 0.0092 | 0.0545 | 1.8460 | 3.8559 | 18.27565173 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 99.2100 | 5 | 20 | 20.6155 | 0.2534 | 0.0055 | 0.0176 | 0.1107 | 0.1244 | 0.027728936 | |
| 1A1. Energy industries | N2O | 3.9813 | 6.4040 | 20 | 40 | 44.7214 | 0.0355 | 0.0001 | 0.0011 | 0.0050 | 0.0321 | 0.001057195 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 1.9370 | 5 | 300 | 300.0417 | 0.0052 | 0.0001 | 0.0003 | 0.0282 | 0.0024 | 0.000799101 | |
| 1A3. Transport | N2O | 27.8034 | 38.5314 | 5 | 300 | 300.0417 | 2.0523 | 0.0002 | 0.0068 | 0.0673 | 0.0483 | 0.006868663 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.5973 | 5 | 300 | 300.0417 | 0.0035 | 0.0000 | 0.0003 | 0.0103 | 0.0020 | 0.000110508 | |
| 1A5. Other | N2O | 0.0265 | 0.0501 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 0.0001 | 5.00121E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 48.6038 | 20 | 20 | 28.2843 | 0.0290 | 0.0019 | 0.0086 | 0.0373 | 0.2438 | 0.060844994 | |
| 3B. Manure management | N2O | 72.5332 | 92.0522 | 50 | 200 | 206.1553 | 5.5297 | 0.0021 | 0.0163 | 0.4174 | 1.1545 | 1.507127584 | |
| 3D. Agricultural soils | N2O | 149.9732 | 163.1371 | 5 | 100 | 100.1249 | 4.0967 | 0.0091 | 0.0289 | 0.9137 | 0.2046 | 0.876746778 | |
| 3F. Field burning of agricultural residu | N2O | 0.1073 | 0.0954 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0010 | 0.0005 | 1.29435E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 14.6884 | 20 | 20 | 28.2843 | 0.0027 | 0.0005 | 0.0026 | 0.0102 | 0.0737 | 0.005534616 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 14.2378 | 5 | 10 | 11.1803 | 0.0004 | 0.0025 | 0.0025 | 0.0249 | 0.0179 | 0.000938057 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.0651 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0010 | 0.0008 | 1.67318E-06 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 8070.0488 | | | | 32.8575 | | | | | 44.4917 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.732143241 | | | | Trend uncertainty %: | 6.670206721 | |

| Reporting year: | 2000 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IPCC category/Group** | **Gas** | **Base year emissions or removals** | **Year x emissions or removals** | **Activity data uncertainty (1)** | **Emission factor / estimation parameter uncertainty (1)** | **Combined uncertainty** | **Contribution to variance by category in year x** | **Type A sensitivity** | **Type B sensitivity** | **Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)** | **Uncertainty in trend in national emissions introduced by activity data uncertainty (3)** | **Uncertainty introduced into the trend in total national emissions** | **Comments (optional)** |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert\frac{D}{\sum C}\right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 2954.6042 | 5 | 5 | 7.0711 | 6.2772 | 0.0618 | 0.5241 | 0.3088 | 3.7056 | 13.82684486 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 818.7305 | 5 | 5 | 7.0711 | 0.6943 | 0.0108 | 0.1452 | 0.0542 | 1.0268 | 1.05732623 | |
| 1A3. Transport | CO2 | 1180.5150 | 1760.0960 | 5 | 5 | 7.0711 | 1.4925 | 0.0025 | 0.3122 | 0.0125 | 2.2075 | 4.873098094 | |
| 1A4. Other sectors | CO2 | 430.4000 | 725.3920 | 2 | 2 | 2.8284 | 0.2460 | 0.0157 | 0.1287 | 0.0315 | 0.3639 | 0.133420475 | |
| 1A5. Other | CO2 | 10.9950 | 21.4290 | 5 | 5 | 7.0711 | 0.0182 | 0.0009 | 0.0038 | 0.0046 | 0.0269 | 0.000743305 | |
| 2A. Mineral industry | CO2 | 759.1845 | 846.5433 | 5 | 5 | 7.0711 | 0.7178 | 0.0489 | 0.1501 | 0.2447 | 1.0617 | 1.187126912 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 10.8971 | 10 | 50 | 50.9902 | 0.0666 | 0.0003 | 0.0019 | 0.0148 | 0.0273 | 0.00096682 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.1630 | 20 | 400 | 400.4997 | 0.0078 | 0.0000 | 0.0000 | 0.0054 | 0.0008 | 3.02058E-05 | |
| 3H. Urea application | CO2 | 1.8150 | 1.6720 | 50 | 200 | 206.1553 | 0.0413 | 0.0002 | 0.0003 | 0.0359 | 0.0210 | 0.001729595 | |
| 1A1. Energy industries | CH4 | 1.7055 | 2.8720 | 5 | 100 | 100.1249 | 0.0345 | 0.0001 | 0.0005 | 0.0062 | 0.0036 | 5.14053E-05 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 0.9906 | 5 | 100 | 100.1249 | 0.0119 | 0.0001 | 0.0002 | 0.0056 | 0.0012 | 3.28495E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 7.1735 | 5 | 100 | 100.1249 | 0.0861 | 0.0001 | 0.0013 | 0.0143 | 0.0090 | 0.000285615 | |
| 1A4. Other sectors | CH4 | 2.5278 | 3.6198 | 5 | 50 | 50.2494 | 0.0218 | 0.0000 | 0.0006 | 0.0011 | 0.0045 | 2.17211E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.0723 | 5 | 20 | 20.6155 | 0.0002 | 0.0000 | 0.0000 | 0.0001 | 0.0001 | 1.20762E-08 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | 0.0001 | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.57491E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 227.4975 | 30 | 100 | 104.4031 | 2.8483 | 0.0120 | 0.0404 | 1.2022 | 1.7119 | 4.375902941 | |
| 3B. Manure management | CH4 | 111.4133 | 158.2913 | 5 | 30 | 30.4138 | 0.5773 | 0.0012 | 0.0281 | 0.0345 | 0.1985 | 0.04060525 | |
| 3F. Field burning of agricultural residu | CH4 | 0.3450 | 0.2775 | 5 | 50 | 50.2494 | 0.0017 | 0.0000 | 0.0000 | 0.0021 | 0.0003 | 4.38225E-06 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 314.8307 | 50 | 200 | 206.1553 | 7.7834 | 0.0100 | 0.0558 | 2.0085 | 3.9485 | 19.62522353 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 99.0625 | 5 | 20 | 20.6155 | 0.2449 | 0.0063 | 0.0176 | 0.1266 | 0.1242 | 0.03146138 | |
| 1A1. Energy industries | N2O | 3.9813 | 6.6990 | 20 | 40 | 44.7214 | 0.0359 | 0.0001 | 0.0012 | 0.0058 | 0.0336 | 0.001162516 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 2.1435 | 5 | 300 | 300.0417 | 0.0059 | 0.0001 | 0.0004 | 0.0215 | 0.0027 | 0.000471419 | |
| 1A3. Transport | N2O | 27.8034 | 39.3539 | 5 | 300 | 300.0417 | 2.0051 | 0.0003 | 0.0070 | 0.0941 | 0.0494 | 0.011287034 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.6450 | 5 | 300 | 300.0417 | 0.0035 | 0.0000 | 0.0003 | 0.0104 | 0.0021 | 0.000111796 | |
| 1A5. Other | N2O | 0.0265 | 0.0519 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 0.0001 | 5.43738E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 49.1104 | 20 | 20 | 28.2843 | 0.0277 | 0.0021 | 0.0087 | 0.0425 | 0.2464 | 0.062504601 | |
| 3B. Manure management | N2O | 72.5332 | 94.1084 | 50 | 200 | 206.1553 | 5.4130 | 0.0023 | 0.0167 | 0.4671 | 1.1803 | 1.611294955 | |
| 3D. Agricultural soils | N2O | 149.9732 | 156.2801 | 5 | 100 | 100.1249 | 3.5212 | 0.0116 | 0.0277 | 1.1621 | 0.1960 | 1.388805862 | |
| 3F. Field burning of agricultural residu | N2O | 0.1073 | 0.0864 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0013 | 0.0004 | 1.83016E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 14.5066 | 20 | 20 | 28.2843 | 0.0024 | 0.0006 | 0.0026 | 0.0130 | 0.0728 | 0.005464145 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 20.5024 | 5 | 10 | 11.1803 | 0.0008 | 0.0036 | 0.0036 | 0.0360 | 0.0257 | 0.001955941 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.0755 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0013 | 0.0009 | 2.65589E-06 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 8338.7778 | | | | 32.1875 | | | | | 48.2379 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.673405803 | | | | Trend uncertainty %: | 6.945353727 | |

| Reporting year: | 2001 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IPCC category/Group** | **Gas** | **Base year emissions or removals** | **Year x emissions or removals** | **Activity data uncertainty (1)** | **Emission factor / estimation parameter uncertainty (1)** | **Combined uncertainty** | **Contribution to variance by category in year x** | **Type A sensitivity** | **Type B sensitivity** | **Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)** | **Uncertainty in trend in national emissions introduced by activity data uncertainty (3)** | **Uncertainty introduced into the trend in total national emissions** | **Comments (optional)** |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\|\frac{D}{\sum C}\right\|$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 2837.2828 | 5 | 5 | 7.0711 | 5.8693 | 0.0442 | 0.5032 | 0.2210 | 3.5585 | 12.71146835 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 764.8269 | 5 | 5 | 7.0711 | 0.6531 | 0.0022 | 0.1357 | 0.0111 | 0.9592 | 0.920243765 | |
| 1A3. Transport | CO2 | 1180.5150 | 1818.0790 | 5 | 5 | 7.0711 | 1.5524 | 0.0149 | 0.3225 | 0.0744 | 2.2802 | 5.20483238 | |
| 1A4. Other sectors | CO2 | 430.4000 | 728.5140 | 2 | 2 | 2.8284 | 0.2488 | 0.0171 | 0.1292 | 0.0341 | 0.3655 | 0.134737711 | |
| 1A5. Other | CO2 | 10.9950 | 21.6530 | 5 | 5 | 7.0711 | 0.0185 | 0.0010 | 0.0038 | 0.0049 | 0.0272 | 0.000761307 | |
| 2A. Mineral industry | CO2 | 759.1845 | 819.4360 | 5 | 5 | 7.0711 | 0.6997 | 0.0524 | 0.1453 | 0.2619 | 1.0277 | 1.124775329 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 11.8986 | 10 | 50 | 50.9902 | 0.0733 | 0.0005 | 0.0021 | 0.0243 | 0.0298 | 0.001479711 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0502 | 20 | 400 | 400.4997 | 0.0024 | 0.0000 | 0.0000 | 0.0025 | 0.0003 | 6.44239E-06 | |
| 3H. Urea application | CO2 | 1.8150 | 0.1665 | 50 | 200 | 206.1553 | 0.0041 | 0.0004 | 0.0000 | 0.0887 | 0.0021 | 0.007865387 | |
| 1A1. Energy industries | CH4 | 1.7055 | 2.7485 | 5 | 100 | 100.1249 | 0.0332 | 0.0000 | 0.0005 | 0.0043 | 0.0034 | 3.05246E-05 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 0.9899 | 5 | 100 | 100.1249 | 0.0120 | 0.0001 | 0.0002 | 0.0054 | 0.0012 | 3.12184E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 7.5543 | 5 | 100 | 100.1249 | 0.0913 | 0.0001 | 0.0013 | 0.0066 | 0.0095 | 0.000133008 | |
| 1A4. Other sectors | CH4 | 2.5278 | 3.6460 | 5 | 50 | 50.2494 | 0.0221 | 0.0000 | 0.0006 | 0.0006 | 0.0046 | 2.12609E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.0730 | 5 | 20 | 20.6155 | 0.0002 | 0.0000 | 0.0000 | 0.0001 | 0.0001 | 1.2761E-08 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | 0.0001 | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.4566E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 243.1975 | 30 | 100 | 104.4031 | 3.0660 | 0.0089 | 0.0431 | 0.8876 | 1.8301 | 4.137096992 | |
| 3B. Manure management | CH4 | 111.4133 | 173.5320 | 5 | 30 | 30.4138 | 0.6373 | 0.0018 | 0.0308 | 0.0526 | 0.2176 | 0.050133348 | |
| 3F. Field burning of agricultural residu | CH4 | 0.3450 | 0.2300 | 5 | 50 | 50.2494 | 0.0014 | 0.0000 | 0.0000 | 0.0025 | 0.0003 | 6.10658E-06 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 322.3987 | 50 | 200 | 206.1553 | 8.0259 | 0.0082 | 0.0572 | 1.6493 | 4.0435 | 19.06962564 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 98.3325 | 5 | 20 | 20.6155 | 0.2448 | 0.0063 | 0.0174 | 0.1259 | 0.1233 | 0.031055371 | |
| 1A1. Energy industries | N2O | 3.9813 | 6.5828 | 20 | 40 | 44.7214 | 0.0355 | 0.0001 | 0.0012 | 0.0052 | 0.0330 | 0.001117787 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 2.0952 | 5 | 300 | 300.0417 | 0.0058 | 0.0001 | 0.0004 | 0.0232 | 0.0026 | 0.000544113 | |
| 1A3. Transport | N2O | 27.8034 | 40.9899 | 5 | 300 | 300.0417 | 2.2056 | 0.0000 | 0.0073 | 0.0081 | 0.0514 | 0.002708045 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.6569 | 5 | 300 | 300.0417 | 0.0036 | 0.0000 | 0.0003 | 0.0115 | 0.0021 | 0.000137423 | |
| 1A5. Other | N2O | 0.0265 | 0.0522 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 0.0001 | 5.90426E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 49.6766 | 20 | 20 | 28.2843 | 0.0288 | 0.0019 | 0.0088 | 0.0390 | 0.2492 | 0.063626812 | |
| 3B. Manure management | N2O | 72.5332 | 100.8432 | 50 | 200 | 206.1553 | 6.3022 | 0.0010 | 0.0179 | 0.2020 | 1.2648 | 1.64040253 | |
| 3D. Agricultural soils | N2O | 149.9732 | 178.8566 | 5 | 100 | 100.1249 | 4.6763 | 0.0073 | 0.0317 | 0.7346 | 0.2243 | 0.589929025 | |
| 3F. Field burning of agricultural residu | N2O | 0.1073 | 0.0715 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0015 | 0.0004 | 2.45843E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 14.6914 | 20 | 20 | 28.2843 | 0.0025 | 0.0006 | 0.0026 | 0.0119 | 0.0737 | 0.00557262 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 31.0082 | 5 | 10 | 11.1803 | 0.0018 | 0.0055 | 0.0055 | 0.0546 | 0.0389 | 0.004495657 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.0766 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0014 | 0.0010 | 2.80686E-06 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 8281.2105 | | | | 34.5181 | | | | | 45.7028 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.875209411 | | | | Trend uncertainty %: | 6.760387799 | |

| Reporting year: | 2002 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IPCC category/Group** | **Gas** | **Base year emissions or removals** | **Year x emissions or removals** | **Activity data uncertainty (1)** | **Emission factor / estimation parameter uncertainty (1)** | **Combined uncertainty** | **Contribution to variance by category in year x** | **Type A sensitivity** | **Type B sensitivity** | **Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)** | **Uncertainty in trend in national emissions introduced by activity data uncertainty (3)** | **Uncertainty introduced into the trend in total national emissions** | **Comments (optional)** |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert\frac{D}{\sum C}\right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 2998.4718 | 5 | 5 | 7.0711 | 6.1963 | 0.0596 | 0.5318 | 0.2982 | 3.7606 | 14.23117616 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 775.2923 | 5 | 5 | 7.0711 | 0.6436 | 0.0003 | 0.1375 | 0.0013 | 0.9724 | 0.945475614 | |
| 1A3. Transport | CO2 | 1180.5150 | 1800.5420 | 5 | 5 | 7.0711 | 1.4948 | 0.0030 | 0.3194 | 0.0151 | 2.2582 | 5.099699365 | |
| 1A4. Other sectors | CO2 | 430.4000 | 732.5730 | 2 | 2 | 2.8284 | 0.2433 | 0.0146 | 0.1299 | 0.0292 | 0.3675 | 0.135916242 | |
| 1A5. Other | CO2 | 10.9950 | 20.7560 | 5 | 5 | 7.0711 | 0.0172 | 0.0007 | 0.0037 | 0.0037 | 0.0260 | 0.000691165 | |
| 2A. Mineral industry | CO2 | 759.1845 | 851.9245 | 5 | 5 | 7.0711 | 0.7072 | 0.0523 | 0.1511 | 0.2613 | 1.0685 | 1.209883598 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 12.8831 | 10 | 50 | 50.9902 | 0.0771 | 0.0006 | 0.0023 | 0.0307 | 0.0323 | 0.001985489 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0470 | 20 | 400 | 400.4997 | 0.0022 | 0.0000 | 0.0000 | 0.0029 | 0.0002 | 8.61924E-06 | |
| 3H. Urea application | CO2 | 1.8150 | 0.4195 | 50 | 200 | 206.1553 | 0.0102 | 0.0004 | 0.0001 | 0.0824 | 0.0053 | 0.006815354 | |
| 1A1. Energy industries | CH4 | 1.7055 | 2.8993 | 5 | 100 | 100.1249 | 0.0341 | 0.0001 | 0.0005 | 0.0057 | 0.0036 | 4.59751E-05 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 1.0021 | 5 | 100 | 100.1249 | 0.0118 | 0.0001 | 0.0002 | 0.0059 | 0.0013 | 3.62534E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 7.7448 | 5 | 100 | 100.1249 | 0.0910 | 0.0001 | 0.0014 | 0.0072 | 0.0097 | 0.00014633 | |
| 1A4. Other sectors | CH4 | 2.5278 | 3.9063 | 5 | 50 | 50.2494 | 0.0230 | 0.0000 | 0.0007 | 0.0008 | 0.0049 | 2.4603E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.0700 | 5 | 20 | 20.6155 | 0.0002 | 0.0000 | 0.0000 | 0.0001 | 0.0001 | 1.02101E-08 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | 0.0001 | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 2.91678E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 255.1450 | 30 | 100 | 104.4031 | 3.1274 | 0.0082 | 0.0453 | 0.8242 | 1.9200 | 4.365716901 | |
| 3B. Manure management | CH4 | 111.4133 | 187.7443 | 5 | 30 | 30.4138 | 0.6704 | 0.0034 | 0.0333 | 0.1033 | 0.2355 | 0.066124881 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.2400 | 5 | 50 | 50.2494 | 0.0014 | 0.0000 | 0.0000 | 0.0025 | 0.0003 | 6.30995E-06 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 330.6611 | 50 | 200 | 206.1553 | 8.0031 | 0.0086 | 0.0586 | 1.7297 | 4.1471 | 20.19022891 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 96.6875 | 5 | 20 | 20.6155 | 0.2340 | 0.0073 | 0.0171 | 0.1453 | 0.1213 | 0.035806702 | |
| 1A1. Energy industries | N2O | 3.9813 | 7.0000 | 20 | 40 | 44.7214 | 0.0368 | 0.0002 | 0.0012 | 0.0070 | 0.0351 | 0.001282076 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 2.1244 | 5 | 300 | 300.0417 | 0.0056 | 0.0001 | 0.0004 | 0.0255 | 0.0027 | 0.000655725 | |
| 1A3. Transport | N2O | 27.8034 | 41.2641 | 5 | 300 | 300.0417 | 2.1129 | 0.0001 | 0.0073 | 0.0394 | 0.0518 | 0.004228202 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.6658 | 5 | 300 | 300.0417 | 0.0034 | 0.0000 | 0.0003 | 0.0098 | 0.0021 | 0.000100902 | |
| 1A5. Other | N2O | 0.0265 | 0.0501 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 0.0001 | 3.5376E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 50.2130 | 20 | 20 | 28.2843 | 0.0278 | 0.0022 | 0.0089 | 0.0432 | 0.2519 | 0.065323877 | |
| 3B. Manure management | N2O | 72.5332 | 105.9092 | 50 | 200 | 206.1553 | 6.5708 | 0.0007 | 0.0188 | 0.1302 | 1.3283 | 1.781302049 | |
| 3D. Agricultural soils | N2O | 149.9732 | 174.1184 | 5 | 100 | 100.1249 | 4.1893 | 0.0093 | 0.0309 | 0.9301 | 0.2184 | 0.912787684 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0745 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0016 | 0.0004 | 2.55231E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 14.7719 | 20 | 20 | 28.2843 | 0.0024 | 0.0007 | 0.0026 | 0.0134 | 0.0741 | 0.005671189 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 41.3333 | 5 | 10 | 11.1803 | 0.0029 | 0.0073 | 0.0073 | 0.0729 | 0.0518 | 0.008004905 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.0821 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0015 | 0.0010 | 3.40434E-06 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 8517.6162 | | | | 34.5403 | | | | | 49.0692 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.877096936 | | | | Trend uncertainty %: | 7.004937621 | |

| Reporting year: | 2003 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IPCC category/Group** | **Gas** | **Base year emissions or removals** | **Year x emissions or removals** | **Activity data uncertainty (1)** | **Emission factor / estimation parameter uncertainty (1)** | **Combined uncertainty** | **Contribution to variance by category in year x** | **Type A sensitivity** | **Type B sensitivity** | **Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)** | **Uncertainty in trend in national emissions introduced by activity data uncertainty (3)** | **Uncertainty introduced into the trend in total national emissions** | **Comments (optional)** |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G\bullet D)^2}{(\sum D)^2}$ | Note B | $\left\|\frac{D}{\sum C}\right\|$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 3224.9118 | 5 | 5 | 7.0711 | 6.5455 | 0.0778 | 0.5720 | 0.3891 | 4.0446 | 16.51034124 | |
| 1A2. Manufacturing industries and cons | CO2 | 512.1969 | 802.6333 | 5 | 5 | 7.0711 | 0.6368 | 0.0013 | 0.1424 | 0.0063 | 1.0066 | 1.013374351 | |
| 1A3. Transport | CO2 | 1180.5150 | 1907.0620 | 5 | 5 | 7.0711 | 1.5129 | 0.0072 | 0.3383 | 0.0361 | 2.3918 | 5.721990261 | |
| 1A4. Other sectors | CO2 | 430.4000 | 757.3330 | 2 | 2 | 2.8284 | 0.2403 | 0.0136 | 0.1343 | 0.0273 | 0.3799 | 0.145091789 | |
| 1A5. Other | CO2 | 10.9950 | 21.3170 | 5 | 5 | 7.0711 | 0.0169 | 0.0007 | 0.0038 | 0.0035 | 0.0267 | 0.000726955 | |
| 2A. Mineral industry | CO2 | 759.1845 | 854.6973 | 5 | 5 | 7.0711 | 0.6781 | 0.0612 | 0.1516 | 0.3060 | 1.0719 | 1.242691057 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 14.1845 | 10 | 50 | 50.9902 | 0.0811 | 0.0008 | 0.0025 | 0.0383 | 0.0356 | 0.002735902 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0338 | 20 | 400 | 400.4997 | 0.0015 | 0.0000 | 0.0000 | 0.0041 | 0.0002 | 1.72446E-05 | |
| 3H. Urea application | CO2 | 1.8150 | 0.7311 | 50 | 200 | 206.1553 | 0.0169 | 0.0004 | 0.0001 | 0.0759 | 0.0092 | 0.005837381 | |
| 1A1. Energy industries | CH4 | 1.7055 | 3.1243 | 5 | 100 | 100.1249 | 0.0351 | 0.0001 | 0.0006 | 0.0076 | 0.0039 | 7.29875E-05 | |
| 1A2. Manufacturing industries and cons | CH4 | 0.8831 | 1.1280 | 5 | 100 | 100.1249 | 0.0127 | 0.0000 | 0.0002 | 0.0048 | 0.0014 | 2.45951E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 8.4515 | 5 | 100 | 100.1249 | 0.0949 | 0.0000 | 0.0015 | 0.0014 | 0.0106 | 0.00011428 | |
| 1A4. Other sectors | CH4 | 2.5278 | 3.9235 | 5 | 50 | 50.2494 | 0.0221 | 0.0000 | 0.0007 | 0.0006 | 0.0049 | 2.46288E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.0720 | 5 | 20 | 20.6155 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 1.04499E-08 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | 0.0001 | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 2.27719E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 247.8650 | 30 | 100 | 104.4031 | 2.9033 | 0.0120 | 0.0440 | 1.2017 | 1.8652 | 4.922973001 | |
| 3B. Manure management | CH4 | 111.4133 | 186.1278 | 5 | 30 | 30.4138 | 0.6351 | 0.0018 | 0.0330 | 0.0532 | 0.2334 | 0.05732003 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.2775 | 5 | 50 | 50.2494 | 0.0016 | 0.0000 | 0.0000 | 0.0024 | 0.0003 | 5.7662E-06 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 338.9954 | 50 | 200 | 206.1553 | 7.8408 | 0.0103 | 0.0601 | 2.0590 | 4.2516 | 22.31550769 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 92.2825 | 5 | 20 | 20.6155 | 0.2134 | 0.0092 | 0.0164 | 0.1836 | 0.1157 | 0.047089026 | |
| 1A1. Energy industries | N2O | 3.9813 | 7.2980 | 20 | 40 | 44.7214 | 0.0366 | 0.0002 | 0.0013 | 0.0071 | 0.0366 | 0.001391182 | |
| 1A2. Manufacturing industries and cons | N2O | 1.7230 | 2.3447 | 5 | 300 | 300.0417 | 0.0062 | 0.0001 | 0.0004 | 0.0202 | 0.0029 | 0.000415956 | |
| 1A3. Transport | N2O | 27.8034 | 44.2798 | 5 | 300 | 300.0417 | 2.2218 | 0.0001 | 0.0079 | 0.0173 | 0.0555 | 0.003383832 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.7016 | 5 | 300 | 300.0417 | 0.0033 | 0.0000 | 0.0003 | 0.0081 | 0.0021 | 6.96531E-05 | |
| 1A5. Other | N2O | 0.0265 | 0.0516 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 0.0001 | 3.33267E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 50.8686 | 20 | 20 | 28.2843 | 0.0261 | 0.0026 | 0.0090 | 0.0512 | 0.2552 | 0.067742358 | |
| 3B. Manure management | N2O | 72.5332 | 100.5154 | 50 | 200 | 206.1553 | 5.4050 | 0.0025 | 0.0178 | 0.5020 | 1.2606 | 1.841196425 | |
| 3D. Agricultural soils | N2O | 149.9732 | 173.8323 | 5 | 100 | 100.1249 | 3.8132 | 0.0112 | 0.0308 | 1.1217 | 0.2180 | 1.305830444 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0864 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0015 | 0.0004 | 2.36455E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 14.1610 | 20 | 20 | 28.2843 | 0.0020 | 0.0009 | 0.0025 | 0.0186 | 0.0710 | 0.005393546 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 52.7576 | 5 | 10 | 11.1803 | 0.0044 | 0.0093 | 0.0094 | 0.0932 | 0.0662 | 0.013058158 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.0890 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0017 | 0.0011 | 4.17528E-06 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 8913.1374 | | | | 33.0078 | | | | | 55.2244 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.745245135 | | | | Trend uncertainty %: | 7.431313903 | |

| IPCC category/Group | Gas | Base year emissions or removals | Year x emissions or removals | Activity data uncertainty (1) | Emission factor / estimation parameter uncertainty (1) | Combined uncertainty | Contribution to variance by category in year x | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2) | Uncertainty in trend in national emissions introduced by activity data uncertainty (3) | Uncertainty introduced into the trend in total national emissions | Comments (optional) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reporting year: | 2004 | | | | | | | | | | | | |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert\frac{D}{\sum C}\right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 3283.4408 | 5 | 5 | 7.0711 | 6.4485 | 0.0755 | 0.5824 | 0.3774 | 4.1180 | 17.10054243 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 880.4472 | 5 | 5 | 7.0711 | 0.6809 | 0.0088 | 0.1562 | 0.0442 | 1.1042 | 1.221291455 | |
| 1A3. Transport | CO2 | 1180.5150 | 2007.4170 | 5 | 5 | 7.0711 | 1.5525 | 0.0165 | 0.3561 | 0.0823 | 2.5177 | 6.34538485 | |
| 1A4. Other sectors | CO2 | 430.4000 | 681.1990 | 2 | 2 | 2.8284 | 0.2107 | 0.0030 | 0.1208 | 0.0059 | 0.3417 | 0.11682017 | |
| 1A5. Other | CO2 | 10.9950 | 20.3869 | 5 | 5 | 7.0711 | 0.0158 | 0.0005 | 0.0036 | 0.0023 | 0.0256 | 0.000658905 | |
| 2A. Mineral industry | CO2 | 759.1845 | 919.4030 | 5 | 5 | 7.0711 | 0.7111 | 0.0552 | 0.1631 | 0.2761 | 1.1531 | 1.405851139 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 17.6709 | 10 | 50 | 50.9902 | 0.0986 | 0.0013 | 0.0031 | 0.0670 | 0.0443 | 0.00645422 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0503 | 20 | 400 | 400.4997 | 0.0022 | 0.0000 | 0.0000 | 0.0031 | 0.0003 | 9.96961E-06 | |
| 3H. Urea application | CO2 | 1.8150 | 0.9467 | 50 | 200 | 206.1553 | 0.0213 | 0.0004 | 0.0002 | 0.0708 | 0.0119 | 0.005157339 | |
| 1A1. Energy industries | CH4 | 1.7055 | 3.2113 | 5 | 100 | 100.1249 | 0.0352 | 0.0001 | 0.0006 | 0.0079 | 0.0040 | 7.86628E-05 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 1.1906 | 5 | 100 | 100.1249 | 0.0130 | 0.0000 | 0.0002 | 0.0043 | 0.0015 | 2.05699E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 9.2948 | 5 | 100 | 100.1249 | 0.1018 | 0.0001 | 0.0016 | 0.0097 | 0.0117 | 0.000229371 | |
| 1A4. Other sectors | CH4 | 2.5278 | 3.7698 | 5 | 50 | 50.2494 | 0.0207 | 0.0001 | 0.0007 | 0.0029 | 0.0047 | 3.08863E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.1540 | 5 | 20 | 20.6155 | 0.0003 | 0.0000 | 0.0000 | 0.0003 | 0.0002 | 1.48491E-07 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | 0.0000 | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 2.91488E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 246.1525 | 30 | 100 | 104.4031 | 2.8108 | 0.0138 | 0.0437 | 1.3763 | 1.8523 | 5.325249537 | |
| 3B. Manure management | CH4 | 111.4133 | 179.5968 | 5 | 30 | 30.4138 | 0.5974 | 0.0002 | 0.0319 | 0.0057 | 0.2252 | 0.050768751 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.2675 | 5 | 50 | 50.2494 | 0.0015 | 0.0001 | 0.0000 | 0.0026 | 0.0003 | 6.81706E-06 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 347.5160 | 50 | 200 | 206.1553 | 7.8358 | 0.0106 | 0.0616 | 2.1198 | 4.3585 | 23.48970363 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 88.2550 | 5 | 20 | 20.6155 | 0.1990 | 0.0106 | 0.0157 | 0.2110 | 0.1107 | 0.056777691 | |
| 1A1. Energy industries | N2O | 3.9813 | 7.7599 | 20 | 40 | 44.7214 | 0.0380 | 0.0002 | 0.0014 | 0.0092 | 0.0389 | 0.001601034 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 2.4940 | 5 | 300 | 300.0417 | 0.0067 | 0.0001 | 0.0004 | 0.0160 | 0.0031 | 0.000264953 | |
| 1A3. Transport | N2O | 27.8034 | 47.6174 | 5 | 300 | 300.0417 | 2.4419 | 0.0004 | 0.0084 | 0.1346 | 0.0597 | 0.021686707 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.5228 | 5 | 300 | 300.0417 | 0.0025 | 0.0000 | 0.0003 | 0.0036 | 0.0019 | 1.64037E-05 | |
| 1A5. Other | N2O | 0.0265 | 0.0515 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 0.0001 | 2.69016E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 51.6136 | 20 | 20 | 28.2843 | 0.0255 | 0.0027 | 0.0092 | 0.0545 | 0.2589 | 0.070015544 | |
| 3B. Manure management | N2O | 72.5332 | 95.7176 | 50 | 200 | 206.1553 | 4.6581 | 0.0039 | 0.0170 | 0.7770 | 1.2005 | 2.044838748 | |
| 3D. Agricultural soils | N2O | 149.9732 | 165.2082 | 5 | 100 | 100.1249 | 3.2733 | 0.0138 | 0.0293 | 1.3830 | 0.2072 | 1.955722684 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0834 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0016 | 0.0004 | 2.75358E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 14.4292 | 20 | 20 | 28.2843 | 0.0020 | 0.0010 | 0.0026 | 0.0194 | 0.0724 | 0.005617868 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 65.9320 | 5 | 10 | 11.1803 | 0.0065 | 0.0117 | 0.0117 | 0.1165 | 0.0827 | 0.02041539 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.1001 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0021 | 0.0013 | 5.85994E-06 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 9142.8997 | | | | 31.8116 | | | | | 59.2452 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.640178418 | | | | Trend uncertainty %: | 7.697091952 | |

| Reporting year: | 2005 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IPCC category/Group | Gas | Base year emissions or removals | Year x emissions or removals | Activity data uncertainty (1) | Emission factor / estimation parameter uncertainty (1) | Combined uncertainty | Contribution to variance by category in year x | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2) | Uncertainty in trend in national emissions introduced by activity data uncertainty (3) | Uncertainty introduced into the trend in total national emissions | Comments (optional) |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert \frac{D}{\sum C} \right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 3471.8400 | 5 | 5 | 7.0711 | 7.0095 | 0.1016 | 0.6158 | 0.5082 | 4.3543 | 19.21822017 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 908.2836 | 5 | 5 | 7.0711 | 0.6926 | 0.0117 | 0.1611 | 0.0584 | 1.1391 | 1.301070968 | |
| 1A3. Transport | CO2 | 1180.5150 | 2045.1480 | 5 | 5 | 7.0711 | 1.5596 | 0.0183 | 0.3627 | 0.0917 | 2.5650 | 6.58753173 | |
| 1A4. Other sectors | CO2 | 430.4000 | 604.5970 | 2 | 2 | 2.8284 | 0.1844 | 0.0183 | 0.1072 | 0.0366 | 0.3033 | 0.093336107 | |
| 1A5. Other | CO2 | 10.9950 | 19.0299 | 5 | 5 | 7.0711 | 0.0145 | 0.0002 | 0.0034 | 0.0008 | 0.0239 | 0.000570334 | |
| 2A. Mineral industry | CO2 | 759.1845 | 894.2013 | 5 | 5 | 7.0711 | 0.6819 | 0.0628 | 0.1586 | 0.3139 | 1.1215 | 1.356248328 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 17.5948 | 10 | 50 | 50.9902 | 0.0968 | 0.0013 | 0.0031 | 0.0651 | 0.0441 | 0.006180205 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0438 | 20 | 400 | 400.4997 | 0.0019 | 0.0000 | 0.0000 | 0.0037 | 0.0002 | 1.37506E-05 | |
| 3H. Urea application | CO2 | 1.8150 | 0.9665 | 50 | 200 | 206.1553 | 0.0215 | 0.0004 | 0.0002 | 0.0716 | 0.0121 | 0.005274175 | |
| 1A1. Energy industries | CH4 | 1.7055 | 3.4000 | 5 | 100 | 100.1249 | 0.0367 | 0.0001 | 0.0006 | 0.0106 | 0.0043 | 0.000129572 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 1.2150 | 5 | 100 | 100.1249 | 0.0131 | 0.0000 | 0.0002 | 0.0042 | 0.0015 | 2.00462E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 9.8420 | 5 | 100 | 100.1249 | 0.1063 | 0.0002 | 0.0017 | 0.0172 | 0.0123 | 0.000447303 | |
| 1A4. Other sectors | CH4 | 2.5278 | 3.7875 | 5 | 50 | 50.2494 | 0.0205 | 0.0001 | 0.0007 | 0.0033 | 0.0048 | 3.33181E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.1495 | 5 | 20 | 20.6155 | 0.0003 | 0.0000 | 0.0000 | 0.0003 | 0.0002 | 1.34044E-07 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 5.27166E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 231.8575 | 30 | 100 | 104.4031 | 2.6106 | 0.0171 | 0.0411 | 1.7112 | 1.7447 | 5.972233834 | |
| 3B. Manure management | CH4 | 111.4133 | 165.1800 | 5 | 30 | 30.4138 | 0.5418 | 0.0032 | 0.0293 | 0.0961 | 0.2072 | 0.052144741 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.1775 | 5 | 50 | 50.2494 | 0.0010 | 0.0001 | 0.0000 | 0.0035 | 0.0002 | 1.20061E-05 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 356.2353 | 50 | 200 | 206.1553 | 7.9201 | 0.0101 | 0.0632 | 2.0154 | 4.4678 | 24.02345798 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 87.8875 | 5 | 20 | 20.6155 | 0.1954 | 0.0110 | 0.0156 | 0.2197 | 0.1102 | 0.060438916 | |
| 1A1. Energy industries | N2O | 3.9813 | 8.0460 | 20 | 40 | 44.7214 | 0.0388 | 0.0003 | 0.0014 | 0.0106 | 0.0404 | 0.001742267 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 2.5407 | 5 | 300 | 300.0417 | 0.0068 | 0.0001 | 0.0005 | 0.0156 | 0.0032 | 0.000253304 | |
| 1A3. Transport | N2O | 27.8034 | 49.3935 | 5 | 300 | 300.0417 | 2.5545 | 0.0007 | 0.0088 | 0.1951 | 0.0619 | 0.041896482 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.3648 | 5 | 300 | 300.0417 | 0.0020 | 0.0000 | 0.0002 | 0.0132 | 0.0017 | 0.000176523 | |
| 1A5. Other | N2O | 0.0265 | 0.0482 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0001 | 1.035E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 52.3586 | 20 | 20 | 28.2843 | 0.0255 | 0.0028 | 0.0093 | 0.0552 | 0.2627 | 0.072044772 | |
| 3B. Manure management | N2O | 72.5332 | 88.5358 | 50 | 200 | 206.1553 | 3.8746 | 0.0055 | 0.0157 | 1.0909 | 1.1104 | 2.423025868 | |
| 3D. Agricultural soils | N2O | 149.9732 | 143.4661 | 5 | 100 | 100.1249 | 2.3998 | 0.0183 | 0.0254 | 1.8297 | 0.1799 | 3.380298596 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0536 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0022 | 0.0003 | 4.8163E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 14.2802 | 20 | 20 | 28.2843 | 0.0019 | 0.0010 | 0.0025 | 0.0210 | 0.0716 | 0.005572054 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 90.9339 | 5 | 10 | 11.1803 | 0.0120 | 0.0161 | 0.0161 | 0.1609 | 0.1140 | 0.038883504 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.1160 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0026 | 0.0015 | 8.9412E-06 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 9272.5743 | | | | 30.6244 | | | | | 64.6413 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.533928167 | | | | Trend uncertainty %: | 8.039979525 | |

| Reporting year: | 2006 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IPCC category/Group | Gas | Base year emissions or removals | Year x emissions or removals | Activity data uncertainty (1) | Emission factor / estimation parameter uncertainty (1) | Combined uncertainty | Contribution to variance by category in year x | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2) | Uncertainty in trend in national emissions introduced by activity data uncertainty (3) | Uncertainty introduced into the trend in total national emissions | Comments (optional) |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\|\frac{D}{\sum C}\right\|$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 3653.3800 | 5 | 5 | 7.0711 | 7.3499 | 0.1196 | 0.6480 | 0.5979 | 4.5820 | 21.35210476 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 865.3334 | 5 | 5 | 7.0711 | 0.6421 | 0.0001 | 0.1535 | 0.0003 | 1.0853 | 1.177837989 | |
| 1A3. Transport | CO2 | 1180.5150 | 2031.3250 | 5 | 5 | 7.0711 | 1.5074 | 0.0064 | 0.3603 | 0.0320 | 2.5476 | 6.491511865 | |
| 1A4. Other sectors | CO2 | 430.4000 | 664.9020 | 2 | 2 | 2.8284 | 0.1974 | 0.0111 | 0.1179 | 0.0222 | 0.3336 | 0.11175487 | |
| 1A5. Other | CO2 | 10.9950 | 13.9469 | 5 | 5 | 7.0711 | 0.0103 | 0.0008 | 0.0025 | 0.0041 | 0.0175 | 0.000322868 | |
| 2A. Mineral industry | CO2 | 759.1845 | 902.1690 | 5 | 5 | 7.0711 | 0.6695 | 0.0675 | 0.1600 | 0.3374 | 1.1315 | 1.39406638 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 19.7374 | 10 | 50 | 50.9902 | 0.1056 | 0.0016 | 0.0035 | 0.0815 | 0.0495 | 0.009100525 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0274 | 20 | 400 | 400.4997 | 0.0012 | 0.0000 | 0.0000 | 0.0051 | 0.0001 | 2.5599E-05 | |
| 3H. Urea application | CO2 | 1.8150 | 1.1660 | 50 | 200 | 206.1553 | 0.0252 | 0.0003 | 0.0002 | 0.0675 | 0.0146 | 0.004763877 | |
| 1A1. Energy industries | CH4 | 1.7055 | 3.4750 | 5 | 100 | 100.1249 | 0.0365 | 0.0001 | 0.0006 | 0.0105 | 0.0044 | 0.000129446 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 1.1326 | 5 | 100 | 100.1249 | 0.0119 | 0.0001 | 0.0002 | 0.0064 | 0.0014 | 4.27479E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 10.2988 | 5 | 100 | 100.1249 | 0.1082 | 0.0002 | 0.0018 | 0.0209 | 0.0129 | 0.000604724 | |
| 1A4. Other sectors | CH4 | 2.5278 | 4.1435 | 5 | 50 | 50.2494 | 0.0219 | 0.0000 | 0.0007 | 0.0011 | 0.0052 | 2.83073E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.1698 | 5 | 20 | 20.6155 | 0.0004 | 0.0000 | 0.0000 | 0.0004 | 0.0002 | 1.89979E-07 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 5.56703E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 224.3775 | 30 | 100 | 104.4031 | 2.4584 | 0.0200 | 0.0398 | 2.0047 | 1.6885 | 6.869612959 | |
| 3B. Manure management | CH4 | 111.4133 | 172.5573 | 5 | 30 | 30.4138 | 0.5508 | 0.0028 | 0.0306 | 0.0837 | 0.2164 | 0.053850493 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.1700 | 5 | 50 | 50.2494 | 0.0009 | 0.0001 | 0.0000 | 0.0037 | 0.0002 | 1.34659E-05 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 364.8780 | 50 | 200 | 206.1553 | 7.8941 | 0.0106 | 0.0647 | 2.1137 | 4.5762 | 25.40961211 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 75.0725 | 5 | 20 | 20.6155 | 0.1624 | 0.0140 | 0.0133 | 0.2799 | 0.0942 | 0.087200965 | |
| 1A1. Energy industries | N2O | 3.9813 | 8.3440 | 20 | 40 | 44.7214 | 0.0392 | 0.0003 | 0.0015 | 0.0115 | 0.0419 | 0.001883535 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 3.1543 | 5 | 300 | 300.0417 | 0.0099 | 0.0000 | 0.0006 | 0.0129 | 0.0040 | 0.000181772 | |
| 1A3. Transport | N2O | 27.8034 | 50.3680 | 5 | 300 | 300.0417 | 2.5153 | 0.0006 | 0.0089 | 0.1797 | 0.0632 | 0.036283951 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.5287 | 5 | 300 | 300.0417 | 0.0023 | 0.0000 | 0.0003 | 0.0068 | 0.0019 | 5.02596E-05 | |
| 1A5. Other | N2O | 0.0265 | 0.0420 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0001 | 5.32926E-09 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 53.3420 | 20 | 20 | 28.2843 | 0.0251 | 0.0029 | 0.0095 | 0.0584 | 0.2676 | 0.07502102 | |
| 3B. Manure management | N2O | 72.5332 | 86.5690 | 50 | 200 | 206.1553 | 3.5078 | 0.0064 | 0.0154 | 1.2776 | 1.0857 | 2.81099884 | |
| 3D. Agricultural soils | N2O | 149.9732 | 159.7280 | 5 | 100 | 100.1249 | 2.8169 | 0.0166 | 0.0283 | 1.6622 | 0.2003 | 2.803156392 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0536 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0023 | 0.0003 | 5.20048E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 14.1312 | 20 | 20 | 28.2843 | 0.0018 | 0.0012 | 0.0025 | 0.0235 | 0.0709 | 0.005576993 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 143.1581 | 5 | 10 | 11.1803 | 0.0282 | 0.0253 | 0.0254 | 0.2535 | 0.1795 | 0.096488575 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.1226 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0028 | 0.0015 | 1.02308E-05 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 9528.8035 | | | | 30.7005 | | | | | 68.7922 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.54080586 | | | | Trend uncertainty %: | 8.294108808 | |

| Reporting year: | 2007 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IPCC category/Group** | **Gas** | **Base year emissions or removals** | **Year x emissions or removals** | **Activity data uncertainty (1)** | **Emission factor / estimation parameter uncertainty (1)** | **Combined uncertainty** | **Contribution to variance by category in year x** | **Type A sensitivity** | **Type B sensitivity** | **Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)** | **Uncertainty in trend in national emissions introduced by activity data uncertainty (3)** | **Uncertainty introduced into the trend in total national emissions** | **Comments (optional)** |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert\frac{D}{\sum C}\right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 3801.6700 | 5 | 5 | 7.0711 | 7.4158 | 0.1269 | 0.6743 | 0.6344 | 4.7680 | 23.13596191 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 923.0426 | 5 | 5 | 7.0711 | 0.6612 | 0.0047 | 0.1637 | 0.0233 | 1.1577 | 1.340717906 | |
| 1A3. Transport | CO2 | 1180.5150 | 2163.7750 | 5 | 5 | 7.0711 | 1.5499 | 0.0171 | 0.3838 | 0.0857 | 2.7138 | 7.371837771 | |
| 1A4. Other sectors | CO2 | 430.4000 | 636.0240 | 2 | 2 | 2.8284 | 0.1822 | 0.0208 | 0.1128 | 0.0417 | 0.3191 | 0.103545056 | |
| 1A5. Other | CO2 | 10.9950 | 20.3199 | 5 | 5 | 7.0711 | 0.0146 | 0.0002 | 0.0036 | 0.0009 | 0.0255 | 0.000650373 | |
| 2A. Mineral industry | CO2 | 759.1845 | 893.7265 | 5 | 5 | 7.0711 | 0.6402 | 0.0771 | 0.1585 | 0.3857 | 1.1209 | 1.405168476 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 18.4459 | 10 | 50 | 50.9902 | 0.0953 | 0.0013 | 0.0033 | 0.0667 | 0.0463 | 0.006593614 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0285 | 20 | 400 | 400.4997 | 0.0012 | 0.0000 | 0.0000 | 0.0052 | 0.0001 | 2.73577E-05 | |
| 3H. Urea application | CO2 | 1.8150 | 1.1059 | 50 | 200 | 206.1553 | 0.0231 | 0.0004 | 0.0002 | 0.0735 | 0.0139 | 0.005594398 | |
| 1A1. Energy industries | CH4 | 1.7055 | 3.6250 | 5 | 100 | 100.1249 | 0.0368 | 0.0001 | 0.0006 | 0.0113 | 0.0045 | 0.000149079 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 1.3429 | 5 | 100 | 100.1249 | 0.0136 | 0.0000 | 0.0002 | 0.0036 | 0.0017 | 1.58271E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 11.1643 | 5 | 100 | 100.1249 | 0.1132 | 0.0003 | 0.0020 | 0.0305 | 0.0140 | 0.001123944 | |
| 1A4. Other sectors | CH4 | 2.5278 | 4.7119 | 5 | 50 | 50.2494 | 0.0240 | 0.0001 | 0.0008 | 0.0025 | 0.0059 | 4.13606E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.1538 | 5 | 20 | 20.6155 | 0.0003 | 0.0000 | 0.0000 | 0.0003 | 0.0002 | 1.36787E-07 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 5.97457E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 234.4100 | 30 | 100 | 104.4031 | 2.4792 | 0.0204 | 0.0416 | 2.0419 | 1.7640 | 7.280973473 | |
| 3B. Manure management | CH4 | 111.4133 | 177.5448 | 5 | 30 | 30.4138 | 0.5470 | 0.0031 | 0.0315 | 0.0932 | 0.2227 | 0.058275962 | |
| 3F. Field burning of agricultural residu | CH4 | 0.3450 | 0.1550 | 5 | 50 | 50.2494 | 0.0008 | 0.0001 | 0.0000 | 0.0040 | 0.0002 | 1.58969E-05 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 374.5257 | 50 | 200 | 206.1553 | 7.8216 | 0.0116 | 0.0664 | 2.3128 | 4.6972 | 27.4130707 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 66.9325 | 5 | 20 | 20.6155 | 0.1398 | 0.0164 | 0.0119 | 0.3284 | 0.0839 | 0.114889423 | |
| 1A1. Energy industries | N2O | 3.9813 | 8.6420 | 20 | 40 | 44.7214 | 0.0392 | 0.0003 | 0.0015 | 0.0119 | 0.0434 | 0.002020201 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 2.7353 | 5 | 300 | 300.0417 | 0.0069 | 0.0000 | 0.0005 | 0.0150 | 0.0034 | 0.000236084 | |
| 1A3. Transport | N2O | 27.8034 | 54.1585 | 5 | 300 | 300.0417 | 2.7098 | 0.0010 | 0.0096 | 0.2915 | 0.0679 | 0.08958033 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.5173 | 5 | 300 | 300.0417 | 0.0021 | 0.0000 | 0.0003 | 0.0106 | 0.0019 | 0.000116107 | |
| 1A5. Other | N2O | 0.0265 | 0.0515 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0001 | 1.22686E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 54.6234 | 20 | 20 | 28.2843 | 0.0245 | 0.0031 | 0.0097 | 0.0628 | 0.2740 | 0.079030832 | |
| 3B. Manure management | N2O | 72.5332 | 88.8934 | 50 | 200 | 206.1553 | 3.4464 | 0.0068 | 0.0158 | 1.3515 | 1.1149 | 3.069430858 | |
| 3D. Agricultural soils | N2O | 149.9732 | 144.1784 | 5 | 100 | 100.1249 | 2.1386 | 0.0210 | 0.0256 | 2.0996 | 0.1808 | 4.440889692 | |
| 3F. Field burning of agricultural residu | N2O | 0.1073 | 0.0477 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0025 | 0.0002 | 6.23675E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 15.3261 | 20 | 20 | 28.2843 | 0.0019 | 0.0011 | 0.0027 | 0.0219 | 0.0769 | 0.00639067 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 168.4089 | 5 | 10 | 11.1803 | 0.0364 | 0.0298 | 0.0299 | 0.2983 | 0.2112 | 0.133565158 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.1385 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0033 | 0.0017 | 1.39858E-05 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 9871.4251 | | | | 30.1656 | | | | | 76.0599 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.492321529 | | | | Trend uncertainty %: | 8.721234593 | |

| Reporting year: | 2008 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IPCC category/Group | Gas | Base year emissions or removals | Year x emissions or removals | Activity data uncertainty (1) | Emission factor / estimation parameter uncertainty (1) | Combined uncertainty | Contribution to variance by category in year x | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2) | Uncertainty in trend in national emissions introduced by activity data uncertainty (3) | Uncertainty introduced into the trend in total national emissions | Comments (optional) |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\|\frac{D}{\sum C}\right\|$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 3967.2900 | 5 | 5 | 7.0711 | 7.7972 | 0.1465 | 0.7037 | 0.7324 | 4.9757 | 25.29396567 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 900.3345 | 5 | 5 | 7.0711 | 0.6337 | 0.0022 | 0.1597 | 0.0109 | 1.1292 | 1.275167322 | |
| 1A3. Transport | CO2 | 1180.5150 | 2205.4870 | 5 | 5 | 7.0711 | 1.5523 | 0.0180 | 0.3912 | 0.0902 | 2.7661 | 7.659302223 | |
| 1A4. Other sectors | CO2 | 430.4000 | 591.6920 | 2 | 2 | 2.8284 | 0.1666 | 0.0311 | 0.1049 | 0.0621 | 0.2968 | 0.091969344 | |
| 1A5. Other | CO2 | 10.9950 | 42.6239 | 5 | 5 | 7.0711 | 0.0300 | 0.0041 | 0.0076 | 0.0204 | 0.0535 | 0.003274942 | |
| 2A. Mineral industry | CO2 | 759.1845 | 895.4398 | 5 | 5 | 7.0711 | 0.6302 | 0.0810 | 0.1588 | 0.4051 | 1.1230 | 1.425288616 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 16.3142 | 10 | 50 | 50.9902 | 0.0828 | 0.0009 | 0.0029 | 0.0461 | 0.0409 | 0.003800504 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0277 | 20 | 400 | 400.4997 | 0.0011 | 0.0000 | 0.0000 | 0.0054 | 0.0001 | 2.93131E-05 | |
| 3H. Urea application | CO2 | 1.8150 | 0.5368 | 50 | 200 | 206.1553 | 0.0110 | 0.0005 | 0.0001 | 0.0957 | 0.0067 | 0.009200799 | |
| 1A1. Energy industries | CH4 | 1.7055 | 3.8000 | 5 | 100 | 100.1249 | 0.0379 | 0.0001 | 0.0007 | 0.0135 | 0.0048 | 0.000204884 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 1.3487 | 5 | 100 | 100.1249 | 0.0134 | 0.0000 | 0.0002 | 0.0040 | 0.0017 | 1.87671E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 11.7688 | 5 | 100 | 100.1249 | 0.1173 | 0.0004 | 0.0021 | 0.0382 | 0.0148 | 0.001678132 | |
| 1A4. Other sectors | CH4 | 2.5278 | 4.7908 | 5 | 50 | 50.2494 | 0.0240 | 0.0001 | 0.0008 | 0.0025 | 0.0060 | 4.25593E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.2290 | 5 | 20 | 20.6155 | 0.0005 | 0.0000 | 0.0000 | 0.0006 | 0.0003 | 4.1711E-07 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 6.18822E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 229.5275 | 30 | 100 | 104.4031 | 2.3853 | 0.0224 | 0.0407 | 2.2383 | 1.7272 | 7.993423541 | |
| 3B. Manure management | CH4 | 111.4133 | 175.4215 | 5 | 30 | 30.4138 | 0.5311 | 0.0041 | 0.0311 | 0.1229 | 0.2200 | 0.06351441 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.1350 | 5 | 50 | 50.2494 | 0.0007 | 0.0001 | 0.0000 | 0.0043 | 0.0002 | 1.81308E-05 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 383.9537 | 50 | 200 | 206.1553 | 7.8789 | 0.0113 | 0.0681 | 2.2549 | 4.8155 | 28.2731947 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 63.2250 | 5 | 20 | 20.6155 | 0.1297 | 0.0176 | 0.0112 | 0.3516 | 0.0793 | 0.129889987 | |
| 1A1. Energy industries | N2O | 3.9813 | 8.9400 | 20 | 40 | 44.7214 | 0.0398 | 0.0003 | 0.0016 | 0.0131 | 0.0448 | 0.002182948 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 2.7282 | 5 | 300 | 300.0417 | 0.0066 | 0.0001 | 0.0005 | 0.0182 | 0.0034 | 0.000343045 | |
| 1A3. Transport | N2O | 27.8034 | 57.0014 | 5 | 300 | 300.0417 | 2.8981 | 0.0013 | 0.0101 | 0.3969 | 0.0715 | 0.162601029 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.4536 | 5 | 300 | 300.0417 | 0.0019 | 0.0001 | 0.0003 | 0.0156 | 0.0018 | 0.0002471 | |
| 1A5. Other | N2O | 0.0265 | 0.1051 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0010 | 0.0001 | 1.07166E-06 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 56.0836 | 20 | 20 | 28.2843 | 0.0249 | 0.0031 | 0.0099 | 0.0621 | 0.2814 | 0.083020161 | |
| 3B. Manure management | N2O | 72.5332 | 82.9036 | 50 | 200 | 206.1553 | 2.8941 | 0.0082 | 0.0147 | 1.6438 | 1.0398 | 3.783021844 | |
| 3D. Agricultural soils | N2O | 149.9732 | 134.2103 | 5 | 100 | 100.1249 | 1.7891 | 0.0236 | 0.0238 | 2.3588 | 0.1683 | 5.592480496 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0417 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0027 | 0.0002 | 7.06961E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 15.8923 | 20 | 20 | 28.2843 | 0.0020 | 0.0011 | 0.0028 | 0.0212 | 0.0797 | 0.006807197 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 192.9170 | 5 | 10 | 11.1803 | 0.0461 | 0.0342 | 0.0342 | 0.3417 | 0.2420 | 0.175308073 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.1525 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0038 | 0.0019 | 1.79644E-05 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 10046.3752 | | | | 29.7263 | | | | | 82.0300 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.452186451 | | | | Trend uncertainty %: | 9.057042688 | |

| Reporting year: | 2009 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IPCC category/Group | Gas | Base year emissions or removals | Year x emissions or removals | Activity data uncertainty (1) | Emission factor / estimation parameter uncertainty (1) | Combined uncertainty | Contribution to variance by category in year x | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2) | Uncertainty in trend in national emissions introduced by activity data uncertainty (3) | Uncertainty introduced into the trend in total national emissions | Comments (optional) |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G\bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert\frac{D}{\sum C}\right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 3992.4700 | 5 | 5 | 7.0711 | 8.2570 | 0.1632 | 0.7081 | 0.8160 | 5.0073 | 25.73854418 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 795.9197 | 5 | 5 | 7.0711 | 0.5728 | 0.0171 | 0.1412 | 0.0856 | 0.9982 | 1.003782267 | |
| 1A3. Transport | CO2 | 1180.5150 | 2205.8050 | 5 | 5 | 7.0711 | 1.5876 | 0.0263 | 0.3912 | 0.1316 | 2.7665 | 7.670684747 | |
| 1A4. Other sectors | CO2 | 430.4000 | 616.7950 | 2 | 2 | 2.8284 | 0.1776 | 0.0236 | 0.1094 | 0.0472 | 0.3094 | 0.09797536 | |
| 1A5. Other | CO2 | 10.9950 | 20.2869 | 5 | 5 | 7.0711 | 0.0146 | 0.0002 | 0.0036 | 0.0010 | 0.0254 | 0.000648366 | |
| 2A. Mineral industry | CO2 | 759.1845 | 723.5988 | 5 | 5 | 7.0711 | 0.5208 | 0.1062 | 0.1283 | 0.5308 | 0.9075 | 1.105340147 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 15.6961 | 10 | 50 | 50.9902 | 0.0815 | 0.0009 | 0.0028 | 0.0428 | 0.0394 | 0.003382117 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0309 | 20 | 400 | 400.4997 | 0.0013 | 0.0000 | 0.0000 | 0.0050 | 0.0002 | 2.53128E-05 | |
| 3H. Urea application | CO2 | 1.8150 | 1.1389 | 50 | 200 | 206.1553 | 0.0239 | 0.0004 | 0.0002 | 0.0718 | 0.0143 | 0.0053583 | |
| 1A1. Energy industries | CH4 | 1.7055 | 3.8500 | 5 | 100 | 100.1249 | 0.0392 | 0.0002 | 0.0007 | 0.0156 | 0.0048 | 0.000265856 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 1.1850 | 5 | 100 | 100.1249 | 0.0121 | 0.0001 | 0.0002 | 0.0063 | 0.0015 | 4.1593E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 12.0110 | 5 | 100 | 100.1249 | 0.1224 | 0.0005 | 0.0021 | 0.0463 | 0.0151 | 0.002368232 | |
| 1A4. Other sectors | CH4 | 2.5278 | 5.3491 | 5 | 50 | 50.2494 | 0.0274 | 0.0002 | 0.0009 | 0.0084 | 0.0067 | 0.000115145 | |
| 1A5. Other | CH4 | 0.0370 | 0.1540 | 5 | 20 | 20.6155 | 0.0003 | 0.0000 | 0.0000 | 0.0003 | 0.0002 | 1.38159E-07 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 5.91804E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 228.9575 | 30 | 100 | 104.4031 | 2.4331 | 0.0211 | 0.0406 | 2.1092 | 1.7229 | 7.417207909 | |
| 3B. Manure management | CH4 | 111.4133 | 174.4005 | 5 | 30 | 30.4138 | 0.5399 | 0.0035 | 0.0309 | 0.1050 | 0.2187 | 0.058876198 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.1550 | 5 | 50 | 50.2494 | 0.0008 | 0.0001 | 0.0000 | 0.0040 | 0.0002 | 1.56952E-05 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 394.0679 | 50 | 200 | 206.1553 | 8.2689 | 0.0077 | 0.0699 | 1.5460 | 4.9423 | 26.81648847 | |
| 5D. Waste water treatment and discha | CH4 | 91.1100 | 53.7225 | 5 | 20 | 20.6155 | 0.1127 | 0.0186 | 0.0095 | 0.3726 | 0.0674 | 0.143343618 | |
| 1A1. Energy industries | N2O | 3.9813 | 9.2380 | 20 | 40 | 44.7214 | 0.0421 | 0.0004 | 0.0016 | 0.0163 | 0.0463 | 0.002414151 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 2.3813 | 5 | 300 | 300.0417 | 0.0053 | 0.0001 | 0.0004 | 0.0331 | 0.0030 | 0.001101459 | |
| 1A3. Transport | N2O | 27.8034 | 57.6213 | 5 | 300 | 300.0417 | 3.0967 | 0.0016 | 0.0102 | 0.4880 | 0.0723 | 0.243384508 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.6184 | 5 | 300 | 300.0417 | 0.0024 | 0.0000 | 0.0003 | 0.0048 | 0.0020 | 2.70744E-05 | |
| 1A5. Other | N2O | 0.0265 | 0.0530 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0001 | 1.88921E-08 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 57.6630 | 20 | 20 | 28.2843 | 0.0276 | 0.0025 | 0.0102 | 0.0508 | 0.2893 | 0.086258639 | |
| 3B. Manure management | N2O | 72.5332 | 79.9534 | 50 | 200 | 206.1553 | 2.8147 | 0.0082 | 0.0142 | 1.6472 | 1.0028 | 3.718796974 | |
| 3D. Agricultural soils | N2O | 149.9732 | 133.2269 | 5 | 100 | 100.1249 | 1.8435 | 0.0227 | 0.0236 | 2.2717 | 0.1671 | 5.188458856 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0477 | 20 | 100 | 101.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0025 | 0.0002 | 6.15846E-06 | |
| 5D. Waste water treatment and discha | N2O | 12.2776 | 15.8149 | 20 | 20 | 28.2843 | 0.0021 | 0.0010 | 0.0028 | 0.0198 | 0.0793 | 0.006686368 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 221.2415 | 5 | 10 | 11.1803 | 0.0634 | 0.0392 | 0.0392 | 0.3920 | 0.2775 | 0.230626102 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.1611 | 50 | 200 | 206.1553 | 0.0000 | 0.0000 | 0.0000 | 0.0041 | 0.0020 | 2.10813E-05 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 9824.6141 | | | | 30.6915 | | | | | 79.5422 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 5.53999172 | | | | Trend uncertainty %: | 8.91864592 | |

| Reporting year: | 2010 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IPCC category/Group** | **Gas** | **Base year emissions or removals** | **Year x emissions or removals** | **Activity data uncertainty (1)** | **Emission factor / estimation parameter uncertainty (1)** | **Combined uncertainty** | **Contribution to variance by category in year x** | **Type A sensitivity** | **Type B sensitivity** | **Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)** | **Uncertainty in trend in national emissions introduced by activity data uncertainty (3)** | **Uncertainty introduced into the trend in total national emissions** | **Comments (optional)** |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G\bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert\frac{D}{\sum C}\right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 3868.0000 | 5 | 5 | 7.0711 | 8.2608 | 0.1582 | 0.6861 | 0.7911 | 4.8512 | 24.15965329 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 697.2583 | 5 | 5 | 7.0711 | 0.5181 | 0.0296 | 0.1237 | 0.1482 | 0.8745 | 0.78668785 | |
| 1A3. Transport | CO2 | 1180.5150 | 2253.2470 | 5 | 5 | 7.0711 | 1.6743 | 0.0461 | 0.3997 | 0.2307 | 2.8260 | 8.039360117 | |
| 1A4. Other sectors | CO2 | 430.4000 | 563.2160 | 2 | 2 | 2.8284 | 0.1674 | 0.0289 | 0.0999 | 0.0579 | 0.2825 | 0.083182098 | |
| 1A5. Other | CO2 | 10.9950 | 20.2869 | 5 | 5 | 7.0711 | 0.0151 | 0.0003 | 0.0036 | 0.0015 | 0.0254 | 0.000649717 | |
| 2A. Mineral industry | CO2 | 759.1845 | 584.6505 | 5 | 5 | 7.0711 | 0.4344 | 0.1234 | 0.1037 | 0.6171 | 0.7333 | 0.918436375 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 17.1587 | 10 | 50 | 50.9902 | 0.0919 | 0.0012 | 0.0030 | 0.0588 | 0.0430 | 0.005309905 | |
| 2G. Other product manufacture and use | CO2 | 0.0584 | 0.0330 | 20 | 400 | 400.4997 | 0.0014 | 0.0000 | 0.0000 | 0.0047 | 0.0002 | 2.16796E-05 | |
| 3H. Urea application | CO2 | 1.8150 | 0.7377 | 50 | 200 | 206.1553 | 0.0160 | 0.0004 | 0.0001 | 0.0825 | 0.0093 | 0.006892268 | |
| 1A1. Energy industries | CH4 | 1.7055 | 3.7250 | 5 | 100 | 100.1249 | 0.0392 | 0.0002 | 0.0007 | 0.0150 | 0.0047 | 0.000247177 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 1.1690 | 5 | 100 | 100.1249 | 0.0123 | 0.0001 | 0.0002 | 0.0057 | 0.0015 | 3.46684E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 12.2385 | 5 | 100 | 100.1249 | 0.1288 | 0.0006 | 0.0022 | 0.0555 | 0.0153 | 0.003320878 | |
| 1A4. Other sectors | CH4 | 2.5278 | 4.1480 | 5 | 50 | 50.2494 | 0.0219 | 0.0000 | 0.0007 | 0.0011 | 0.0052 | 2.81682E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.1540 | 5 | 20 | 20.6155 | 0.0003 | 0.0000 | 0.0000 | 0.0003 | 0.0002 | 1.42772E-07 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 5.55224E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 238.8100 | 30 | 100 | 104.4031 | 2.6200 | 0.0174 | 0.0424 | 1.7408 | 1.7971 | 6.259924057 | |
| 3B. Manure management | CH4 | 111.4133 | 174.8425 | 5 | 30 | 30.4138 | 0.5588 | 0.0023 | 0.0310 | 0.0703 | 0.2193 | 0.053021879 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.2050 | 5 | 50 | 50.2494 | 0.0011 | 0.0001 | 0.0000 | 0.0033 | 0.0003 | 1.12627E-05 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 404.5393 | 50 | 200 | 206.1553 | 8.7638 | 0.0034 | 0.0718 | 0.6874 | 5.0736 | 26.21441123 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 50.0750 | 5 | 20 | 20.6155 | 0.1085 | 0.0184 | 0.0089 | 0.3678 | 0.0628 | 0.139236083 | |
| 1A1. Energy industries | N2O | 3.9813 | 8.9400 | 5 | 20 | 20.6155 | 0.0194 | 0.0004 | 0.0016 | 0.0079 | 0.0112 | 0.000187743 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 2.2851 | 20 | 40 | 44.7214 | 0.0107 | 0.0001 | 0.0004 | 0.0044 | 0.0115 | 0.000150959 | |
| 1A3. Transport | N2O | 27.8034 | 58.8103 | 5 | 300 | 300.0417 | 3.4383 | 0.0021 | 0.0104 | 0.6322 | 0.0738 | 0.4051467 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.3343 | 5 | 300 | 300.0417 | 0.0018 | 0.0001 | 0.0002 | 0.0171 | 0.0017 | 0.00029371 | |
| 1A5. Other | N2O | 0.0265 | 0.0530 | 5 | 300 | 300.0417 | 0.0000 | 0.0000 | 0.0000 | 0.0004 | 0.0001 | 1.96379E-07 | |
| 2G. Other product manufacture and use | N2O | 41.3028 | 59.0934 | 5 | 100 | 100.1249 | 0.3866 | 0.0019 | 0.0105 | 0.1883 | 0.0741 | 0.040967078 | |
| 3B. Manure management | N2O | 72.5332 | 81.8904 | 20 | 20 | 28.2843 | 0.0592 | 0.0072 | 0.0145 | 0.1438 | 0.4108 | 0.189444559 | |
| 3D. Agricultural soils | N2O | 149.9732 | 147.1792 | 50 | 200 | 206.1553 | 10.1662 | 0.0188 | 0.0261 | 3.7576 | 1.8459 | 17.52653744 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0626 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0021 | 0.0001 | 4.42323E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 16.4168 | 20 | 100 | 101.9804 | 0.0310 | 0.0008 | 0.0029 | 0.0764 | 0.0824 | 0.012615703 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 245.4311 | 20 | 20 | 28.2843 | 0.5321 | 0.0435 | 0.0435 | 0.8698 | 1.2313 | 2.272475603 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.1507 | 5 | 20 | 20.6155 | 0.0000 | 0.0000 | 0.0000 | 0.0004 | 0.0002 | 1.80394E-07 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 9516.1413 | | | | 38.0795 | | | | | 87.1183 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 6.170858072 | | | | Trend uncertainty %: | 9.333715934 | |

| Reporting year: | 2011 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IPCC category/Group | Gas | Base year emissions or removals | Year x emissions or removals | Activity data uncertainty (1) | Emission factor / estimation parameter uncertainty (1) | Combined uncertainty | Contribution to variance by category in year x | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2) | Uncertainty in trend in national emissions introduced by activity data uncertainty (3) | Uncertainty introduced into the trend in total national emissions | Comments (optional) |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\lvert \frac{D}{\sum C} \right\rvert$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 3710.0400 | 5 | 5 | 7.0711 | 8.0758 | 0.1460 | 0.6580 | 0.7301 | 4.6531 | 22.18395148 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 579.9082 | 5 | 5 | 7.0711 | 0.4442 | 0.0459 | 0.1029 | 0.2293 | 0.7273 | 0.581535578 | |
| 1A3. Transport | CO2 | 1180.5150 | 2181.5880 | 5 | 5 | 7.0711 | 1.6710 | 0.0440 | 0.3869 | 0.2201 | 2.7361 | 7.534670949 | |
| 1A4. Other sectors | CO2 | 430.4000 | 613.1140 | 2 | 2 | 2.8284 | 0.1879 | 0.0162 | 0.1087 | 0.0325 | 0.3076 | 0.09566091 | |
| 1A5. Other | CO2 | 10.9950 | 26.6259 | 5 | 5 | 7.0711 | 0.0204 | 0.0015 | 0.0047 | 0.0076 | 0.0334 | 0.001173613 | |
| 2A. Mineral industry | CO2 | 759.1845 | 571.7278 | 5 | 5 | 7.0711 | 0.4379 | 0.1189 | 0.1014 | 0.5946 | 0.7170 | 0.867663581 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 12.3875 | 10 | 50 | 50.9902 | 0.0684 | 0.0004 | 0.0022 | 0.0193 | 0.0311 | 0.001337218 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0269 | 20 | 400 | 400.4997 | 0.0012 | 0.0000 | 0.0000 | 0.0049 | 0.0001 | 2.37534E-05 | |
| 3H. Urea application | CO2 | 1.8150 | 0.9086 | 50 | 200 | 206.1553 | 0.0203 | 0.0004 | 0.0002 | 0.0732 | 0.0114 | 0.005486517 | |
| 1A1. Energy industries | CH4 | 1.7055 | 3.6000 | 5 | 100 | 100.1249 | 0.0390 | 0.0001 | 0.0006 | 0.0143 | 0.0045 | 0.000225505 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 0.8195 | 5 | 100 | 100.1249 | 0.0089 | 0.0001 | 0.0001 | 0.0111 | 0.0010 | 0.000124494 | |
| 1A3. Transport | CH4 | 5.3955 | 12.0357 | 5 | 100 | 100.1249 | 0.1305 | 0.0006 | 0.0021 | 0.0568 | 0.0151 | 0.003451772 | |
| 1A4. Other sectors | CH4 | 2.5278 | 4.7325 | 5 | 50 | 50.2494 | 0.0258 | 0.0001 | 0.0008 | 0.0053 | 0.0059 | 6.29465E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.1758 | 5 | 20 | 20.6155 | 0.0004 | 0.0000 | 0.0000 | 0.0004 | 0.0002 | 2.15491E-07 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 5.22502E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 244.6000 | 30 | 100 | 104.4031 | 2.7663 | 0.0146 | 0.0434 | 1.4594 | 1.8406 | 5.517854641 | |
| 3B. Manure management | CH4 | 111.4133 | 174.0905 | 5 | 30 | 30.4138 | 0.5736 | 0.0015 | 0.0309 | 0.0443 | 0.2183 | 0.049638055 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.2850 | 5 | 50 | 50.2494 | 0.0016 | 0.0000 | 0.0001 | 0.0025 | 0.0004 | 6.28894E-06 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 418.1733 | 50 | 200 | 206.1553 | 9.3386 | 0.0012 | 0.0742 | 0.2457 | 5.2446 | 27.56658893 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 42.9075 | 5 | 20 | 20.6155 | 0.0958 | 0.0188 | 0.0076 | 0.3769 | 0.0538 | 0.14496875 | |
| 1A1. Energy industries | N2O | 3.9813 | 8.6420 | 5 | 20 | 20.6155 | 0.0193 | 0.0004 | 0.0015 | 0.0075 | 0.0108 | 0.000174202 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 1.6807 | 20 | 40 | 44.7214 | 0.0081 | 0.0002 | 0.0003 | 0.0081 | 0.0084 | 0.000136567 | |
| 1A3. Transport | N2O | 27.8034 | 57.4530 | 5 | 300 | 300.0417 | 3.4870 | 0.0021 | 0.0102 | 0.6347 | 0.0721 | 0.408034992 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.4795 | 5 | 300 | 300.0417 | 0.0023 | 0.0000 | 0.0003 | 0.0067 | 0.0019 | 4.82456E-05 | |
| 1A5. Other | N2O | 0.0265 | 0.0679 | 5 | 300 | 300.0417 | 0.0000 | 0.0000 | 0.0000 | 0.0013 | 0.0001 | 1.70304E-06 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 60.6728 | 5 | 100 | 100.1249 | 0.4330 | 0.0012 | 0.0108 | 0.1233 | 0.0761 | 0.021005056 | |
| 3B. Manure management | N2O | 72.5332 | 80.7580 | 20 | 20 | 28.2843 | 0.0612 | 0.0067 | 0.0143 | 0.1348 | 0.4051 | 0.182309348 | |
| 3D. Agricultural soils | N2O | 149.9732 | 132.5802 | 50 | 200 | 206.1553 | 8.7661 | 0.0200 | 0.0235 | 4.0067 | 1.6628 | 18.81888454 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0894 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0015 | 0.0001 | 2.35319E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 16.5777 | 20 | 100 | 101.9804 | 0.0335 | 0.0006 | 0.0029 | 0.0625 | 0.0832 | 0.010825709 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 273.5648 | 20 | 20 | 28.2843 | 0.7025 | 0.0485 | 0.0485 | 0.9696 | 1.3724 | 2.823566646 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.1523 | 5 | 20 | 20.6155 | 0.0000 | 0.0000 | 0.0000 | 0.0004 | 0.0002 | 1.88909E-07 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 9231.4649 | | | | 37.4206 | | | | | 86.8194 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 6.117241892 | | | | Trend uncertainty %: | 9.317693639 | |

| Reporting year: | 2012 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IPCC category/Group** | **Gas** | **Base year emissions or removals** | **Year x emissions or removals** | **Activity data uncertainty (1)** | **Emission factor / estimation parameter uncertainty (1)** | **Combined uncertainty** | **Contribution to variance by category in year x** | **Type A sensitivity** | **Type B sensitivity** | **Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)** | **Uncertainty in trend in national emissions introduced by activity data uncertainty (3)** | **Uncertainty introduced into the trend in total national emissions** | **Comments (optional)** |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\|\frac{D}{\sum C}\right\|$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 3545.9300 | 5 | 5 | 7.0711 | 8.3002 | 0.1462 | 0.6289 | 0.7310 | 4.4472 | 20.31217325 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 456.8864 | 5 | 5 | 7.0711 | 0.3712 | 0.0591 | 0.0810 | 0.2957 | 0.5730 | 0.415800542 | |
| 1A3. Transport | CO2 | 1180.5150 | 2010.1930 | 5 | 5 | 7.0711 | 1.6332 | 0.0333 | 0.3565 | 0.1663 | 2.5211 | 6.383802869 | |
| 1A4. Other sectors | CO2 | 430.4000 | 587.7300 | 2 | 2 | 2.8284 | 0.1910 | 0.0136 | 0.1042 | 0.0272 | 0.2948 | 0.087673164 | |
| 1A5. Other | CO2 | 10.9950 | 20.2869 | 5 | 5 | 7.0711 | 0.0165 | 0.0006 | 0.0036 | 0.0029 | 0.0254 | 0.000656006 | |
| 2A. Mineral industry | CO2 | 759.1845 | 527.5157 | 5 | 5 | 7.0711 | 0.4286 | 0.1141 | 0.0936 | 0.5707 | 0.6616 | 0.763413613 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 11.5782 | 10 | 50 | 50.9902 | 0.0678 | 0.0003 | 0.0021 | 0.0173 | 0.0290 | 0.001142341 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0293 | 20 | 400 | 400.4997 | 0.0013 | 0.0000 | 0.0000 | 0.0043 | 0.0001 | 1.86699E-05 | |
| 3H. Urea application | CO2 | 1.8150 | 0.5488 | 50 | 200 | 206.1553 | 0.0130 | 0.0004 | 0.0001 | 0.0799 | 0.0069 | 0.006434293 | |
| 1A1. Energy industries | CH4 | 1.7055 | 3.4250 | 5 | 100 | 100.1249 | 0.0394 | 0.0001 | 0.0006 | 0.0141 | 0.0043 | 0.000215945 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 0.4960 | 5 | 100 | 100.1249 | 0.0057 | 0.0002 | 0.0001 | 0.0154 | 0.0006 | 0.000236922 | |
| 1A3. Transport | CH4 | 5.3955 | 11.5035 | 5 | 100 | 100.1249 | 0.1323 | 0.0006 | 0.0020 | 0.0563 | 0.0144 | 0.003378996 | |
| 1A4. Other sectors | CH4 | 2.5278 | 4.8268 | 5 | 50 | 50.2494 | 0.0279 | 0.0002 | 0.0009 | 0.0082 | 0.0061 | 0.000103912 | |
| 1A5. Other | CH4 | 0.0370 | 0.1540 | 5 | 20 | 20.6155 | 0.0004 | 0.0000 | 0.0000 | 0.0003 | 0.0002 | 1.55425E-07 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 4.64398E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 238.6250 | 30 | 100 | 104.4031 | 2.8626 | 0.0123 | 0.0423 | 1.2336 | 1.7957 | 4.74615391 | |
| 3B. Manure management | CH4 | 111.4133 | 150.7225 | 5 | 30 | 30.4138 | 0.5267 | 0.0038 | 0.0267 | 0.1131 | 0.1890 | 0.048524834 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.2300 | 5 | 50 | 50.2494 | 0.0013 | 0.0001 | 0.0000 | 0.0027 | 0.0003 | 7.28264E-06 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 431.0199 | 50 | 200 | 206.1553 | 10.2099 | 0.0077 | 0.0764 | 1.5359 | 5.4058 | 31.58109872 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 34.6275 | 5 | 20 | 20.6155 | 0.0820 | 0.0188 | 0.0061 | 0.3760 | 0.0434 | 0.143266747 | |
| 1A1. Energy industries | N2O | 3.9813 | 8.0460 | 5 | 20 | 20.6155 | 0.0191 | 0.0003 | 0.0014 | 0.0067 | 0.0101 | 0.000147274 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 1.0886 | 20 | 40 | 44.7214 | 0.0056 | 0.0003 | 0.0002 | 0.0111 | 0.0055 | 0.000154076 | |
| 1A3. Transport | N2O | 27.8034 | 54.0249 | 5 | 300 | 300.0417 | 3.4690 | 0.0020 | 0.0096 | 0.5909 | 0.0678 | 0.353811382 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.4505 | 5 | 300 | 300.0417 | 0.0025 | 0.0000 | 0.0003 | 0.0033 | 0.0018 | 1.45007E-05 | |
| 1A5. Other | N2O | 0.0265 | 0.0530 | 5 | 300 | 300.0417 | 0.0000 | 0.0000 | 0.0000 | 0.0006 | 0.0001 | 4.16143E-07 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 60.9410 | 5 | 100 | 100.1249 | 0.4915 | 0.0005 | 0.0108 | 0.0499 | 0.0764 | 0.008335288 | |
| 3B. Manure management | N2O | 72.5332 | 74.3808 | 20 | 20 | 28.2843 | 0.0584 | 0.0067 | 0.0132 | 0.1333 | 0.3731 | 0.15700968 | |
| 3D. Agricultural soils | N2O | 149.9732 | 135.4768 | 50 | 200 | 206.1553 | 10.2985 | 0.0170 | 0.0240 | 3.4055 | 1.6991 | 14.48467693 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0715 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0017 | 0.0001 | 2.79261E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 16.6493 | 20 | 100 | 101.9804 | 0.0381 | 0.0004 | 0.0030 | 0.0408 | 0.0835 | 0.008644704 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 314.3798 | 20 | 20 | 28.2843 | 1.0439 | 0.0557 | 0.0558 | 1.1144 | 1.5772 | 3.729341665 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.1575 | 5 | 20 | 20.6155 | 0.0000 | 0.0000 | 0.0000 | 0.0004 | 0.0002 | 2.13469E-07 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 8703.0481 | | | | 40.3378 | | | | | 83.2362 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 6.351202894 | | | | Trend uncertainty %: | 9.123389781 | |

| Reporting year: | 2013 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IPCC category/Group** | **Gas** | **Base year emissions or removals** | **Year x emissions or removals** | **Activity data uncertainty (1)** | **Emission factor / estimation parameter uncertainty (1)** | **Combined uncertainty** | **Contribution to variance by category in year x** | **Type A sensitivity** | **Type B sensitivity** | **Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)** | **Uncertainty in trend in national emissions introduced by activity data uncertainty (3)** | **Uncertainty introduced into the trend in total national emissions** | **Comments (optional)** |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G \bullet D)^2}{(\sum D)^2}$ | Note B | $\left\|\frac{D}{\sum C}\right\|$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 2829.7300 | 5 | 5 | 7.0711 | 6.3280 | 0.0609 | 0.5019 | 0.3046 | 3.5490 | 12.68810578 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 509.3222 | 5 | 5 | 7.0711 | 0.4528 | 0.0378 | 0.0903 | 0.1890 | 0.6388 | 0.443757522 | |
| 1A3. Transport | CO2 | 1180.5150 | 1808.4230 | 5 | 5 | 7.0711 | 1.6076 | 0.0253 | 0.3208 | 0.1265 | 2.2681 | 5.160208355 | |
| 1A4. Other sectors | CO2 | 430.4000 | 503.0950 | 2 | 2 | 2.8284 | 0.1789 | 0.0185 | 0.0892 | 0.0369 | 0.2524 | 0.065062079 | |
| 1A5. Other | CO2 | 10.9950 | 23.4399 | 5 | 5 | 7.0711 | 0.0208 | 0.0014 | 0.0042 | 0.0070 | 0.0294 | 0.000913661 | |
| 2A. Mineral industry | CO2 | 759.1845 | 765.1219 | 5 | 5 | 7.0711 | 0.6802 | 0.0542 | 0.1357 | 0.2710 | 0.9596 | 0.99425347 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 9.4746 | 10 | 50 | 50.9902 | 0.0607 | 0.0001 | 0.0017 | 0.0060 | 0.0238 | 0.000600556 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0230 | 20 | 400 | 400.4997 | 0.0012 | 0.0000 | 0.0000 | 0.0042 | 0.0001 | 1.77695E-05 | |
| 3H. Urea application | CO2 | 1.8150 | 0.7905 | 50 | 200 | 206.1553 | 0.0205 | 0.0003 | 0.0001 | 0.0628 | 0.0099 | 0.004041259 | |
| 1A1. Energy industries | CH4 | 1.7055 | 2.7250 | 5 | 100 | 100.1249 | 0.0343 | 0.0001 | 0.0005 | 0.0057 | 0.0034 | 4.36614E-05 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 0.6176 | 5 | 100 | 100.1249 | 0.0078 | 0.0001 | 0.0001 | 0.0111 | 0.0008 | 0.00012475 | |
| 1A3. Transport | CH4 | 5.3955 | 10.6914 | 5 | 100 | 100.1249 | 0.1346 | 0.0005 | 0.0019 | 0.0546 | 0.0134 | 0.003162794 | |
| 1A4. Other sectors | CH4 | 2.5278 | 4.3200 | 5 | 50 | 50.2494 | 0.0273 | 0.0001 | 0.0008 | 0.0067 | 0.0054 | 7.40429E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.1650 | 5 | 20 | 20.6155 | 0.0004 | 0.0000 | 0.0000 | 0.0004 | 0.0002 | 2.02936E-07 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.87921E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 227.6850 | 30 | 100 | 104.4031 | 2.9885 | 0.0096 | 0.0404 | 0.9574 | 1.7133 | 3.852134724 | |
| 3B. Manure management | CH4 | 111.4133 | 138.0858 | 5 | 30 | 30.4138 | 0.5280 | 0.0034 | 0.0245 | 0.1016 | 0.1732 | 0.040316197 | |
| 3F. Field burning of agricultural residu | CH4 | 0.3450 | 0.1875 | 5 | 50 | 50.2494 | 0.0012 | 0.0001 | 0.0000 | 0.0027 | 0.0002 | 7.09753E-06 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 445.0365 | 50 | 200 | 206.1553 | 11.5343 | 0.0161 | 0.0789 | 3.2157 | 5.5816 | 41.49427109 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 25.9500 | 5 | 20 | 20.6155 | 0.0673 | 0.0182 | 0.0046 | 0.3639 | 0.0325 | 0.133456542 | |
| 1A1. Energy industries | N2O | 3.9813 | 6.5560 | 5 | 20 | 20.6155 | 0.0170 | 0.0002 | 0.0012 | 0.0033 | 0.0082 | 7.87057E-05 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 1.3318 | 20 | 40 | 44.7214 | 0.0075 | 0.0002 | 0.0002 | 0.0078 | 0.0067 | 0.000105446 | |
| 1A3. Transport | N2O | 27.8034 | 49.4820 | 5 | 300 | 300.0417 | 3.4839 | 0.0018 | 0.0088 | 0.5457 | 0.0621 | 0.3016545 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.2387 | 5 | 300 | 300.0417 | 0.0022 | 0.0000 | 0.0002 | 0.0077 | 0.0016 | 6.15587E-05 | |
| 1A5. Other | N2O | 0.0265 | 0.0590 | 5 | 300 | 300.0417 | 0.0000 | 0.0000 | 0.0000 | 0.0011 | 0.0001 | 1.3193E-06 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 60.3748 | 5 | 100 | 100.1249 | 0.5776 | 0.0004 | 0.0107 | 0.0373 | 0.0757 | 0.007125879 | |
| 3B. Manure management | N2O | 72.5332 | 68.9274 | 20 | 20 | 28.2843 | 0.0601 | 0.0059 | 0.0122 | 0.1185 | 0.3458 | 0.133607773 | |
| 3D. Agricultural soils | N2O | 149.9732 | 120.6930 | 50 | 200 | 206.1553 | 9.7849 | 0.0161 | 0.0214 | 3.2234 | 1.5137 | 12.68178248 | |
| 3F. Field burning of agricultural residu | N2O | 0.1073 | 0.0566 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0017 | 0.0001 | 2.82831E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 16.5003 | 20 | 100 | 101.9804 | 0.0448 | 0.0001 | 0.0029 | 0.0146 | 0.0828 | 0.007064219 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 323.9791 | 20 | 20 | 28.2843 | 1.3272 | 0.0574 | 0.0575 | 1.1485 | 1.6253 | 3.960774196 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.1503 | 5 | 20 | 20.6155 | 0.0000 | 0.0000 | 0.0000 | 0.0004 | 0.0002 | 1.98774E-07 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 7954.2326 | | | | 39.9792 | | | | | 81.9728 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 6.322912186 | | | | Trend uncertainty %: | 9.053883733 | |

| Reporting year: | 2014 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IPCC category/Group | Gas | Base year emissions or removals | Year x emissions or removals | Activity data uncertainty (1) | Emission factor / estimation parameter uncertainty (1) | Combined uncertainty | Contribution to variance by category in year x | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2) | Uncertainty in trend in national emissions introduced by activity data uncertainty (3) | Uncertainty introduced into the trend in total national emissions | Comments (optional) |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | | % | % | % | % | % | |
| | | input data | input data | input data Note A | input data Note A | $\sqrt{E^2+F^2}$ | $\frac{(G\bullet D)^2}{(\sum D)^2}$ | Note B | $\left\|\frac{D}{\sum C}\right\|$ | I*F Note C | J*E*sqrt(2) Note D | K^2 + L^2 | |
| 1A1. Energy industries | CO2 | 1761.4882 | 2940.3200 | 5 | 5 | 7.0711 | 6.1509 | 0.0568 | 0.5215 | 0.2839 | 3.6877 | 13.67963715 | |
| 1A2. Manufacturing industries and con | CO2 | 512.1969 | 699.6741 | 5 | 5 | 7.0711 | 0.5902 | 0.0110 | 0.1241 | 0.0549 | 0.8775 | 0.77304407 | |
| 1A3. Transport | CO2 | 1180.5150 | 1761.2000 | 5 | 5 | 7.0711 | 1.4855 | 0.0010 | 0.3124 | 0.0052 | 2.2089 | 4.879084851 | |
| 1A4. Other sectors | CO2 | 430.4000 | 446.7790 | 2 | 2 | 2.8284 | 0.1507 | 0.0342 | 0.0792 | 0.0685 | 0.2241 | 0.054926223 | |
| 1A5. Other | CO2 | 10.9950 | 34.9830 | 5 | 5 | 7.0711 | 0.0295 | 0.0033 | 0.0062 | 0.0165 | 0.0439 | 0.002198098 | |
| 2A. Mineral industry | CO2 | 759.1845 | 985.7014 | 5 | 5 | 7.0711 | 0.8314 | 0.0254 | 0.1748 | 0.1268 | 1.2362 | 1.544372566 | |
| 2D. Non-energy products from fuels an | CO2 | 6.2377 | 9.2573 | 10 | 50 | 50.9902 | 0.0563 | 0.0000 | 0.0016 | 0.0002 | 0.0232 | 0.000539222 | |
| 2G. Other product manufacture and us | CO2 | 0.0584 | 0.0091 | 20 | 400 | 400.4997 | 0.0004 | 0.0000 | 0.0000 | 0.0055 | 0.0000 | 3.03873E-05 | |
| 3H. Urea application | CO2 | 1.8150 | 0.4070 | 50 | 200 | 206.1553 | 0.0100 | 0.0004 | 0.0001 | 0.0813 | 0.0051 | 0.006635049 | |
| 1A1. Energy industries | CH4 | 1.7055 | 2.8250 | 5 | 100 | 100.1249 | 0.0337 | 0.0001 | 0.0005 | 0.0051 | 0.0035 | 3.88426E-05 | |
| 1A2. Manufacturing industries and con | CH4 | 0.8831 | 1.1124 | 5 | 100 | 100.1249 | 0.0133 | 0.0000 | 0.0002 | 0.0036 | 0.0014 | 1.46044E-05 | |
| 1A3. Transport | CH4 | 5.3955 | 10.4196 | 5 | 100 | 100.1249 | 0.1244 | 0.0004 | 0.0018 | 0.0425 | 0.0131 | 0.00197826 | |
| 1A4. Other sectors | CH4 | 2.5278 | 3.9673 | 5 | 50 | 50.2494 | 0.0238 | 0.0000 | 0.0007 | 0.0019 | 0.0050 | 2.81832E-05 | |
| 1A5. Other | CH4 | 0.0370 | 0.1188 | 5 | 20 | 20.6155 | 0.0003 | 0.0000 | 0.0000 | 0.0002 | 0.0001 | 7.32972E-08 | |
| 1B2. Oil and natural gas and other emis | CH4 | 0.0001 | | 20 | 40 | 44.7214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 4.3089E-13 | |
| 3A. Enteric fermentation | CH4 | 199.6575 | 233.0900 | 30 | 100 | 104.4031 | 2.9029 | 0.0113 | 0.0413 | 1.1309 | 1.7540 | 4.355491355 | |
| 3B. Manure management | CH4 | 111.4133 | 133.3240 | 5 | 30 | 30.4138 | 0.4837 | 0.0057 | 0.0236 | 0.1720 | 0.1672 | 0.057555242 | |
| 3F. Field burning of agricultural residue | CH4 | 0.3450 | 0.1650 | 5 | 50 | 50.2494 | 0.0010 | 0.0001 | 0.0000 | 0.0031 | 0.0002 | 9.56649E-06 | |
| 5A. Solid waste disposal | CH4 | 251.1627 | 455.5907 | 50 | 200 | 206.1553 | 11.2037 | 0.0146 | 0.0808 | 2.9123 | 5.7139 | 41.13050159 | |
| 5D. Waste water treatment and dischar | CH4 | 91.1100 | 17.3450 | 5 | 20 | 20.6155 | 0.0427 | 0.0209 | 0.0031 | 0.4190 | 0.0218 | 0.176009756 | |
| 1A1. Energy industries | N2O | 3.9813 | 6.8540 | 5 | 20 | 20.6155 | 0.0169 | 0.0002 | 0.0012 | 0.0033 | 0.0086 | 8.48757E-05 | |
| 1A2. Manufacturing industries and con | N2O | 1.7230 | 2.1796 | 20 | 40 | 44.7214 | 0.0116 | 0.0001 | 0.0004 | 0.0027 | 0.0109 | 0.00012692 | |
| 1A3. Transport | N2O | 27.8034 | 47.9055 | 5 | 300 | 300.0417 | 2.9398 | 0.0012 | 0.0085 | 0.3493 | 0.0601 | 0.125605588 | |
| 1A4. Other sectors | N2O | 0.9804 | 1.0668 | 5 | 300 | 300.0417 | 0.0015 | 0.0001 | 0.0002 | 0.0208 | 0.0013 | 0.000434543 | |
| 1A5. Other | N2O | 0.0265 | 0.0864 | 5 | 300 | 300.0417 | 0.0000 | 0.0000 | 0.0000 | 0.0025 | 0.0001 | 6.26197E-06 | |
| 2G. Other product manufacture and us | N2O | 41.3028 | 59.6298 | 5 | 100 | 100.1249 | 0.5072 | 0.0003 | 0.0106 | 0.0316 | 0.0748 | 0.006593691 | |
| 3B. Manure management | N2O | 72.5332 | 72.7716 | 20 | 20 | 28.2843 | 0.0603 | 0.0062 | 0.0129 | 0.1244 | 0.3651 | 0.14875954 | |
| 3D. Agricultural soils | N2O | 149.9732 | 120.0940 | 50 | 200 | 206.1553 | 8.7219 | 0.0182 | 0.0213 | 3.6493 | 1.5062 | 15.5862614 | |
| 3F. Field burning of agricultural residue | N2O | 0.1073 | 0.0507 | 5 | 100 | 100.1249 | 0.0000 | 0.0000 | 0.0000 | 0.0019 | 0.0001 | 3.7318E-06 | |
| 5D. Waste water treatment and dischar | N2O | 12.2776 | 16.2946 | 20 | 100 | 101.9804 | 0.0393 | 0.0003 | 0.0029 | 0.0348 | 0.0817 | 0.00789207 | |
| 2F Product uses as ODS substitutes | HFCs | 0.1456 | 319.8255 | 20 | 20 | 28.2843 | 1.1644 | 0.0567 | 0.0567 | 1.1338 | 1.6045 | 3.859756598 | |
| 2F Product uses as ODS substitutes | SF6 | 0.0258 | 0.1483 | 5 | 20 | 20.6155 | 0.0000 | 0.0000 | 0.0000 | 0.0004 | 0.0002 | 1.86918E-07 | |
| END | | | | | | | | | | | | | |
| Total | | 5638.0082 | 8383.1956 | | | | 37.5973 | | | | | 86.3976 | |
| Total Uncertainties | | | | | | Uncertainty in total inventory %: | 6.131661856 | | | | Trend uncertainty %: | 9.295032033 | |

# Annex II. CRF summary tables for 1990-2015

This Annex contains CRF summary table 2 for 1990-2015. These tables have also been submitted in excel format.

**SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS**
**(Sheet 1 of 1)**

Inventory 1990
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)**[(1)] | 4520.60 | 693.61 | 303.14 | NO,NE | | 0.03 | | | 5517.37 |
| **1. Energy** | 3895.60 | 10.55 | 34.51 | | | | | | 3940.66 |
| A. Fuel combustion (sectoral approach) | 3895.60 | 10.55 | 34.51 | | | | | | 3940.66 |
| 1. Energy industries | 1761.49 | 1.71 | 3.98 | | | | | | 1767.17 |
| 2. Manufacturing industries and construction | 512.20 | 0.88 | 1.72 | | | | | | 514.80 |
| 3. Transport | 1180.52 | 5.40 | 27.80 | | | | | | 1213.71 |
| 4. Other sectors | 430.40 | 2.53 | 0.98 | | | | | | 433.91 |
| 5. Other | 11.00 | 0.04 | 0.03 | | | | | | 11.06 |
| B. Fugitive emissions from fuels | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 723.58 | NE,NA,NO | 41.30 | NO,NE | | 0.03 | | | 764.91 |
| A. Mineral industry | 717.24 | | | | | | | | 717.24 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 6.30 | NE,NA | NE,NA | | | | | | 6.30 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | NO,NE | | | | | NO,NE |
| G. Other product manufacture and use | 0.04 | NE | 41.30 | | | 0.03 | | | 41.37 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 1.82 | 308.39 | 215.00 | | | | | | 525.21 |
| A. Enteric fermentation | | 196.97 | | | | | | | 196.97 |
| B. Manure management | | 111.07 | 71.72 | | | | | | 182.79 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 143.18 | | | | | | 143.18 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.35 | 0.11 | | | | | | 0.45 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 1.82 | | | | | | | | 1.82 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry**[(1)] | -100.39 | 0.04 | 0.03 | | | | | | -100.32 |
| A. Forest land | -100.39 | 0.04 | 0.03 | | | | | | -100.32 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 374.63 | 12.29 | | | | | | 386.92 |
| A. Solid waste disposal | NA,NO | 258.34 | | | | | | | 258.34 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 116.29 | 12.29 | | | | | | 128.58 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |
| | | | | | | | | | |
| **Memo items:**[(2)] | | | | | | | | | |
| **International bunkers** | 915.95 | 0.47 | 8.38 | | | | | | 924.79 |
| Aviation | 733.16 | 0.13 | 6.11 | | | | | | 739.40 |
| Navigation | 182.79 | 0.34 | 2.26 | | | | | | 185.39 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 17.95 | | | | | | | | 17.95 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$** [(3)] | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 5617.69 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 5517.37 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

[(1)] For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

## SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS
**(Sheet 1 of 1)**



| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [1] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt ) | | | | | | | | |
| **Total (net emissions)[1]** | 4987.71 | 704.48 | 303.28 | 0.00 | | 0.03 | | | 5995.51 |
| **1. Energy** | 4423.58 | 11.12 | 36.24 | | | | | | 4470.94 |
| A. Fuel combustion (sectoral approach) | 4423.58 | 11.12 | 36.24 | | | | | | 4470.94 |
| 1. Energy industries | 1824.04 | 1.76 | 4.29 | | | | | | 1830.09 |
| 2. Manufacturing industries and construction | 938.38 | 1.29 | 2.68 | | | | | | 942.35 |
| 3. Transport | 1178.56 | 5.56 | 28.19 | | | | | | 1212.31 |
| 4. Other sectors | 470.37 | 2.48 | 1.05 | | | | | | 473.89 |
| 5. Other | 12.23 | 0.04 | 0.03 | | | | | | 12.30 |
| B. Fugitive emissions from fuels | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 682.02 | NE,NA,NO | 42.47 | 0.00 | | 0.03 | | | 724.51 |
| A. Mineral industry | 676.36 | | | | | | | | 676.36 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 5.61 | NE,NA | NE,NA | | | | | | 5.61 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 0.00 | | | | | 0.00 |
| G. Other product manufacture and use | 0.04 | NE | 42.47 | | | 0.03 | | | 42.54 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 1.47 | 313.68 | 212.46 | | | | | | 527.61 |
| A. Enteric fermentation | | 195.66 | | | | | | | 195.66 |
| B. Manure management | | 117.70 | 72.10 | | | | | | 189.80 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 140.26 | | | | | | 140.26 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.32 | 0.10 | | | | | | 0.42 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 1.47 | | | | | | | | 1.47 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry[1]** | -119.36 | 0.13 | 0.08 | | | | | | -119.15 |
| A. Forest land | -119.36 | 0.13 | 0.08 | | | | | | -119.15 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 379.56 | 12.04 | | | | | | 391.60 |
| A. Solid waste disposal | NA,NO | 262.74 | | | | | | | 262.74 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 116.82 | 12.04 | | | | | | 128.85 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |

| Memo items:[2] | $CO_2$ | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| **International bunkers** | 1046.15 | 0.49 | 9.12 | | | | | | 1055.75 |
| Aviation | 869.85 | 0.15 | 7.25 | | | | | | 877.25 |
| Navigation | 176.30 | 0.34 | 1.87 | | | | | | 178.50 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 15.45 | | | | | | | | 15.45 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ [3]** | NE,NO | | | | | | | | |

| | |
|---|---|
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | 6114.65 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | 5995.51 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | NA |

[1] For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

**SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS** Inventory 1992
**(Sheet 1 of 1)** Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)[(1)]** | 5356.50 | 733.61 | 334.60 | 0.00 | | 0.03 | | | 6424.75 |
| **1. Energy** | 4748.14 | 11.45 | 38.54 | | | | | | 4798.13 |
| A. Fuel combustion (sectoral approach) | 4748.14 | 11.45 | 38.54 | | | | | | 4798.13 |
| 1. Energy industries | 2120.79 | 2.06 | 4.89 | | | | | | 2127.74 |
| 2. Manufacturing industries and construction | 726.57 | 0.79 | 1.77 | | | | | | 729.12 |
| 3. Transport | 1324.53 | 5.80 | 30.60 | | | | | | 1360.93 |
| 4. Other sectors | 561.45 | 2.75 | 1.24 | | | | | | 565.44 |
| 5. Other | 14.81 | 0.05 | 0.04 | | | | | | 14.90 |
| B. Fugitive emissions from fuels | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 732.89 | NE,NA,NO | 43.57 | 0.00 | | 0.03 | | | 776.50 |
| A. Mineral industry | 726.77 | | | | | | | | 726.77 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 6.08 | NE,NA | NE,NA | | | | | | 6.08 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 0.00 | | | | | 0.00 |
| G. Other product manufacture and use | 0.04 | NE | 43.57 | | | 0.03 | | | 43.65 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 1.92 | 334.57 | 238.99 | | | | | | 575.47 |
| A. Enteric fermentation | | 200.52 | | | | | | | 200.52 |
| B. Manure management | | 133.73 | 76.09 | | | | | | 209.81 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 162.80 | | | | | | 162.80 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.32 | 0.10 | | | | | | 0.41 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 1.92 | | | | | | | | 1.92 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry[(1)]** | -126.46 | 0.04 | 0.03 | | | | | | -126.39 |
| A. Forest land | -126.46 | 0.04 | 0.03 | | | | | | -126.39 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 387.56 | 13.48 | | | | | | 401.04 |
| A. Solid waste disposal | NA,NO | 267.47 | | | | | | | 267.47 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 120.09 | 13.48 | | | | | | 133.57 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:[(2)]** | | | | | | | | | |
| **International bunkers** | 1030.73 | 0.50 | 9.01 | | | | | | 1040.25 |
| Aviation | 845.00 | 0.15 | 7.04 | | | | | | 852.19 |
| Navigation | 185.74 | 0.36 | 1.96 | | | | | | 188.06 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 15.25 | | | | | | | | 15.25 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ [(3)]** | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 6551.13 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 6424.75 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

(2) See footnote 7 to table Summary 1.A.

(3) In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect $CO_2$, the national totals shall be provided with and without indirect $CO_2$.

**SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS**
**(Sheet 1 of 1)**

Inventory 1993
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ (1) | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)(1)** | 5622.70 | 762.00 | 354.65 | 0.01 | | 0.04 | | | 6739.39 |
| **1. Energy** | 4926.99 | 11.57 | 39.03 | | | | | | 4977.59 |
| A. Fuel combustion (sectoral approach) | 4926.99 | 11.57 | 39.03 | | | | | | 4977.59 |
| 1. Energy industries | 2242.99 | 2.18 | 5.18 | | | | | | 2250.35 |
| 2. Manufacturing industries and construction | 768.41 | 0.84 | 1.88 | | | | | | 771.14 |
| 3. Transport | 1342.09 | 5.75 | 30.68 | | | | | | 1378.52 |
| 4. Other sectors | 558.13 | 2.75 | 1.25 | | | | | | 562.13 |
| 5. Other | 15.37 | 0.05 | 0.04 | | | | | | 15.46 |
| B. Fugitive emissions from fuels | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 805.08 | NE,NA,NO | 44.55 | 0.01 | | 0.04 | | | 849.67 |
| A. Mineral industry | 795.32 | | | | | | | | 795.32 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 9.74 | NE,NA | NE,NA | | | | | | 9.74 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 0.01 | | | | | 0.01 |
| G. Other product manufacture and use | 0.01 | NE | 44.55 | | | 0.04 | | | 44.60 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 1.60 | 353.63 | 257.42 | | | | | | 612.65 |
| A. Enteric fermentation | | 209.32 | | | | | | | 209.32 |
| B. Manure management | | 144.01 | 81.23 | | | | | | 225.24 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 176.09 | | | | | | 176.09 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.31 | 0.10 | | | | | | 0.40 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 1.60 | | | | | | | | 1.60 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry(1)** | -110.97 | 0.32 | 0.21 | | | | | | -110.43 |
| A. Forest land | -110.97 | 0.32 | 0.21 | | | | | | -110.43 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 396.48 | 13.44 | | | | | | 409.91 |
| A. Solid waste disposal | NA,NO | 272.85 | | | | | | | 272.85 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 123.63 | 13.44 | | | | | | 137.06 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:(2)** | | | | | | | | | |
| **International bunkers** | 874.81 | 0.44 | 7.55 | | | | | | 882.79 |
| Aviation | 717.63 | 0.13 | 5.98 | | | | | | 723.73 |
| Navigation | 157.18 | 0.31 | 1.57 | | | | | | 159.06 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 15.15 | | | | | | | | 15.15 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ (3)** | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 6849.82 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 6739.39 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

## SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS
**(Sheet 1 of 1)**

Inventory 1994
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ (1) | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)(1)** | 5862.16 | 774.01 | 344.57 | 0.28 | | 0.05 | | | 6981.07 |
| **1. Energy** | 5134.26 | 11.95 | 40.83 | | | | | | 5187.04 |
| A. Fuel combustion (sectoral approach) | 5134.26 | 11.95 | 40.83 | | | | | | 5187.04 |
| 1. Energy industries | 2370.90 | 2.27 | 5.50 | | | | | | 2378.67 |
| 2. Manufacturing industries and construction | 782.00 | 0.84 | 1.89 | | | | | | 784.73 |
| 3. Transport | 1395.25 | 6.08 | 32.15 | | | | | | 1433.48 |
| 4. Other sectors | 570.29 | 2.70 | 1.26 | | | | | | 574.26 |
| 5. Other | 15.82 | 0.05 | 0.04 | | | | | | 15.91 |
| B. Fugitive emissions from fuels | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 841.29 | NE,NA,NO | 45.42 | 0.28 | | 0.05 | | | 887.03 |
| A. Mineral industry | 827.93 | | | | | | | | 827.93 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 13.34 | NE,NA | NE,NA | | | | | | 13.34 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 0.28 | | | | | 0.28 |
| G. Other product manufacture and use | 0.01 | NE | 45.42 | | | 0.05 | | | 45.48 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 1.70 | 353.77 | 244.12 | | | | | | 599.60 |
| A. Enteric fermentation | | 212.63 | | | | | | | 212.63 |
| B. Manure management | | 140.94 | 81.01 | | | | | | 221.96 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 163.05 | | | | | | 163.05 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.19 | 0.06 | | | | | | 0.25 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 1.70 | | | | | | | | 1.70 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry(1)** | -115.09 | 0.84 | 0.55 | | | | | | -113.71 |
| A. Forest land | -115.09 | 0.84 | 0.55 | | | | | | -113.71 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 407.46 | 13.65 | | | | | | 421.10 |
| A. Solid waste disposal | NA,NO | 278.42 | | | | | | | 278.42 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 129.04 | 13.65 | | | | | | 142.68 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:(2)** | | | | | | | | | |
| **International bunkers** | 930.85 | 0.53 | 7.94 | | | | | | 939.32 |
| Aviation | 736.27 | 0.13 | 6.14 | | | | | | 742.53 |
| Navigation | 194.58 | 0.40 | 1.80 | | | | | | 196.79 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 15.40 | | | | | | | | 15.40 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ (3)** | NE,NO | | | | | | | | |

| | |
|---|---|
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | 7094.78 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | 6981.07 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

## SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS
**(Sheet 1 of 1)**

Inventory 1995
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)[(1)]** | 5721.42 | 797.86 | 388.00 | 1.64 | | 0.06 | | | 6908.98 |
| **1. Energy** | 5038.75 | 12.80 | 41.82 | | | | | | 5093.38 |
| A. Fuel combustion (sectoral approach) | 5038.75 | 12.80 | 41.82 | | | | | | 5093.38 |
| 1. Energy industries | 2166.14 | 2.09 | 4.91 | | | | | | 2173.15 |
| 2. Manufacturing industries and construction | 770.90 | 0.80 | 1.81 | | | | | | 773.51 |
| 3. Transport | 1482.01 | 6.26 | 33.67 | | | | | | 1521.94 |
| 4. Other sectors | 602.54 | 3.59 | 1.38 | | | | | | 607.52 |
| 5. Other | 17.17 | 0.06 | 0.04 | | | | | | 17.27 |
| B. Fugitive emissions from fuels | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 807.75 | NE,NA,NO | 46.19 | 1.64 | | 0.06 | | | 855.64 |
| A. Mineral industry | 794.60 | | | | | | | | 794.60 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 13.14 | NE,NA | NE,NA | | | | | | 13.14 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 1.64 | | | | | 1.64 |
| G. Other product manufacture and use | 0.01 | NE | 46.19 | | | 0.06 | | | 46.26 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 1.54 | 369.82 | 285.44 | | | | | | 656.79 |
| A. Enteric fermentation | | 221.98 | | | | | | | 221.98 |
| B. Manure management | | 147.64 | 84.02 | | | | | | 231.66 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 201.35 | | | | | | 201.35 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.20 | 0.06 | | | | | | 0.26 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 1.54 | | | | | | | | 1.54 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry[(1)]** | -126.62 | 0.33 | 0.22 | | | | | | -126.08 |
| A. Forest land | -126.62 | 0.33 | 0.22 | | | | | | -126.08 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 414.91 | 14.33 | | | | | | 429.24 |
| A. Solid waste disposal | NA,NO | 284.39 | | | | | | | 284.39 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 130.52 | 14.33 | | | | | | 144.85 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |
| | | | | | | | | | |
| **Memo items:[(2)]** | | | | | | | | | |
| **International bunkers** | 1024.37 | 0.59 | 8.78 | | | | | | 1033.74 |
| Aviation | 807.72 | 0.14 | 6.73 | | | | | | 814.59 |
| Navigation | 216.65 | 0.44 | 2.05 | | | | | | 219.15 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 33.26 | | | | | | | | 33.26 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ [(3)]** | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 7035.05 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 6908.98 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

**SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS**

**(Sheet 1 of 1)**



| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)[(1)]** | 6028.78 | 819.63 | 357.41 | 2.70 | | 0.07 | | | 7208.58 |
| **1. Energy** | 5288.94 | 13.58 | 43.45 | | | | | | 5345.97 |
| A. Fuel combustion (sectoral approach) | 5288.94 | 13.58 | 43.45 | | | | | | 5345.97 |
| 1. Energy industries | 2281.12 | 2.21 | 5.20 | | | | | | 2288.53 |
| 2. Manufacturing industries and construction | 829.30 | 0.88 | 2.03 | | | | | | 832.21 |
| 3. Transport | 1532.13 | 6.40 | 34.68 | | | | | | 1573.20 |
| 4. Other sectors | 628.34 | 4.02 | 1.50 | | | | | | 633.86 |
| 5. Other | 18.06 | 0.06 | 0.04 | | | | | | 18.17 |
| B. Fugitive emissions from fuels | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 865.80 | NE,NA,NO | 46.91 | 2.70 | | 0.07 | | | 915.46 |
| A. Mineral industry | 852.59 | | | | | | | | 852.59 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 13.17 | NE,NA | NE,NA | | | | | | 13.17 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 2.70 | | | | | 2.70 |
| G. Other product manufacture and use | 0.04 | NE | 46.91 | | | 0.07 | | | 47.01 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 1.38 | 384.79 | 252.83 | | | | | | 639.00 |
| A. Enteric fermentation | | 228.44 | | | | | | | 228.44 |
| B. Manure management | | 156.15 | 87.72 | | | | | | 243.87 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 165.05 | | | | | | 165.05 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.20 | 0.06 | | | | | | 0.26 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 1.38 | | | | | | | | 1.38 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry[(1)]** | -127.34 | 0.54 | 0.36 | | | | | | -126.43 |
| A. Forest land | -127.34 | 0.54 | 0.36 | | | | | | -126.43 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 420.71 | 13.87 | | | | | | 434.58 |
| A. Solid waste disposal | NA,NO | 291.10 | | | | | | | 291.10 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 129.62 | 13.87 | | | | | | 143.48 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:[(2)]** | | | | | | | | | |
| **International bunkers** | 1056.46 | 0.70 | 9.26 | | | | | | 1066.42 |
| Aviation | 773.55 | 0.14 | 6.45 | | | | | | 780.13 |
| Navigation | 282.91 | 0.56 | 2.81 | | | | | | 286.29 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 37.76 | | | | | | | | 37.76 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ [(3)]** | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 7335.01 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 7208.58 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

[(1)] For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

## SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS
**(Sheet 1 of 1)**

Inventory 1997
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)[(1)]** | 6155.11 | 827.43 | 347.36 | 5.21 | | 0.07 | | | 7335.19 |
| **1. Energy** | 5453.52 | 13.40 | 44.77 | | | | | | 5511.69 |
| A. Fuel combustion (sectoral approach) | 5453.52 | 13.40 | 44.77 | | | | | | 5511.69 |
| 1. Energy industries | 2410.95 | 2.34 | 5.49 | | | | | | 2418.77 |
| 2. Manufacturing industries and construction | 772.52 | 0.79 | 1.80 | | | | | | 775.11 |
| 3. Transport | 1598.27 | 6.61 | 35.96 | | | | | | 1640.83 |
| 4. Other sectors | 652.82 | 3.61 | 1.48 | | | | | | 657.91 |
| 5. Other | 18.96 | 0.06 | 0.05 | | | | | | 19.07 |
| B. Fugitive emissions from fuels | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 832.39 | NE,NA,NO | 47.53 | 5.21 | | 0.07 | | | 885.21 |
| A. Mineral industry | 819.39 | | | | | | | | 819.39 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 12.96 | NE,NA | NE,NA | | | | | | 12.96 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 5.21 | | | | | 5.21 |
| G. Other product manufacture and use | 0.04 | NE | 47.53 | | | 0.07 | | | 47.64 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 1.10 | 384.60 | 240.54 | | | | | | 626.24 |
| A. Enteric fermentation | | 223.31 | | | | | | | 223.31 |
| B. Manure management | | 161.02 | 90.70 | | | | | | 251.72 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 149.76 | | | | | | 149.76 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.27 | 0.08 | | | | | | 0.36 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 1.10 | | | | | | | | 1.10 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry[(1)]** | -131.90 | 0.78 | 0.52 | | | | | | -130.60 |
| A. Forest land | -131.90 | 0.78 | 0.52 | | | | | | -130.60 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 428.65 | 14.01 | | | | | | 442.65 |
| A. Solid waste disposal | NA,NO | 297.98 | | | | | | | 297.98 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 130.66 | 14.01 | | | | | | 144.67 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |
| | | | | | | | | | |
| **Memo items:[(2)]** | | | | | | | | | |
| **International bunkers** | 1069.16 | 0.75 | 9.40 | | | | | | 1079.32 |
| Aviation | 761.12 | 0.13 | 6.34 | | | | | | 767.60 |
| Navigation | 308.04 | 0.62 | 3.06 | | | | | | 311.72 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 31.16 | | | | | | | | 31.16 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ [(3)]** | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 7465.80 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 7335.19 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

**SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS**
**(Sheet 1 of 1)**

Inventory 1998
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)**[(1)] | 6466.22 | 832.93 | 373.25 | 10.62 | | 0.07 | | | 7683.09 |
| **1. Energy** | 5793.70 | 14.07 | 46.99 | | | | | | 5854.76 |
| A. Fuel combustion (sectoral approach) | 5793.70 | 14.07 | 46.99 | | | | | | 5854.76 |
| 1. Energy industries | 2643.21 | 2.57 | 6.09 | | | | | | 2651.87 |
| 2. Manufacturing industries and construction | 776.49 | 0.82 | 1.86 | | | | | | 779.16 |
| 3. Transport | 1674.88 | 6.80 | 37.44 | | | | | | 1719.12 |
| 4. Other sectors | 678.93 | 3.81 | 1.56 | | | | | | 684.29 |
| 5. Other | 20.20 | 0.07 | 0.05 | | | | | | 20.31 |
| B. Fugitive emissions from fuels | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 785.74 | NE,NA,NO | 48.07 | 10.62 | | 0.07 | | | 844.49 |
| A. Mineral industry | 776.99 | | | | | | | | 776.99 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 8.70 | NE,NA | NE,NA | | | | | | 8.70 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 10.62 | | | | | 10.62 |
| G. Other product manufacture and use | 0.04 | NE | 48.07 | | | 0.07 | | | 48.18 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 0.84 | 381.46 | 261.96 | | | | | | 644.25 |
| A. Enteric fermentation | | 216.25 | | | | | | | 216.25 |
| B. Manure management | | 164.92 | 90.79 | | | | | | 255.71 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 171.08 | | | | | | 171.08 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.29 | 0.09 | | | | | | 0.38 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 0.84 | | | | | | | | 0.84 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry**[(1)] | -114.05 | 2.66 | 1.75 | | | | | | -109.65 |
| A. Forest land | -114.05 | 2.66 | 1.75 | | | | | | -109.65 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 434.75 | 14.48 | | | | | | 449.23 |
| A. Solid waste disposal | NA,NO | 305.09 | | | | | | | 305.09 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 129.66 | 14.48 | | | | | | 144.14 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** ***(as specified in summary 1.A)*** | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:**[(2)] | | | | | | | | | |
| **International bunkers** | 1110.02 | 0.73 | 10.40 | | | | | | 1121.16 |
| Aviation | 801.51 | 0.14 | 6.68 | | | | | | 808.33 |
| Navigation | 308.52 | 0.59 | 3.72 | | | | | | 312.83 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 34.01 | | | | | | | | 34.01 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$** [(3)] | NE,NO | | | | | | | | |

| | |
|---|---|
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | 7792.73 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | 7683.09 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

**SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS**
**(Sheet 1 of 1)**

Inventory 1999
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)[(1)]** | 6699.94 | 831.11 | 359.52 | 16.97 | | 0.07 | | | 7907.60 |
| **1. Energy** | 6054.67 | 14.61 | 48.52 | | | | | | 6117.80 |
| A. Fuel combustion (sectoral approach) | 6054.67 | 14.61 | 48.52 | | | | | | 6117.80 |
| 1. Energy industries | 2826.94 | 2.75 | 6.40 | | | | | | 2836.09 |
| 2. Manufacturing industries and construction | 802.06 | 0.88 | 1.94 | | | | | | 804.87 |
| 3. Transport | 1718.84 | 7.05 | 38.53 | | | | | | 1764.42 |
| 4. Other sectors | 686.09 | 3.87 | 1.60 | | | | | | 691.55 |
| 5. Other | 20.76 | 0.07 | 0.05 | | | | | | 20.88 |
| B. Fugitive emissions from fuels | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 792.05 | NE,NA,NO | 48.60 | 16.97 | | 0.07 | | | 857.68 |
| A. Mineral industry | 782.35 | | | | | | | | 782.35 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 9.63 | NE,NA | NE,NA | | | | | | 9.63 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 16.97 | | | | | 16.97 |
| G. Other product manufacture and use | 0.06 | NE | 48.60 | | | 0.07 | | | 48.73 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 0.92 | 374.67 | 247.65 | | | | | | 623.23 |
| A. Enteric fermentation | | 214.73 | | | | | | | 214.73 |
| B. Manure management | | 159.62 | 91.03 | | | | | | 250.65 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 156.52 | | | | | | 156.52 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.31 | 0.10 | | | | | | 0.41 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 0.92 | | | | | | | | 0.92 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry[(1)]** | -147.70 | 0.02 | 0.01 | | | | | | -147.67 |
| A. Forest land | -147.70 | 0.02 | 0.01 | | | | | | -147.67 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 441.81 | 14.74 | | | | | | 456.55 |
| A. Solid waste disposal | NA,NO | 312.20 | | | | | | | 312.20 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 129.61 | 14.74 | | | | | | 144.35 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** ***(as specified in summary 1.A)*** | | | | | | | | | |
| | | | | | | | | | |
| **Memo items:[(2)]** | | | | | | | | | |
| **International bunkers** | 1304.43 | 1.10 | 11.74 | | | | | | 1317.26 |
| Aviation | 820.14 | 0.14 | 6.84 | | | | | | 827.12 |
| Navigation | 484.28 | 0.96 | 4.90 | | | | | | 490.14 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 32.96 | | | | | | | | 32.96 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ [(3)]** | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 8055.26 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 7907.60 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

## SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS
**(Sheet 1 of 1)**

Inventory 2000
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ (1) | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)(1)** | 7012.79 | 853.16 | 360.64 | 25.20 | | 0.08 | | | 8251.86 |
| **1. Energy** | 6280.25 | 14.73 | 49.89 | | | | | | 6344.87 |
| A. Fuel combustion (sectoral approach) | 6280.25 | 14.73 | 49.89 | | | | | | 6344.87 |
| 1. Energy industries | 2954.60 | 2.87 | 6.70 | | | | | | 2964.18 |
| 2. Manufacturing industries and construction | 818.73 | 0.99 | 2.14 | | | | | | 821.86 |
| 3. Transport | 1760.10 | 7.17 | 39.35 | | | | | | 1806.62 |
| 4. Other sectors | 725.39 | 3.62 | 1.64 | | | | | | 730.66 |
| 5. Other | 21.43 | 0.07 | 0.05 | | | | | | 21.55 |
| B. Fugitive emissions from fuels | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 813.99 | NE,NA,NO | 49.11 | 25.20 | | 0.08 | | | 888.38 |
| A. Mineral industry | 802.92 | | | | | | | | 802.92 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 10.96 | NE,NA | NE,NA | | | | | | 10.96 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 25.20 | | | | | 25.20 |
| G. Other product manufacture and use | 0.12 | NE | 49.11 | | | 0.08 | | | 49.30 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 1.67 | 382.37 | 243.31 | | | | | | 627.36 |
| A. Enteric fermentation | | 224.21 | | | | | | | 224.21 |
| B. Manure management | | 157.89 | 93.09 | | | | | | 250.97 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 150.14 | | | | | | 150.14 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.28 | 0.09 | | | | | | 0.36 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 1.67 | | | | | | | | 1.67 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry(1)** | -83.13 | 5.71 | 3.76 | | | | | | -73.66 |
| A. Forest land | -83.13 | 5.71 | 3.76 | | | | | | -73.66 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 450.35 | 14.56 | | | | | | 464.91 |
| A. Solid waste disposal | NA,NO | 319.38 | | | | | | | 319.38 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 130.98 | 14.56 | | | | | | 145.54 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** ***(as specified in summary 1.A)*** | | | | | | | | | |

| | $CO_2$ | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:(2)** | | | | | | | | | |
| **International bunkers** | 1439.04 | 1.37 | 12.88 | | | | | | 1453.29 |
| Aviation | 832.57 | 0.15 | 6.94 | | | | | | 839.66 |
| Navigation | 606.47 | 1.22 | 5.94 | | | | | | 613.63 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 29.16 | | | | | | | | 29.16 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ (3)** | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 8325.52 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 8251.86 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

## SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS
**(Sheet 1 of 1)**

Inventory 2001
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)[(1)]** | 6831.41 | 889.50 | 388.81 | 36.55 | | 0.08 | | | 8146.35 |
| **1. Energy** | 6170.36 | 15.01 | 51.38 | | | | | | 6236.74 |
| A. Fuel combustion (sectoral approach) | 6170.36 | 15.01 | 51.38 | | | | | | 6236.74 |
| 1. Energy industries | 2837.28 | 2.75 | 6.58 | | | | | | 2846.61 |
| 2. Manufacturing industries and construction | 764.83 | 0.99 | 2.10 | | | | | | 767.91 |
| 3. Transport | 1818.08 | 7.55 | 40.99 | | | | | | 1866.62 |
| 4. Other sectors | 728.51 | 3.65 | 1.66 | | | | | | 733.82 |
| 5. Other | 21.65 | 0.07 | 0.05 | | | | | | 21.78 |
| B. Fugitive emissions from fuels | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 798.93 | NE,NA,NO | 49.68 | 36.55 | | 0.08 | | | 885.24 |
| A. Mineral industry | 786.89 | | | | | | | | 786.89 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 12.00 | NE,NA | NE,NA | | | | | | 12.00 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 36.55 | | | | | 36.55 |
| G. Other product manufacture and use | 0.04 | NE | 49.68 | | | 0.08 | | | 49.79 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 0.17 | 413.27 | 271.75 | | | | | | 685.19 |
| A. Enteric fermentation | | 239.91 | | | | | | | 239.91 |
| B. Manure management | | 173.13 | 99.82 | | | | | | 272.95 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 171.85 | | | | | | 171.85 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.23 | 0.07 | | | | | | 0.30 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 0.17 | | | | | | | | 0.17 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry[(1)]** | -138.04 | 1.90 | 1.25 | | | | | | -134.88 |
| A. Forest land | -138.04 | 1.90 | 1.25 | | | | | | -134.88 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 459.32 | 14.75 | | | | | | 474.07 |
| A. Solid waste disposal | NA,NO | 326.74 | | | | | | | 326.74 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 132.58 | 14.75 | | | | | | 147.33 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |
| | | | | | | | | | |
| **Memo items:[(2)]** | | | | | | | | | |
| **International bunkers** | 1578.64 | 1.39 | 13.97 | | | | | | 1594.01 |
| Aviation | 975.48 | 0.17 | 8.13 | | | | | | 983.78 |
| Navigation | 603.17 | 1.22 | 5.84 | | | | | | 610.23 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 32.26 | | | | | | | | 32.26 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ [(3)]** | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 8281.24 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 8146.35 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

**SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS**
**(Sheet 1 of 1)**

Inventory 2002
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)[(1)]** | 6992.45 | 921.31 | 389.98 | 47.77 | | 0.08 | | | 8351.59 |
| **1. Energy** | 6327.64 | 15.62 | 52.10 | | | | | | 6395.36 |
| A. Fuel combustion (sectoral approach) | 6327.64 | 15.62 | 52.10 | | | | | | 6395.36 |
| 1. Energy industries | 2998.47 | 2.90 | 7.00 | | | | | | 3008.37 |
| 2. Manufacturing industries and construction | 775.29 | 1.00 | 2.12 | | | | | | 778.42 |
| 3. Transport | 1800.54 | 7.74 | 41.26 | | | | | | 1849.55 |
| 4. Other sectors | 732.57 | 3.91 | 1.67 | | | | | | 738.15 |
| 5. Other | 20.76 | 0.07 | 0.05 | | | | | | 20.88 |
| B. Fugitive emissions from fuels | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 832.32 | NE,NA,NO | 50.21 | 47.77 | | 0.08 | | | 930.39 |
| A. Mineral industry | 819.31 | | | | | | | | 819.31 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 12.97 | NE,NA | NE,NA | | | | | | 12.97 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 47.77 | | | | | 47.77 |
| G. Other product manufacture and use | 0.03 | NE | 50.21 | | | 0.08 | | | 50.33 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 0.42 | 439.20 | 272.79 | | | | | | 712.41 |
| A. Enteric fermentation | | 251.64 | | | | | | | 251.64 |
| B. Manure management | | 187.31 | 104.83 | | | | | | 292.14 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 167.89 | | | | | | 167.89 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.24 | 0.07 | | | | | | 0.31 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 0.42 | | | | | | | | 0.42 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry[(1)]** | -167.93 | 0.05 | 0.04 | | | | | | -167.84 |
| A. Forest land | -167.93 | 0.05 | 0.04 | | | | | | -167.84 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 466.43 | 14.83 | | | | | | 481.27 |
| A. Solid waste disposal | NA,NO | 334.81 | | | | | | | 334.81 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 131.62 | 14.83 | | | | | | 146.45 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** ***(as specified in summary 1.A)*** | | | | | | | | | |
| | | | | | | | | | |
| **Memo items:[(2)]** | | | | | | | | | |
| **International bunkers** | 1371.67 | 1.04 | 12.75 | | | | | | 1385.47 |
| Aviation | 938.20 | 0.16 | 7.82 | | | | | | 946.18 |
| Navigation | 433.48 | 0.88 | 4.93 | | | | | | 439.29 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 40.56 | | | | | | | | 40.56 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ [(3)]** | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 8519.43 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 8351.59 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

[(1)] For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS

(Sheet 1 of 1)

Inventory 2003
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)[(1)]** | 7378.30 | 917.94 | 387.89 | 59.40 | | 0.09 | | | 8743.62 |
| **1. Energy** | 6713.26 | 16.70 | 55.68 | | | | | | 6785.63 |
| A. Fuel combustion (sectoral approach) | 6713.26 | 16.70 | 55.68 | | | | | | 6785.63 |
| 1. Energy industries | 3224.91 | 3.12 | 7.30 | | | | | | 3235.33 |
| 2. Manufacturing industries and construction | 802.63 | 1.13 | 2.34 | | | | | | 806.11 |
| 3. Transport | 1907.06 | 8.45 | 44.28 | | | | | | 1959.79 |
| 4. Other sectors | 757.33 | 3.92 | 1.70 | | | | | | 762.96 |
| 5. Other | 21.32 | 0.07 | 0.05 | | | | | | 21.44 |
| B. Fugitive emissions from fuels | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 836.08 | NE,NA,NO | 50.87 | 59.40 | | 0.09 | | | 946.44 |
| A. Mineral industry | 821.77 | | | | | | | | 821.77 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 14.29 | NE,NA | NE,NA | | | | | | 14.29 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 59.40 | | | | | 59.40 |
| G. Other product manufacture and use | 0.02 | NE | 50.87 | | | 0.09 | | | 50.98 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 0.73 | 430.60 | 266.98 | | | | | | 698.31 |
| A. Enteric fermentation | | 244.59 | | | | | | | 244.59 |
| B. Manure management | | 185.73 | 99.50 | | | | | | 285.22 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 167.40 | | | | | | 167.40 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.28 | 0.09 | | | | | | 0.36 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 0.73 | | | | | | | | 0.73 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry[(1)]** | -171.77 | 0.24 | 0.16 | | | | | | -171.37 |
| A. Forest land | -171.77 | 0.24 | 0.16 | | | | | | -171.37 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 470.41 | 14.21 | | | | | | 484.62 |
| A. Solid waste disposal | NA,NO | 343.01 | | | | | | | 343.01 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 127.40 | 14.21 | | | | | | 141.60 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:[(2)]** | | | | | | | | | |
| **International bunkers** | 1393.31 | 0.95 | 12.28 | | | | | | 1406.55 |
| Aviation | 1003.43 | 0.18 | 8.36 | | | | | | 1011.97 |
| Navigation | 389.88 | 0.77 | 3.92 | | | | | | 394.57 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 51.96 | | | | | | | | 51.96 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ [(3)]** | NE,NO | | | | | | | | |

| | |
|---|---|
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | 8914.99 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | 8743.62 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

## SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS
**(Sheet 1 of 1)**

Inventory 2004
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)**[(1)] | 7604.53 | 915.17 | 379.51 | 77.60 | | 0.10 | | | 8976.92 |
| **1. Energy** | 6872.89 | 17.62 | 59.45 | | | | | | 6949.96 |
| A. Fuel combustion (sectoral approach) | 6872.89 | 17.62 | 59.45 | | | | | | 6949.96 |
| 1. Energy industries | 3283.44 | 3.21 | 7.76 | | | | | | 3294.41 |
| 2. Manufacturing industries and construction | 880.45 | 1.19 | 2.49 | | | | | | 884.13 |
| 3. Transport | 2007.42 | 9.29 | 47.62 | | | | | | 2064.33 |
| 4. Other sectors | 681.20 | 3.77 | 1.52 | | | | | | 686.49 |
| 5. Other | 20.39 | 0.15 | 0.05 | | | | | | 20.59 |
| B. Fugitive emissions from fuels | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | 0.00 | NE,NO | | | | | | 0.00 |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 903.06 | NE,NA,NO | 51.61 | 77.60 | | 0.10 | | | 1032.37 |
| A. Mineral industry | 885.26 | | | | | | | | 885.26 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 17.76 | NE,NA | NE,NA | | | | | | 17.76 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 77.60 | | | | | 77.60 |
| G. Other product manufacture and use | 0.04 | NE | 51.61 | | | 0.10 | | | 51.75 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 0.95 | 422.28 | 253.72 | | | | | | 676.94 |
| A. Enteric fermentation | | 242.82 | | | | | | | 242.82 |
| B. Manure management | | 179.19 | 94.68 | | | | | | 273.87 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 158.95 | | | | | | 158.95 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.27 | 0.08 | | | | | | 0.35 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 0.95 | | | | | | | | 0.95 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry**[(1)] | -172.36 | 0.46 | 0.30 | | | | | | -171.60 |
| A. Forest land | -172.36 | 0.46 | 0.30 | | | | | | -171.60 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 474.81 | 14.44 | | | | | | 489.25 |
| A. Solid waste disposal | NA,NO | 351.36 | | | | | | | 351.36 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 123.46 | 14.44 | | | | | | 137.89 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |
| | | | | | | | | | |
| **Memo items:**[(2)] | | | | | | | | | |
| **International bunkers** | 1086.91 | 0.46 | 9.64 | | | | | | 1097.01 |
| Aviation | 916.45 | 0.16 | 7.64 | | | | | | 924.25 |
| Navigation | 170.46 | 0.30 | 2.00 | | | | | | 172.76 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 46.41 | | | | | | | | 46.41 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$** [(3)] | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 9148.52 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 8976.92 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

## SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS
**(Sheet 1 of 1)**

Inventory 2005
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$[(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)[(1)]** | 7782.49 | 894.40 | 353.88 | 103.28 | | 0.12 | | | 9134.18 |
| **1. Energy** | 7048.90 | 18.39 | 61.39 | | | | | | 7128.69 |
| A. Fuel combustion (sectoral approach) | 7048.90 | 18.39 | 61.39 | | | | | | 7128.69 |
| 1. Energy industries | 3471.84 | 3.40 | 8.05 | | | | | | 3483.29 |
| 2. Manufacturing industries and construction | 908.28 | 1.21 | 2.54 | | | | | | 912.04 |
| 3. Transport | 2045.15 | 9.84 | 49.39 | | | | | | 2104.38 |
| 4. Other sectors | 604.60 | 3.79 | 1.36 | | | | | | 609.75 |
| 5. Other | 19.03 | 0.15 | 0.05 | | | | | | 19.23 |
| B. Fugitive emissions from fuels | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 912.11 | NE,NA,NO | 52.36 | 103.28 | | 0.12 | | | 1067.86 |
| A. Mineral industry | 894.48 | | | | | | | | 894.48 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 17.60 | NE,NA | NE,NA | | | | | | 17.60 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 103.28 | | | | | 103.28 |
| G. Other product manufacture and use | 0.03 | NE | 52.36 | | | 0.12 | | | 52.51 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 0.97 | 393.41 | 225.76 | | | | | | 620.14 |
| A. Enteric fermentation | | 228.47 | | | | | | | 228.47 |
| B. Manure management | | 164.77 | 87.49 | | | | | | 252.25 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 138.22 | | | | | | 138.22 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.18 | 0.05 | | | | | | 0.23 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 0.97 | | | | | | | | 0.97 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry[(1)]** | -179.48 | 0.15 | 0.10 | | | | | | -179.22 |
| A. Forest land | -179.48 | 0.15 | 0.10 | | | | | | -179.22 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 482.44 | 14.27 | | | | | | 496.71 |
| A. Solid waste disposal | NA,NO | 359.91 | | | | | | | 359.91 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 122.54 | 14.27 | | | | | | 136.81 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** ***(as specified in summary 1.A)*** | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:[(2)]** | | | | | | | | | |
| **International bunkers** | 1762.63 | 2.02 | 15.81 | | | | | | 1780.46 |
| Aviation | 845.58 | 0.15 | 7.05 | | | | | | 852.78 |
| Navigation | 917.05 | 1.87 | 8.77 | | | | | | 927.69 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 44.12 | | | | | | | | 44.12 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$[(3)]** | NE,NO | | | | | | | | |

| | |
|---|---|
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | 9313.40 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | 9134.18 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

## SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS

**(Sheet 1 of 1)**



| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)** [(1)] | 7972.28 | 903.42 | 369.87 | 156.10 | | 0.12 | | | 9401.78 |
| **1. Energy** | 7228.89 | 19.22 | 63.44 | | | | | | 7311.54 |
| A. Fuel combustion (sectoral approach) | 7228.89 | 19.22 | 63.44 | | | | | | 7311.54 |
| 1. Energy industries | 3653.38 | 3.48 | 8.34 | | | | | | 3665.20 |
| 2. Manufacturing industries and construction | 865.33 | 1.13 | 3.15 | | | | | | 869.62 |
| 3. Transport | 2031.33 | 10.30 | 50.37 | | | | | | 2091.99 |
| 4. Other sectors | 664.90 | 4.14 | 1.53 | | | | | | 670.57 |
| 5. Other | 13.95 | 0.17 | 0.04 | | | | | | 14.16 |
| B. Fugitive emissions from fuels | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 922.43 | NE,NA,NO | 53.34 | 156.10 | | 0.12 | | | 1132.00 |
| A. Mineral industry | 902.66 | | | | | | | | 902.66 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 19.75 | NE,NA | NE,NA | | | | | | 19.75 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 156.10 | | | | | 156.10 |
| G. Other product manufacture and use | 0.02 | NE | 53.34 | | | 0.12 | | | 53.48 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 1.17 | 402.24 | 238.73 | | | | | | 642.14 |
| A. Enteric fermentation | | 229.93 | | | | | | | 229.93 |
| B. Manure management | | 172.14 | 85.51 | | | | | | 257.64 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 153.17 | | | | | | 153.17 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.17 | 0.05 | | | | | | 0.22 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 1.17 | | | | | | | | 1.17 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry** [(1)] | -180.21 | 0.37 | 0.25 | | | | | | -179.59 |
| A. Forest land | -180.21 | 0.37 | 0.25 | | | | | | -179.59 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NE,NA,NO | 481.59 | 14.11 | | | | | | 495.69 |
| A. Solid waste disposal | NE,NA | 368.39 | | | | | | | 368.39 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 113.20 | 14.11 | | | | | | 127.30 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** ***(as specified in summary 1.A)*** | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:** [(2)] | | | | | | | | | |
| **International bunkers** | 1782.26 | 1.94 | 18.33 | | | | | | 1802.53 |
| Aviation | 850.39 | 0.15 | 7.09 | | | | | | 857.63 |
| Navigation | 931.87 | 1.79 | 11.24 | | | | | | 944.90 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 49.02 | | | | | | | | 49.02 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$** [(3)] | NE,NO | | | | | | | | |

| | |
|---|---|
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | 9581.37 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | 9401.78 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

**SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS**
**(Sheet 1 of 1)**

Inventory 2007
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)**[(1)] | 8341.17 | 922.49 | 366.32 | 182.93 | | 0.14 | | | 9813.06 |
| **1. Energy** | 7544.83 | 21.00 | 67.10 | | | | | | 7632.93 |
| A. Fuel combustion (sectoral approach) | 7544.83 | 21.00 | 67.10 | | | | | | 7632.93 |
| 1. Energy industries | 3801.67 | 3.63 | 8.64 | | | | | | 3813.94 |
| 2. Manufacturing industries and construction | 923.04 | 1.34 | 2.74 | | | | | | 927.12 |
| 3. Transport | 2163.78 | 11.16 | 54.16 | | | | | | 2229.10 |
| 4. Other sectors | 636.02 | 4.71 | 1.52 | | | | | | 642.25 |
| 5. Other | 20.32 | 0.15 | 0.05 | | | | | | 20.53 |
| B. Fugitive emissions from fuels | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 912.72 | NE,NA,NO | 54.62 | 182.93 | | 0.14 | | | 1150.41 |
| A. Mineral industry | 894.20 | | | | | | | | 894.20 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 18.50 | NE,NA | NE,NA | | | | | | 18.50 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 182.93 | | | | | 182.93 |
| G. Other product manufacture and use | 0.02 | NE | 54.62 | | | 0.14 | | | 54.78 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 1.11 | 411.93 | 227.01 | | | | | | 640.04 |
| A. Enteric fermentation | | 234.63 | | | | | | | 234.63 |
| B. Manure management | | 177.15 | 87.85 | | | | | | 264.99 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 139.11 | | | | | | 139.11 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.16 | 0.05 | | | | | | 0.20 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 1.11 | | | | | | | | 1.11 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry**[(1)] | -117.48 | 3.47 | 2.29 | | | | | | -111.72 |
| A. Forest land | -117.48 | 3.47 | 2.29 | | | | | | -111.72 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 486.09 | 15.29 | | | | | | 501.38 |
| A. Solid waste disposal | NA,NO | 377.88 | | | | | | | 377.88 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 108.21 | 15.29 | | | | | | 123.50 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** ***(as specified in summary 1.A)*** | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:**[(2)] | | | | | | | | | |
| **International bunkers** | 1702.69 | 1.79 | 16.29 | | | | | | 1720.77 |
| Aviation | 836.61 | 0.15 | 6.97 | | | | | | 843.73 |
| Navigation | 866.09 | 1.65 | 9.32 | | | | | | 877.05 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 72.36 | | | | | | | | 72.36 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$** [(3)] | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 9924.78 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 9813.06 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

**SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS**
**(Sheet 1 of 1)**

Inventory 2008
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)[(1)]** | 8459.66 | 919.22 | 353.66 | 216.65 | | 0.15 | | | 9949.33 |
| **1. Energy** | 7707.43 | 21.94 | 70.23 | | | | | | 7799.59 |
| A. Fuel combustion (sectoral approach) | 7707.43 | 21.94 | 70.23 | | | | | | 7799.59 |
| 1. Energy industries | 3967.29 | 3.80 | 8.94 | | | | | | 3980.03 |
| 2. Manufacturing industries and construction | 900.33 | 1.35 | 2.73 | | | | | | 904.41 |
| 3. Transport | 2205.49 | 11.77 | 57.00 | | | | | | 2274.26 |
| 4. Other sectors | 591.69 | 4.79 | 1.45 | | | | | | 597.94 |
| 5. Other | 42.62 | 0.23 | 0.11 | | | | | | 42.96 |
| B. Fugitive emissions from fuels | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 912.42 | NE,NA,NO | 56.08 | 216.65 | | 0.15 | | | 1185.31 |
| A. Mineral industry | 896.05 | | | | | | | | 896.05 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 16.35 | NE,NA | NE,NA | | | | | | 16.35 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 216.65 | | | | | 216.65 |
| G. Other product manufacture and use | 0.02 | NE | 56.08 | | | 0.15 | | | 56.26 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 0.54 | 401.34 | 211.39 | | | | | | 613.26 |
| A. Enteric fermentation | | 226.19 | | | | | | | 226.19 |
| B. Manure management | | 175.02 | 81.88 | | | | | | 256.89 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 129.47 | | | | | | 129.47 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.14 | 0.04 | | | | | | 0.18 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 0.54 | | | | | | | | 0.54 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry[(1)]** | -160.73 | 0.12 | 0.08 | | | | | | -160.53 |
| A. Forest land | -160.73 | 0.12 | 0.08 | | | | | | -160.53 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 495.82 | 15.88 | | | | | | 511.70 |
| A. Solid waste disposal | NA,NO | 387.17 | | | | | | | 387.17 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 108.66 | 15.88 | | | | | | 124.53 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |

| Memo items:[(2)] | $CO_2$ | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| **International bunkers** | 1663.84 | 1.69 | 16.80 | | | | | | 1682.33 |
| Aviation | 867.50 | 0.15 | 7.23 | | | | | | 874.89 |
| Navigation | 796.34 | 1.54 | 9.56 | | | | | | 807.44 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 132.79 | | | | | | | | 132.79 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ [(3)]** | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 10109.86 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 9949.33 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

**SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS**
**(Sheet 1 of 1)**

Inventory 2009
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [1] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)[1]** | 8194.33 | 921.47 | 351.78 | 249.22 | | 0.16 | | | 9716.96 |
| **1. Energy** | 7631.28 | 22.55 | 70.91 | | | | | | 7724.74 |
| A. Fuel combustion (sectoral approach) | 7631.28 | 22.55 | 70.91 | | | | | | 7724.74 |
| 1. Energy industries | 3992.47 | 3.85 | 9.24 | | | | | | 4005.56 |
| 2. Manufacturing industries and construction | 795.92 | 1.18 | 2.38 | | | | | | 799.49 |
| 3. Transport | 2205.81 | 12.01 | 57.62 | | | | | | 2275.44 |
| 4. Other sectors | 616.80 | 5.35 | 1.62 | | | | | | 623.76 |
| 5. Other | 20.29 | 0.15 | 0.05 | | | | | | 20.49 |
| B. Fugitive emissions from fuels | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 739.97 | NE,NA,NO | 57.66 | 249.22 | | 0.16 | | | 1047.01 |
| A. Mineral industry | 724.20 | | | | | | | | 724.20 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 15.75 | NE,NA | NE,NA | | | | | | 15.75 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 249.22 | | | | | 249.22 |
| G. Other product manufacture and use | 0.02 | NE | 57.66 | | | 0.16 | | | 57.85 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 1.14 | 399.70 | 207.30 | | | | | | 608.14 |
| A. Enteric fermentation | | 225.56 | | | | | | | 225.56 |
| B. Manure management | | 173.99 | 78.88 | | | | | | 252.87 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 128.37 | | | | | | 128.37 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.16 | 0.05 | | | | | | 0.20 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 1.14 | | | | | | | | 1.14 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry[1]** | -178.06 | 0.20 | 0.13 | | | | | | -177.73 |
| A. Forest land | -178.06 | 0.20 | 0.13 | | | | | | -177.73 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 499.02 | 15.78 | | | | | | 514.80 |
| A. Solid waste disposal | NA,NO | 397.14 | | | | | | | 397.14 |
| B. Biological treatment of solid waste | | NO | NO | | | | | | NO |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 101.88 | 15.78 | | | | | | 117.66 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:[2]** | | | | | | | | | |
| **International bunkers** | 1507.86 | 1.48 | 13.99 | | | | | | 1523.33 |
| Aviation | 818.73 | 0.14 | 6.82 | | | | | | 825.69 |
| Navigation | 689.14 | 1.34 | 7.16 | | | | | | 697.64 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 148.46 | | | | | | | | 148.46 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ [3]** | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 9894.70 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 9716.96 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

[1] For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

**SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS**
**(Sheet 1 of 1)**

Inventory 2010
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [1] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)[1]** | 7837.64 | 942.32 | 370.35 | 280.66 | | 0.15 | | | 9431.12 |
| **1. Energy** | 7402.01 | 21.43 | 71.42 | | | | | | 7494.87 |
| A. Fuel combustion (sectoral approach) | 7402.01 | 21.43 | 71.42 | | | | | | 7494.87 |
| 1. Energy industries | 3868.00 | 3.73 | 8.94 | | | | | | 3880.67 |
| 2. Manufacturing industries and construction | 697.26 | 1.17 | 2.29 | | | | | | 700.71 |
| 3. Transport | 2253.25 | 12.24 | 58.81 | | | | | | 2324.30 |
| 4. Other sectors | 563.22 | 4.15 | 1.33 | | | | | | 568.70 |
| 5. Other | 20.29 | 0.15 | 0.05 | | | | | | 20.49 |
| B. Fugitive emissions from fuels | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 602.16 | NE,NA,NO | 59.09 | 280.66 | | 0.15 | | | 942.06 |
| A. Mineral industry | 584.95 | | | | | | | | 584.95 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 17.19 | NE,NA | NE,NA | | | | | | 17.19 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 280.66 | | | | | 280.66 |
| G. Other product manufacture and use | 0.02 | NE | 59.09 | | | 0.15 | | | 59.27 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 0.74 | 409.98 | 222.38 | | | | | | 633.10 |
| A. Enteric fermentation | | 235.35 | | | | | | | 235.35 |
| B. Manure management | | 174.42 | 80.80 | | | | | | 255.23 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 141.52 | | | | | | 141.52 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.21 | 0.06 | | | | | | 0.27 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 0.74 | | | | | | | | 0.74 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry[1]** | -167.26 | 0.74 | 0.49 | | | | | | -166.03 |
| A. Forest land | -167.26 | 0.74 | 0.49 | | | | | | -166.03 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 510.16 | 16.96 | | | | | | 527.12 |
| A. Solid waste disposal | NA,NO | 407.48 | | | | | | | 407.48 |
| B. Biological treatment of solid waste | | 0.79 | 0.57 | | | | | | 1.36 |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 101.89 | 16.39 | | | | | | 118.29 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** ***(as specified in summary 1.A)*** | | | | | | | | | |

| | $CO_2$ | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:[2]** | | | | | | | | | |
| **International bunkers** | 1423.68 | 1.32 | 13.81 | | | | | | 1438.81 |
| Aviation | 835.79 | 0.15 | 6.97 | | | | | | 842.90 |
| Navigation | 587.89 | 1.17 | 6.85 | | | | | | 595.90 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 142.57 | | | | | | | | 142.57 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ [3]** | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 9597.15 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 9431.12 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

[1] For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

## SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS

**(Sheet 1 of 1)**

Inventory 2011
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)** [(1)] | 7526.79 | 951.32 | 355.73 | 313.24 | | 0.15 | | | 9147.24 |
| **1. Energy** | 7111.28 | 21.36 | 69.32 | | | | | | 7201.96 |
| A. Fuel combustion (sectoral approach) | 7111.28 | 21.36 | 69.32 | | | | | | 7201.96 |
| 1. Energy industries | 3710.04 | 3.60 | 8.64 | | | | | | 3722.28 |
| 2. Manufacturing industries and construction | 579.91 | 0.82 | 1.68 | | | | | | 582.41 |
| 3. Transport | 2181.59 | 12.04 | 57.45 | | | | | | 2251.08 |
| 4. Other sectors | 613.11 | 4.73 | 1.48 | | | | | | 619.33 |
| 5. Other | 26.63 | 0.18 | 0.07 | | | | | | 26.87 |
| B. Fugitive emissions from fuels | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 584.48 | NE,NA,NO | 60.67 | 313.24 | | 0.15 | | | 958.54 |
| A. Mineral industry | 572.05 | | | | | | | | 572.05 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 12.41 | NE,NA | NE,NA | | | | | | 12.41 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 313.24 | | | | | 313.24 |
| G. Other product manufacture and use | 0.02 | NE | 60.67 | | | 0.15 | | | 60.84 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 0.91 | 407.27 | 207.69 | | | | | | 615.87 |
| A. Enteric fermentation | | 241.14 | | | | | | | 241.14 |
| B. Manure management | | 165.84 | 79.64 | | | | | | 245.48 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 127.96 | | | | | | 127.96 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.29 | 0.09 | | | | | | 0.37 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 0.91 | | | | | | | | 0.91 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry** [(1)] | -169.87 | 0.60 | 0.40 | | | | | | -168.87 |
| A. Forest land | -169.87 | 0.60 | 0.40 | | | | | | -168.87 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 522.08 | 17.65 | | | | | | 539.73 |
| A. Solid waste disposal | NA,NO | 420.62 | | | | | | | 420.62 |
| B. Biological treatment of solid waste | | 1.50 | 1.07 | | | | | | 2.57 |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 99.97 | 16.58 | | | | | | 116.55 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |
| | | | | | | | | | |
| **Memo items:** [(2)] | | | | | | | | | |
| **International bunkers** | 1487.14 | 1.39 | 13.48 | | | | | | 1502.00 |
| Aviation | 861.43 | 0.15 | 7.18 | | | | | | 868.76 |
| Navigation | 625.71 | 1.24 | 6.29 | | | | | | 633.24 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 157.83 | | | | | | | | 157.83 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$** [(3)] | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 9316.11 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 9147.24 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

**SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS**
**(Sheet 1 of 1)**



| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)[(1)]** | 7000.08 | 933.51 | 347.85 | 356.67 | | 0.16 | | | 8638.26 |
| **1. Energy** | 6624.15 | 20.35 | 64.57 | | | | | | 6709.07 |
| A. Fuel combustion (sectoral approach) | 6624.15 | 20.35 | 64.57 | | | | | | 6709.07 |
| 1. Energy industries | 3545.93 | 3.43 | 8.05 | | | | | | 3557.40 |
| 2. Manufacturing industries and construction | 456.89 | 0.43 | 0.98 | | | | | | 458.30 |
| 3. Transport | 2010.19 | 11.50 | 54.02 | | | | | | 2075.72 |
| 4. Other sectors | 590.86 | 4.84 | 1.46 | | | | | | 597.15 |
| 5. Other | 20.29 | 0.15 | 0.05 | | | | | | 20.49 |
| B. Fugitive emissions from fuels | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 539.39 | NE,NA,NO | 60.94 | 356.67 | | 0.16 | | | 957.16 |
| A. Mineral industry | 527.75 | | | | | | | | 527.75 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 11.62 | NE,NA | NE,NA | | | | | | 11.62 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 356.67 | | | | | 356.67 |
| G. Other product manufacture and use | 0.02 | NE | 60.94 | | | 0.16 | | | 61.12 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 0.55 | 385.70 | 203.66 | | | | | | 589.91 |
| A. Enteric fermentation | | 235.17 | | | | | | | 235.17 |
| B. Manure management | | 150.30 | 73.26 | | | | | | 223.57 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 130.32 | | | | | | 130.32 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.23 | 0.07 | | | | | | 0.30 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 0.55 | | | | | | | | 0.55 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry[(1)]** | -164.01 | 0.66 | 0.43 | | | | | | -162.92 |
| A. Forest land | -164.01 | 0.66 | 0.43 | | | | | | -162.92 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 526.80 | 18.26 | | | | | | 545.06 |
| A. Solid waste disposal | NA,NO | 432.90 | | | | | | | 432.90 |
| B. Biological treatment of solid waste | | 2.30 | 1.64 | | | | | | 3.94 |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 91.61 | 16.62 | | | | | | 108.22 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:[(2)]** | | | | | | | | | |
| **International bunkers** | 1452.28 | 1.34 | 14.39 | | | | | | 1468.01 |
| Aviation | 832.18 | 0.15 | 6.94 | | | | | | 839.26 |
| Navigation | 620.11 | 1.19 | 7.45 | | | | | | 628.75 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 133.96 | | | | | | | | 133.96 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ [(3)]** | NE,NO | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 8801.19 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 8638.26 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

**SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS**
**(Sheet 1 of 1)**

Inventory 2013
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ (1) | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)(1)** | 6314.71 | 913.77 | 320.88 | 363.98 | | 0.15 | | | 7913.48 |
| **1. Energy** | 5711.65 | 18.43 | 58.49 | | | | | | 5788.58 |
| A. Fuel combustion (sectoral approach) | 5711.65 | 18.43 | 58.49 | | | | | | 5788.58 |
| 1. Energy industries | 2829.73 | 2.73 | 6.56 | | | | | | 2839.01 |
| 2. Manufacturing industries and construction | 537.46 | 0.50 | 1.14 | | | | | | 539.10 |
| 3. Transport | 1808.42 | 10.69 | 49.48 | | | | | | 1868.60 |
| 4. Other sectors | 512.60 | 4.35 | 1.26 | | | | | | 518.21 |
| 5. Other | 23.44 | 0.17 | 0.06 | | | | | | 23.66 |
| B. Fugitive emissions from fuels | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | NO,NE | NE,NO | | | | | | NO,NE |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 774.80 | NE,NA,NO | 60.37 | 363.98 | | 0.15 | | | 1199.30 |
| A. Mineral industry | 765.27 | | | | | | | | 765.27 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 9.52 | NE,NA | NE,NA | | | | | | 9.52 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 363.98 | | | | | 363.98 |
| G. Other product manufacture and use | 0.02 | NE | 60.37 | | | 0.15 | | | 60.54 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 0.79 | 362.08 | 184.00 | | | | | | 546.87 |
| A. Enteric fermentation | | 224.23 | | | | | | | 224.23 |
| B. Manure management | | 137.67 | 67.81 | | | | | | 205.48 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 116.13 | | | | | | 116.13 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.19 | 0.06 | | | | | | 0.24 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 0.79 | | | | | | | | 0.79 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry(1)** | -172.54 | 0.22 | 0.15 | | | | | | -172.17 |
| A. Forest land | -172.54 | 0.22 | 0.15 | | | | | | -172.17 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | NO | NO | NO | | | | | | NO |
| **5. Waste** | NA,NO | 533.03 | 17.87 | | | | | | 550.90 |
| A. Solid waste disposal | NA,NO | 446.19 | | | | | | | 446.19 |
| B. Biological treatment of solid waste | | 1.96 | 1.40 | | | | | | 3.37 |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 84.88 | 16.46 | | | | | | 101.34 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** ***(as specified in summary 1.A)*** | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:(2)** | | | | | | | | | |
| **International bunkers** | 1531.23 | 1.59 | 14.40 | | | | | | 1547.22 |
| Aviation | 775.83 | 0.14 | 6.47 | | | | | | 782.44 |
| Navigation | 755.40 | 1.46 | 7.93 | | | | | | 764.78 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 127.60 | | | | | | | | 127.60 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$ (3)** | NE,NO | | | | | | | | |

| | |
|---|---|
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | 8085.65 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | 7913.48 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

**SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS**
**(Sheet 1 of 1)**

Inventory 2014
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)** [(1)] | 6704.74 | 911.43 | 314.72 | 359.31 | | 0.15 | | | 8290.35 |
| **1. Energy** | 5882.93 | 18.20 | 57.91 | | | | | | 5959.03 |
| A. Fuel combustion (sectoral approach) | 5882.93 | 18.20 | 57.91 | | | | | | 5959.03 |
| 1. Energy industries | 2940.32 | 2.83 | 6.85 | | | | | | 2950.00 |
| 2. Manufacturing industries and construction | 690.47 | 0.99 | 1.98 | | | | | | 693.44 |
| 3. Transport | 1760.88 | 10.42 | 47.90 | | | | | | 1819.20 |
| 4. Other sectors | 456.28 | 3.85 | 1.08 | | | | | | 461.21 |
| 5. Other | 34.98 | 0.12 | 0.09 | | | | | | 35.19 |
| B. Fugitive emissions from fuels | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 995.03 | NE,NA,NO | 59.63 | 359.31 | | 0.15 | | | 1414.12 |
| A. Mineral industry | 985.87 | | | | | | | | 985.87 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 9.16 | NE,NA | NE,NA | | | | | | 9.16 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 359.31 | | | | | 359.31 |
| G. Other product manufacture and use | 0.01 | NE | 59.63 | | | 0.15 | | | 59.78 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 0.41 | 355.56 | 178.65 | | | | | | 534.61 |
| A. Enteric fermentation | | 222.73 | | | | | | | 222.73 |
| B. Manure management | | 132.66 | 66.47 | | | | | | 199.13 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 112.13 | | | | | | 112.13 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.17 | 0.05 | | | | | | 0.22 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 0.41 | | | | | | | | 0.41 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry** [(1)] | -173.63 | 0.24 | 0.16 | | | | | | -173.22 |
| A. Forest land | -173.63 | 0.24 | 0.16 | | | | | | -173.22 |
| B. Cropland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| C. Grassland | NE,NO | NE,NO | NE | | | | | | NE,NO |
| D. Wetlands | NE,NO | NE,NO | NE,NO | | | | | | NE,NO |
| E. Settlements | NE,NO | NE | NE,NO | | | | | | NE,NO |
| F. Other land | NE,NO | NE | NE,NO | | | | | | NE,NO |
| G. Harvested wood products | NE,NO | | | | | | | | NE,NO |
| H. Other | | | | | | | | | |
| **5. Waste** | NA,NO | 537.43 | 18.37 | | | | | | 555.80 |
| A. Solid waste disposal | NA,NO | 456.11 | | | | | | | 456.11 |
| B. Biological treatment of solid waste | | 2.96 | 2.12 | | | | | | 5.07 |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 78.36 | 16.25 | | | | | | 94.62 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:** [(2)] | | | | | | | | | |
| **International bunkers** | 1509.74 | 1.55 | 14.16 | | | | | | 1525.45 |
| Aviation | 776.41 | 0.14 | 6.47 | | | | | | 783.02 |
| Navigation | 733.33 | 1.42 | 7.68 | | | | | | 742.43 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 125.07 | | | | | | | | 125.07 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NE,NO | | | | | | |
| **Indirect $CO_2$** [(3)] | NE,NO | | | | | | | | |

| | |
|---|---|
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | 8463.57 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | 8290.35 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

## SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS
**(Sheet 1 of 1)**

Inventory 2015
Submission 2017 v1
CYPRUS

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Unspecified mix of HFCs and PFCs | $NF_3$ | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (kt) | | | | | | | | |
| **Total (net emissions)[(1)]** | 6691.40 | 923.38 | 322.15 | 359.31 | | 0.15 | | | 8296.39 |
| **1. Energy** | 5961.81 | 19.19 | 58.82 | | | | | | 6039.82 |
| A. Fuel combustion (sectoral approach) | 5961.81 | 19.19 | 58.82 | | | | | | 6039.82 |
| 1. Energy industries | 3023.00 | 2.93 | 6.85 | | | | | | 3032.78 |
| 2. Manufacturing industries and construction | 546.18 | 0.62 | 1.35 | | | | | | 548.15 |
| 3. Transport | 1829.51 | 10.60 | 49.20 | | | | | | 1889.32 |
| 4. Other sectors | 540.85 | 4.96 | 1.36 | | | | | | 547.17 |
| 5. Other | 22.27 | 0.08 | 0.05 | | | | | | 22.40 |
| B. Fugitive emissions from fuels | NO,NE | NO,NE | NO,NE | | | | | | NO,NE |
| 1. Solid fuels | NO | NO | NO | | | | | | NO |
| 2. Oil and natural gas | NO,NE | NO,NE | NO,NE | | | | | | NO,NE |
| C. $CO_2$ transport and storage | NO | | | | | | | | NO |
| **2. Industrial processes and product use** | 897.44 | NO,NE,NA | 59.63 | 359.31 | | 0.15 | | | 1316.53 |
| A. Mineral industry | 886.72 | | | | | | | | 886.72 |
| B. Chemical industry | NO | NO | NO | | | | | | NO |
| C. Metal industry | NO | NO | | | | | | | NO |
| D. Non-energy products from fuels and solvent use | 10.70 | NE,NA | NE,NA | | | | | | 10.70 |
| E. Electronic Industry | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | 359.31 | | | | | 359.31 |
| G. Other product manufacture and use | 0.01 | NE | 59.63 | | | 0.15 | | | 59.79 |
| H. Other | | | | | | | | | |
| **3. Agriculture** | 0.40 | 362.01 | 184.22 | | | | | | 546.64 |
| A. Enteric fermentation | | 224.40 | | | | | | | 224.40 |
| B. Manure management | | 137.29 | 64.38 | | | | | | 201.67 |
| C. Rice cultivation | | NO | | | | | | | NO |
| D. Agricultural soils | | NE | 119.74 | | | | | | 119.74 |
| E. Prescribed burning of savannas | | NO | NO | | | | | | NO |
| F. Field burning of agricultural residues | | 0.32 | 0.10 | | | | | | 0.42 |
| G. Liming | NO | | | | | | | | NO |
| H. Urea application | 0.40 | | | | | | | | 0.40 |
| I. Other carbon-containing fertilizers | NO | | | | | | | | NO |
| J. Other | | | | | | | | | |
| **4. Land use, land-use change and forestry[(1)]** | -168.25 | 0.09 | 0.06 | | | | | | -168.11 |
| A. Forest land | -168.25 | 0.09 | 0.06 | | | | | | -168.11 |
| B. Cropland | NO,NE | NO,NE | NE | | | | | | NO,NE |
| C. Grassland | NO,NE | NO,NE | NE | | | | | | NO,NE |
| D. Wetlands | NO,NE | NO,NE | NO,NE | | | | | | NO,NE |
| E. Settlements | | | | | | | | | |
| F. Other land | | | | | | | | | |
| G. Harvested wood products | | | | | | | | | |
| H. Other | | | | | | | | | |
| **5. Waste** | NO,NA | 542.10 | 19.42 | | | | | | 561.51 |
| A. Solid waste disposal | NO,NA | 465.05 | | | | | | | 465.05 |
| B. Biological treatment of solid waste | | 4.39 | 3.14 | | | | | | 7.52 |
| C. Incineration and open burning of waste | NO | NO | NO | | | | | | NO |
| D. Waste water treatment and discharge | | 72.66 | 16.28 | | | | | | 88.94 |
| E. Other | NO | NO | NO | | | | | | NO |
| **6. Other** *(as specified in summary 1.A)* | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Memo items:[(2)]** | | | | | | | | | |
| **International bunkers** | 1519.22 | 1.64 | 14.09 | | | | | | 1534.95 |
| Aviation | 751.79 | 0.13 | 6.27 | | | | | | 758.19 |
| Navigation | 767.43 | 1.51 | 7.82 | | | | | | 776.76 |
| **Multilateral operations** | NO | NO | NO | | | | | | NO |
| **$CO_2$ emissions from biomass** | 134.35 | | | | | | | | 134.35 |
| **$CO_2$ captured** | NO | | | | | | | | NO |
| **Long-term storage of C in waste disposal sites** | NE | | | | | | | | NE |
| **Indirect $N_2O$** | | | NO,NE | | | | | | |
| **Indirect $CO_2$ [(3)]** | NO,NE | | | | | | | | |
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | | | | | | | | | 8464.49 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | | | | | | | | | 8296.39 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | | | | | | | | | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | | | | | | | | | NA |

(1) For carbon dioxide ($CO_2$) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

# Annex III. CO2 reference approach and comparison with sectoral approach, and relevant information on the national energy balance

## IV1. Fuel consumption: Reference Vs. Sectoral approach

Due to the unavailability of consumption data for several years and sectors, using the data as is, would create issues of consistence and comparability. Therefore it was decided to complete the reporting period using certain assumptions. The assumptions made for each fuel are presented section 3.2.2.

The revised data used for the calculations of emissions is presented in the Tables that follow.

## Crude oil (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Imports (Balance) | 624 | 763 | 749 | 789 | 916 | 797 | 804 | 1039 | 1075 | 1186 | 1155 | 1154 | 1078 | 969 | 243 | NO |
| Stock changes | 12 | -7 | -22 | -8 | -10 | 31 | -44 | 4 | 7 | -6 | 18 | 2 | 8 | 2 | 35 | NO |
| Gross inland deliveries (Calculated) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NO |
| Statistical difference | 0 | -17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | NO |
| Gross inland deliveries (Observed) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NO |
| Refinery intake (Observed) | 636 | 763 | 727 | 781 | 906 | 828 | 760 | 1043 | 1082 | 1180 | 1173 | 1156 | 1086 | 971 | 279 | NO |

## LPG (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | 25 | 29 | 28 | 27 | 32 | 27 | 26 | 32 | 30 | 34 | 30 | 31 | 33 | 28 | 9 | |
| Imports (Balance) | 25 | 16 | 28 | 25 | 13 | 21 | 24 | 17 | 20 | 10 | 14 | 19 | 19 | 28 | 45 | 49 |
| Stock changes | 1 | -4 | 1 | 1 | -2 | 0 | 1 | 0 | 0 | 0 | 0 | -1 | -1 | 1 | 1 | -2 |
| Gross inland deliveries (Calculated) | 49 | 49 | 55 | 51 | 47 | 48 | 49 | 49 | 50 | 44 | 44 | 51 | 53 | 55 | 53 | 51 |
| Statistical difference | 0 | 0 | 0 | 0 | -3 | -3 | -2 | -3 | 0 | -5 | -9 | -2 | -1 | -3 | -3 | -2 |
| Gross inland deliveries (Observed) | 49 | 49 | 55 | 51 | 50 | 51 | 51 | 52 | 50 | 49 | 53 | 53 | 54 | 58 | 56 | 53 |
| Non-ferrous metals | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Non-metallic minerals | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Food, beverages and tobacco | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Not elsewhere specified (Industry) | | | | | | | | | | | | | | | | |
| Commercial and public services | 12 | 12 | 13 | 12 | 12 | 12 | 12 | 13 | 12 | 12 | 13 | 13 | 13 | 14 | 13 | 13 |
| Residential | 32 | 32 | 36 | 33 | 32 | 33 | 33 | 34 | 32 | 32 | 34 | 34 | 35 | 38 | 36 | 34 |
| Agriculture/forestry | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | | | | | | | | | | | | | | | | |
| Imports (Balance) | 54 | 52 | 52 | 50 | 51 | 54 | 53 | 50 | 48 | 54 | | | | | | |
| Stock changes | 1 | 1 | 0 | -1 | 2 | -1 | 1 | -2 | 0 | 0 | | | | | | |
| Gross inland deliveries (Calculated) | 53 | 51 | 52 | 51 | 49 | 55 | 52 | 52 | 48 | 54 | | | | | | |
| Statistical difference | -1 | -4 | -1 | -4 | -4 | -4 | -7 | 0 | 0 | 0 | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gross inland deliveries (Observed) | 54 | 55 | 53 | 55 | 53 | 59 | 59 | 52 | 48 | 54 | | | | | | |
| Non-ferrous metals | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | | | | | | |
| Non-metallic minerals | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | | | | | | |
| Food, beverages and tobacco | 3 | 3 | 3 | 3 | 3 | 4 | 5 | 4 | 3 | 2 | | | | | | |
| Not elsewhere specified (Industry) | | | | | | | | 0 | 2 | 1 | | | | | | |
| Commercial and public services | 13 | 13 | 14 | 13 | 13 | 14 | 14 | 12 | 11 | 12 | | | | | | |
| Residential | 35 | 36 | 34 | 36 | 34 | 38 | 37 | 33 | 31 | 34 | | | | | | |
| Agriculture/forestry | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | | | | | | |

## Gasoline (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | 122 | 121 | 102 | 94 | 122 | 102 | 95 | 141 | 142 | 148 | 153 | 150 | 153 | 146 | 40 | |
| Imports (Balance) | 32 | 40 | 70 | 75 | 58 | 72 | 99 | 50 | 51 | 57 | 62 | 84 | 78 | 110 | 239 | 331 |
| Stock changes | -9 | -9 | 0 | 0 | -1 | -5 | 5 | -3 | 2 | 3 | 3 | 0 | 3 | -5 | -6 | 4 |
| Gross inland deliveries (Calculated) | 163 | 170 | 172 | 169 | 181 | 179 | 189 | 194 | 191 | 202 | 212 | 234 | 228 | 261 | 285 | 327 |
| Statistical difference | 0 | 0 | 0 | 0 | 1 | -4 | 3 | 3 | -4 | -1 | 6 | 15 | 0 | 9 | 3 | 24 |
| Gross inland deliveries (Observed) | 163 | 170 | 172 | 169 | 180 | 183 | 186 | 191 | 195 | 203 | 206 | 219 | 228 | 252 | 282 | 303 |
| Non-ferrous metals | 163 | 170 | 172 | 169 | 180 | 183 | 186 | 191 | 195 | 203 | 206 | 219 | 228 | 252 | 282 | 303 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | | | | | | | | | | | | | | | | |
| Imports (Balance) | 335 | 344 | 372 | 380 | 402 | 376 | 364 | 343 | 342 | 362 | | | | | | |
| Stock changes | 29 | -1 | -9 | 2 | 9 | 0 | 0 | -2 | 2 | 14 | | | | | | |
| Gross inland deliveries (Calculated) | 306 | 345 | 381 | 378 | 393 | 376 | 364 | 345 | 340 | 348 | | | | | | |
| Statistical difference | -17 | -7 | 8 | -5 | 3 | -9 | -8 | -4 | -1 | 3 | | | | | | |
| Gross inland deliveries (Observed) | 323 | 352 | 373 | 383 | 390 | 385 | 372 | 349 | 341 | 345 | | | | | | |
| Non-ferrous metals | 323 | 352 | 373 | 383 | 390 | 385 | 372 | 349 | 341 | 345 | | | | | | |

## Jet kerosene (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | 19 | 27 | 23 | 30 | 34 | 16 | 3 | 5 | 4 | 11 | 18 | 13 | 7 | | | |
| Imports (Balance) | 279 | 253 | 249 | 260 | 401 | 290 | 286 | 252 | 260 | 264 | 268 | 314 | 295 | 323 | 297 | 306 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exports | | | | | | | | | | | | | | | | |
| Stock changes | | | | -18 | 8 | -4 | 3 | -5 | 4 | -4 | -4 | 10 | -1 | -3 | | -4 |
| | 0 | 0 | 0 | 18 | -8 | 4 | -3 | 5 | -4 | 4 | 4 | -10 | 1 | 3 | 0 | 4 |
| Gross inland deliveries (Calculated) | 298 | 280 | 272 | 272 | 443 | 302 | 292 | 252 | 268 | 271 | 282 | 337 | 301 | 320 | 297 | 302 |
| Statistical difference | 62 | 0 | 0 | 41 | 206 | 42 | 43 | 7 | 10 | 7 | 14 | 23 | -1 | -3 | 2 | 11 |
| Gross inland deliveries (Observed) | 236 | 280 | 272 | 231 | 237 | 260 | 249 | 245 | 258 | 264 | 268 | 314 | 302 | 323 | 295 | 291 |
| International aviation | 232.5 | 275.9 | 268.0 | 227.6 | 233.5 | 256.2 | 245.3 | 241.4 | 254.2 | 260.1 | 264.0 | 309.4 | 297.5 | 318.2 | 290.6 | 268.2 |
| Domestic aviation | 3.5 | 4.1 | 4.0 | 3.4 | 3.5 | 3.8 | 3.7 | 3.6 | 3.8 | 3.9 | 4.0 | 4.6 | 4.5 | 4.8 | 4.4 | 4.0 |
| Not elsewhere specified (Other) | | | | | | | | | | | | | | | | |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | | | | | | | | | | | | | | | | |
| Imports (Balance) | 321 | 269 | 286 | 285 | 277 | 284 | 265 | 238 | 221 | 265 | | | | | | |
| Exports | | | | | | | | | | 23 | | | | | | |
| | -18 | 16 | -3 | | -8 | 5 | 4 | -8 | 4 | -8 | | | | | | |
| Stock changes | 18 | -16 | 3 | 0 | 8 | -5 | -4 | 8 | -4 | 8 | | | | | | |
| Gross inland deliveries (Calculated) | 303 | 285 | 283 | 285 | 269 | 289 | 269 | 230 | 225 | 234 | | | | | | |
| Statistical difference | 3 | -2 | -3 | 19 | -2 | -7 | 4 | -7 | -8 | 0 | | | | | | |
| Gross inland deliveries (Observed) | 300 | 287 | 286 | 266 | 271 | 296 | 265 | 237 | 233 | | | | | | | |
| International aviation | 266.4 | 262.4 | 272.3 | 257.4 | 262.6 | 272.5 | 263.4 | 245.7 | 246.0 | 238.1 | | | | | | |
| Domestic aviation | 3.3 | 3.0 | 2.8 | 2.3 | 2.4 | 0.7 | 0.5 | 0.3 | 0.2 | 0.3 | | | | | | |
| Not elsewhere specified (Other) | | | | 1 | 1 | 2 | 1 | 2 | 2 | 1.0 | | | | | | |

## Other kerosene (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | 12 | 12 | 14 | 14 | 15 | 14 | 18 | 20 | 23 | 20 | 19 | 24 | 29 | 38 | 11 | |
| Imports (Balance) | | | 3 | 2 | | 3 | | | | | 5 | | | | | 15 |
| Stock changes | | | | -2 | 2 | | | | -2 | | | | 2 | -5 | 3 | -1 |
| | 0 | 0 | 0 | 2 | -2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | -2 | 5 | -3 | 1 |
| Gross inland deliveries (Calculated) | 12 | 12 | 17 | 14 | 17 | 17 | 18 | 20 | 21 | 20 | 24 | 24 | 31 | 33 | 14 | 14 |
| Statistical difference | 0 | 0 | 0 | -2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | -10 | -2 |
| Gross inland deliveries (Observed) | 12 | 12 | 17 | 16 | 17 | 17 | 18 | 20 | 21 | 20 | 24 | 24 | 31 | 31 | 24 | 16 |
| Residential | 12 | 12 | 17 | 16 | 17 | 17 | 18 | 20 | 21 | 20 | 24 | 24 | 31 | 31 | 24 | 13 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oil and gas extraction | | | | | | | | | | | | | | | | |
| Not elsewhere specified (Industry) | | | | | | | | | | | | | | | | 3 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | | | | | | | | | | | | | | | | |
| Imports (Balance) | 10 | 13 | 18 | 19 | 8 | 16 | 13 | 12 | 13 | 11 | | | | | | |
| Stock changes | | 1 | -2 | | | -1 | 2 | 1 | 0 | 1 | | | | | | |
| | 0 | -1 | 2 | 0 | 0 | 1 | -2 | -1 | 0 | -1 | | | | | | |
| Gross inland deliveries (Calculated) | 10 | 14 | 16 | 19 | 8 | 15 | 15 | 13 | 13 | 12 | | | | | | |
| Statistical difference | -6 | -2 | 2 | 0 | -6 | -1 | -2 | 1 | 2 | -2 | | | | | | |
| Gross inland deliveries (Observed) | 16 | 16 | 14 | 19 | 14 | 16 | 17 | 12 | 11 | 14 | | | | | | |
| Residential | 16 | 16 | 14 | 19 | 14 | 16 | 17 | 12 | 9 | 14 | | | | | | |
| Oil and gas extraction | | | | | | | | | 2 | | | | | | | |
| Not elsewhere specified (Industry) | | | | | | | | | | | | | | | | |

## Biodiesels (kt)

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | | | | | | | | | | 7 | 7 | 6 | 6 | 7 | 6 | 4 | 3 |
| Imports (Balance) | | | | | | | | | 1 | 9 | 10 | 11 | 12 | 12 | 11 | 7 | 8 |
| Stock changes | | | | | | | | | -1 | | | | | 2 | | | |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | -2 | 0 | 0 | 0 |
| Gross inland deliveries (Calculated) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 17 | 17 | 18 | 20 | 17 | 11 | 11 |
| Statistical difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| Gross inland deliveries (Observed) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 16 | 17 | 17 | 18 | 18 | 17 | 11 | 11 |
| Road | | | | | | | | | 1 | 16 | 17 | 17 | 18 | 18 | 17 | 11 | 11 |

## Diesel (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | 230 | 278 | 252 | 253 | 324 | 300 | 258 | 365 | 382 | 411 | 406 | 390 | 362 | 327 | 88 | |
| Imports (Balance) | 118 | 32 | 182 | 168 | 85 | 152 | 225 | 146 | 175 | 165 | 194 | 198 | 194 | 252 | 480 | 603 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| International marine bunkers | 24 | 20 | 21 | 14 | 12 | 15 | 25 | 27 | 35 | 46 | 50 | 47 | 33 | 36 | 27 | 67 |
| Stock changes | | | | | | | | | | -30 | 1 | -2 | 3 | -2 | 16 | -17 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | -1 | 2 | -3 | 2 | -16 | 17 |
| Gross inland deliveries (Calculated) | 324 | 290 | 413 | 407 | 397 | 437 | 458 | 484 | 522 | 500 | 551 | 539 | 526 | 541 | 557 | 519 |
| Statistical difference | 16 | -21 | 24 | 12 | -7 | -9 | -7 | -5 | -4 | -46 | -9 | -13 | -2 | -5 | 24 | 0 |
| Gross inland deliveries (Observed) | 308 | 311 | 389 | 395 | 404 | 446 | 465 | 489 | 526 | 546 | 560 | 552 | 528 | 546 | 533 | 519 |
| Main activity producer electricity plants | | | 11 | 3 | 2 | 8 | 6 | 6 | 12 | 21 | 19 | 4 | 2 | 5 | 8 | 16 |
| Road | 209 | 201 | 245 | 254 | 260 | 284 | 297 | 313 | 333 | 339 | 349 | 355 | 340 | 351 | 353 | 345 |
| Water-borne navigation | 0.69 | 0.66 | 0.81 | 0.84 | 0.86 | 0.94 | 0.98 | 1.03 | 1.10 | 1.24 | 0.53 | 0.43 | 0.56 | 0.43 | 0.60 | 0.73 |
| Chemical and petrochemical | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Non-ferrous metals | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Non-metallic minerals | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 |
| Mining and Quarrying | 3 | 4 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 6 | 6 |
| Food, beverages and tobacco | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 |
| Construction | 3 | 4 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 6 | 6 |
| Not elsewhere specified (Industry) | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 |
| Commercial and public services | 11 | 12 | 15 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 22 | 21 | 21 | 19 | 18 |
| Residential | 52 | 58 | 71 | 73 | 75 | 82 | 86 | 90 | 96 | 99 | 102 | 103 | 99 | 102 | 92 | 83 |
| Agriculture/forestry | 14 | 16 | 20 | 20 | 21 | 23 | 24 | 25 | 27 | 27 | 28 | 29 | 27 | 28 | 25 | 24 |
| Fishing | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 |
| Not elsewhere specified (Other) | 3 | 4 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 6 | 6 |

| | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | | | | | | | | | | | | | | | | |
| Imports (Balance) | 629 | 606 | 615 | 629 | 680 | 620 | 704 | 673 | 549 | 562 | | | | | | |
| International marine bunkers | 106 | 104 | 88 | 73 | 53 | 58 | 69 | 83 | 80 | 75 | | | | | | |
| Stock changes | -46 | 20 | -2 | -19 | -34 | 7 | -2 | -14 | -6 | -38 | | | | | | |
| | 46 | -20 | 2 | 19 | 34 | -7 | 2 | 14 | 6 | 38 | | | | | | |
| Gross inland deliveries (Calculated) | 477 | 522 | 525 | 537 | 593 | 569 | 633 | 576 | 463 | 449 | | | | | | |
| Statistical difference | -26 | 7 | 17 | -25 | -29 | -5 | 3 | -11 | 2 | -7 | | | | | | |
| Gross inland deliveries (Observed) | 503 | 515 | 508 | 562 | 622 | 574 | 630 | 588 | 462 | 456 | | | | | | |
| Main activity producer electricity plants | 7 | 16 | 23 | 92 | 158 | 112 | 214 | 236 | 124 | 89 | | | | | | |
| Road | 322 | 336 | 329 | 320 | 328 | 312 | 271 | 231 | 223 | 241 | | | | | | |
| Water-borne navigation | 0.56 | 0.63 | 0.76 | 1.49 | 0.95 | 0.89 | 0.63 | 0.47 | 0.56 | 0.49 | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chemical and petrochemical | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | | | | | | |
| Non-ferrous metals | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | | | | | | |
| Non-metallic minerals | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 1 | | | | | | |
| Mining and Quarrying | 6 | 5 | 4 | 4 | 3 | 4 | 5 | 4 | 1 | 2 | | | | | | |
| Food, beverages and tobacco | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 3 | | | | | | |
| Construction | 6 | 5 | 4 | 4 | 3 | 4 | 5 | 3 | 5 | 3 | | | | | | |
| Not elsewhere specified (Industry) | 3 | 4 | 3 | 3 | 2 | 4 | 5 | 3 | 2 | 2 | | | | | | |
| Commercial and public services | 19 | 18 | 20 | 19 | 23 | 20 | 16 | 14 | 15 | 19 | | | | | | |
| Residential | 98 | 89 | 78 | 83 | 70 | 80 | 76 | 63 | 57 | 65 | | | | | | |
| Agriculture/forestry | 25 | 25 | 23 | 20 | 19 | 22 | 21 | 21 | 19 | 22 | | | | | | |
| Fishing | 3 | 3 | 3 | 4 | 4 | 3 | 3 | 2 | 2 | 2 | | | | | | |
| Not elsewhere specified (Other) | 4 | 6 | 13 | 5 | 5 | 6 | 5 | 5 | 9 | 6 | | | | | | |

## Total Fuel Oil (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | 162 | 235 | 264 | 313 | 316 | 317 | 316 | 421 | 442 | 495 | 491 | 482 | 423 | 362 | 112 | |
| Refinery fuel | 11 | 12 | 13 | 13 | 14 | 17 | 16 | 14 | 15 | 16 | 16 | | | | | |
| Recycled products | | | | | | | | | | | | | | | | |
| Imports (Balance) | 460 | 510 | 509 | 577 | 546 | 539 | 599 | 476 | 515 | 586 | 637 | 585 | 690 | 821 | 925 | 1298 |
| Exports | | | | | | | 22 | | | | | | | | | |
| International marine bunkers | 34 | 36 | 38 | 36 | 50 | 54 | 65 | 71 | 63 | 108 | 143 | 145 | 105 | 88 | 27 | 225 |
| Stock changes | 0 | -12 | 41 | -44 | 52 | -63 | 52 | -3 | 10 | -59 | 11 | 22 | -23 | 49 | -20 | -49 |
| | 0 | 12 | -41 | 44 | -52 | 63 | -52 | 3 | -10 | 59 | -11 | -22 | 23 | -49 | 20 | 49 |
| Gross inland deliveries (Calculated) | 577 | 685 | 763 | 797 | 850 | 722 | 864 | 809 | 889 | 898 | 980 | 944 | 985 | 1144 | 990 | 1024 |
| Refinery fuel | 11 | 12 | 13 | 13 | 14 | 17 | 16 | 14 | 15 | 16 | 16 | | | | | |
| Main activity producer electricity plants | 540 | 561 | 645 | 697 | 727 | 662 | 703 | 743 | 811 | 856 | 902 | 897 | 932 | 1095 | 1046 | 1104 |
| Chemical and petrochemical | | | | | | | | | | | | | | | | |
| Non-metallic minerals | 13 | 45 | 43 | 36 | 40 | 35 | 40 | 25 | 25 | 25 | 25 | 20 | 20 | 23 | 25 | 37 |
| Food, beverages and tobacco | 15 | 51 | 48 | 41 | 45 | 40 | 45 | 29 | 28 | 28 | 29 | 22 | 23 | 25 | 28 | 23 |
| Paper, pulp and printing | 2 | 6 | 5 | 5 | 5 | 4 | 5 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| Not elsewhere specified (Industry) | 2 | 6 | 5 | 5 | 5 | 4 | 5 | 3 | 3 | 3 | 3 | 2 | 3 | 5 | 8 | 9 |
| Commercial and public services | 5 | 17 | 16 | 14 | 15 | 13 | 15 | 10 | 9 | 9 | 10 | 7 | 8 | 8 | 9 | 1 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | | | | | | | | | | | | | | | | |
| Refinery fuel | | | | | | | | | | | | | | | | |
| Recycled products | | | | | | | 2 | 3 | 5 | 5 | | | | | | |
| Imports (Balance) | 1404 | 1403 | 1479 | 1356 | 1317 | 1153 | 1072 | 830 | 942 | 1053 | | | | | | |
| Exports | | | | | | | | | | | | | | | | |
| International marine bunkers | 190 | 171 | 165 | 146 | 134 | 141 | 128 | 157 | 153 | 169 | | | | | | |
| Stock changes | -11 | 10 | 4 | 37 | -66 | 85 | -24 | 4 | 39 | -14 | | | | | | |
| | 11 | -10 | -4 | -37 | 66 | -85 | 24 | -4 | -39 | 14 | | | | | | |
| Gross inland deliveries (Calculated) | 1203 | 1242 | 1318 | 1247 | 1117 | 1097 | 922 | 680 | 833 | 875 | | | | | | |
| Refinery fuel | | | | | | | | | | | | | | | | |
| Main activity producer electricity plants | 1137 | 1174 | 1219 | 1163 | 1053 | 1058 | 896 | 649 | 793 | 858 | | | | | | |
| Chemical and petrochemical | | | | | | | | | | 1 | | | | | | |
| Non-metallic minerals | 35 | 38 | 38 | 30 | 25 | 15 | 13 | 8 | 7 | 8 | | | | | | |
| Food, beverages and tobacco | 16 | 11 | 20 | 14 | 16 | 28 | 9 | 8 | 13 | 9 | | | | | | |
| Paper, pulp and printing | 2 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | | | | | | |
| Not elsewhere specified (Industry) | 9 | 20 | 17 | 15 | 12 | 7 | 3 | 5 | 5 | 1 | | | | | | |
| Commercial and public services | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 4 | 2 | 3 | | | | | | |

## White spirit and SPB (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Imports (Balance) | | | | 1 | | 1 | 1 | 1 | | 1 | | 1 | | | | 1 |
| Gross inland deliveries (Calculated) | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| Statistical difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gross inland deliveries (Observed) | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| Not elsewhere specified (Industry) | | | | 1 | | 1 | 1 | 1 | | 1 | | 1 | | | | 1 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Imports (Balance) | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| Gross inland deliveries (Calculated) | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| Statistical difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| Gross inland deliveries (Observed) | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| Not elsewhere specified (Industry) | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |

## Lubricants (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Imports (Balance) | | | | 8 | 11 | 11 | 13 | 12 | 6 | 6 | 7 | 9 | 10 | 9 | 11 | 12 |
| International marine bunkers | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Stock changes | | | | -2 | | | | | -1 | | 1 | 1 | -1 | | 1 | -1 |
| | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | -1 | -1 | 1 | 0 | -1 | 1 |
| Gross inland deliveries (Calculated) | 0 | 0 | 0 | 6 | 11 | 11 | 12 | 11 | 4 | 5 | 7 | 9 | 8 | 8 | 11 | 10 |
| Statistical difference | 0 | 0 | 0 | -2 | 0 | 0 | 0 | 0 | -3 | -2 | 0 | 2 | 0 | 0 | 1 | 4 |
| Gross inland deliveries (Observed) | 0 | 0 | 0 | 8 | 11 | 11 | 12 | 11 | 7 | 7 | 7 | 7 | 8 | 8 | 10 | 6 |
| Non-energy use: Road | | | | 6 | 8 | 8 | 9 | 8 | 5 | 5 | 5 | 5 | 6 | 6 | 7 | 2 |
| Non-energy use: Not elsewhere specified (Industry) | | | | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 4 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Imports (Balance) | 12 | 11 | 11 | 10 | 10 | 10 | 9 | 7 | 7 | 8 | | | | | | |
| International marine bunkers | 1 | 1 | 1 | | | | | | | | | | | | | |
| Stock changes | | | | | 1 | | | | | | | | | | | |
| | 0 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| Gross inland deliveries (Calculated) | 11 | 10 | 10 | 10 | 11 | 10 | 9 | 7 | 7 | 8 | | | | | | |
| Statistical difference | 5 | 4 | 4 | 4 | 5 | 4 | 4 | 3 | 3 | 4 | | | | | | |
| Gross inland deliveries (Observed) | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 4 | 4 | 4 | | | | | | |
| Non-energy use: Road | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | | | |
| Non-energy use: Not elsewhere specified (Industry) | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | | | | | | |

## Bitumen (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | 33 | 23 | 24 | 34 | 35 | 37 | 30 | 37 | 37 | 37 | 36 | 42 | 38 | 30 | 9 | |
| Imports (Balance) | | | 28 | 21 | 23 | 17 | 25 | 21 | 38 | 48 | 50 | 41 | 46 | 40 | 53 | 70 |
| Stock changes | | -4 | -2 | 4 | | -3 | | 2 | | 1 | -1 | -2 | | -1 | 4 | 1 |
| | 0 | 4 | 2 | -4 | 0 | 3 | 0 | -2 | 0 | -1 | 1 | 2 | 0 | 1 | -4 | -1 |
| Gross inland deliveries (Calculated) | 33 | 19 | 50 | 59 | 58 | 51 | 55 | 60 | 75 | 86 | 85 | 81 | 84 | 69 | 66 | 71 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Statistical difference | 0 | -4 | 0 | 0 | 1 | -3 | -2 | -2 | 0 | 0 | 2 | 0 | 0 | -1 | 1 | 2 |
| Gross inland deliveries (Observed) | 33 | 23 | 50 | 59 | 57 | 54 | 57 | 62 | 75 | 86 | 83 | 81 | 84 | 70 | 65 | 69 |
| Construction | 33 | 23 | 50 | 59 | 57 | 54 | 57 | 62 | 75 | 86 | 83 | 81 | 84 | 70 | 65 | 69 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | | | | | | | | | | | | | | | | |
| Imports (Balance) | 70 | 62 | 69 | 61 | 68 | 60 | 36 | 29 | 21 | 21 | | | | | | |
| Stock changes | -5 | -2 | | -4 | 6 | 4 | -1 | -3 | 1 | 0 | | | | | | |
| | 5 | 2 | 0 | 4 | -6 | -4 | 1 | 3 | -1 | 0 | | | | | | |
| Gross inland deliveries (Calculated) | 65 | 60 | 69 | 57 | 74 | 64 | 35 | 26 | 22 | 21 | | | | | | |
| Statistical difference | -4 | 3 | 3 | -17 | -9 | 0 | -1 | 2 | 1 | | | | | | | |
| Gross inland deliveries (Observed) | 69 | 57 | 66 | 74 | 83 | 64 | 36 | 24 | 21 | 21 | | | | | | |
| Construction | 69 | 57 | 66 | 74 | 83 | 64 | 36 | 24 | 21 | 21 | | | | | | |

## Pet-coke (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Imports (Balance) | 33 | 93 | 85 | 121 | 110 | 152 | 153 | 142 | 133 | 144 | 180 | 93 | 188 | 113 | 135 | 143 |
| Stock changes | 2 | | -22 | -7 | 2 | -27 | -6 | 10 | 17 | 10 | -39 | 40 | -49 | 24 | 11 | 11 |
| | -2 | 0 | 22 | 7 | -2 | 27 | 6 | -10 | -17 | -10 | 39 | -40 | 49 | -24 | -11 | -11 |
| Gross inland deliveries (Calculated) | 40 | 93 | 63 | 114 | 112 | 125 | 147 | 152 | 150 | 154 | 141 | 133 | 139 | 137 | 146 | 154 |
| Statistical difference | 0 | 0 | -22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gross inland deliveries (Observed) | 0 | 93 | 85 | 114 | 112 | 125 | 147 | 152 | 150 | 154 | 141 | 133 | 139 | 137 | 146 | 154 |
| Non-metallic minerals | 40 | 93 | 85 | 114 | 112 | 125 | 147 | 152 | 150 | 154 | 141 | 133 | 139 | 137 | 146 | 154 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Imports (Balance) | 153 | 149 | 163 | 118 | 123 | 78 | 102 | 142 | 149 | 124 | | | | | | |
| Stock changes | -7 | -6 | -11 | 26 | -7 | 23 | -8 | -7 | 13 | 4 | | | | | | |
| | 7 | 6 | 11 | -26 | 7 | -23 | 8 | 7 | -13 | -4 | | | | | | |
| Gross inland deliveries (Calculated) | 146 | 143 | 152 | 144 | 116 | 101 | 94 | 135 | 162 | 128 | | | | | | |
| Statistical difference | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | | | | | | |
| Gross inland deliveries (Observed) | 146 | 143 | 152 | 144 | 116 | 100 | 94 | 135 | 162 | 128 | | | | | | |
| Non-metallic minerals | 146 | 143 | 152 | 144 | 116 | 100 | 94 | 135 | 162 | 128 | | | | | | |

## Other Liquid fuels (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery gross output | 5 | 5 | | | | | | 1 | | | | | 16 | 16 | 1 | |
| Refinery fuel | | | | | | | | | | | | | 16 | 16 | | |
| Imports (Balance) | 33 | | | | | | | | | | | | 5 | 5 | 6 | |
| Stock changes | 2 | | | | | | | | | | | | | | | |
| | -2 | | | | | | | | | | | | | | | |
| Gross inland deliveries (Calculated) | 40 | 5 | | | | | | 1 | | | | | 5 | 5 | 7 | |
| Statistical difference | | | | | | | | | | | | | 5 | 5 | 1 | |
| Gross inland deliveries (Observed) | 40 | 5 | | | | | | 1 | | | | | | | 6 | |
| Refinery fuel | | | | | | | | | | | | | 16 | 16 | | |
| Not elsewhere specified (Industry) | 0 | 5 | | | | | | 1 | | | | | | | 6 | |

## Other bituminous coal (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total imports (Balance) | 97 | 97 | 26 | 33 | 27 | 20 | 18 | 19 | 21 | 26 | 50 | 59 | 66 | 51 | 39 | 63 |
| Stock changes (National territory) | 0 | 0 | 0 | -2 | 0 | 0 | 0 | 0 | 5 | 4 | -1 | -6 | -13 | 2 | 18 | -11 |
| | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | -5 | -4 | 1 | 6 | 13 | -2 | -18 | 11 |
| Non-metallic minerals | 97 | 97 | 26 | 31 | 27 | 20 | 18 | 19 | 26 | 30 | 49 | 53 | 53 | 53 | 57 | 52 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total imports (Balance) | 63 | 33 | 41 | 26 | 17 | | | | 5.452 | 6.029 | | | | | | |
| Stock changes (National territory) | -9 | 16 | -1 | -5 | 9 | 12 | 0 | 0 | -1.3 | 0 | | | | | | |
| | 9 | -16 | 1 | 5 | -9 | -12 | 0 | 0 | 1.3 | 0 | | | | | | |
| Non-metallic minerals | 54 | 49 | 40 | 21 | 26 | 12 | 20 | 20 | 4.152 | 6.029 | | | | | | |

## Lignite (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total imports (Balance) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Not elsewhere specified (Other) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total imports (Balance) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | | | | | | |
| Not elsewhere specified (Other) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | | | | | | |

## Industrial waste (non-renewable) (TJ)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous production | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 0 | 15 | 71 | 138 |
| Imports | | | | | | | | | | | | | | | | |
| Stock change | | | | | | | | | | | | | | | | |
| Inland consumption (calculated) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 0 | 15 | 71 | 138 |
| Non-metallic minerals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 0 | 15 | 71 | 138 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous production | 73 | 288 | 239 | 276 | 299 | 4 | 0 | 0 | 273 | 124 | | | | | | |
| Imports | | | | | | | | | 6 | 1 | | | | | | |
| Stock change | | | | | | | | | | 96 | | | | | | |
| Inland consumption (calculated) | 73 | 288 | 239 | 276 | 299 | 4 | 0 | 0 | 279 | 221 | | | | | | |
| Non-metallic minerals | 73 | 288 | 239 | 276 | 299 | 4 | 0 | 0 | 279 | 221 | | | | | | |

## Solid biofuel (TJ)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous production | 257 | 232 | 230 | 229 | 490 | 479 | 464 | 358 | 378 | 369 | 367 | 403 | 399 | 486 | 368 | 266 |
| Total imports (balance) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 4 |
| Stock Change | | | | | | | | | | | | | | | | |
| Inland consumption (calculated) | 257 | 232 | 230 | 229 | 490 | 479 | 464 | 358 | 378 | 369 | 367 | 403 | 399 | 487 | 372 | 270 |
| Statistical difference | | | | | | | | | | | | | | | | |
| Chemical and petrochemical | | | | | | | | | | | | | | | | |
| Non-metallic minerals | | | | | | | | | | | 41 | 70 | 90 | 211 | 127 | 38 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Food, beverages and tobacco | | | | | | | | | | | | | | | | |
| Commercial and public services | 19 | 15 | 15 | 15 | 11 | 12 | 17 | 9 | 8 | 11 | 10 | 10 | 10 | 9 | 8 | 7 |
| Residential | 126 | 105 | 103 | 102 | 74 | 79 | 119 | 61 | 56 | 77 | 68 | 70 | 64 | 58 | 53 | 51 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous production | 269 | 512 | 452 | 295 | 225 | 211 | 236 | 209 | 303 | 271 | | | | | | |
| Total imports (balance) | 6 | 4 | 178 | 293 | 269 | 276 | 34 | 18 | 43 | 106 | | | | | | |
| Stock Change | | | | | | | | | | 30 | | | | | | |
| Inland consumption (calculated) | 275 | 516 | 630 | 588 | 494 | 487 | 270 | 227 | 346 | 407 | | | | | | |
| Statistical difference | | | | | | | | | -1 | -2 | | | | | | |
| Chemical and petrochemical | | | | | | | | | 42 | 52 | | | | | | |
| Non-metallic minerals | 61 | 133 | 281 | 304 | 347 | 306 | 29 | 28 | 116 | 95 | | | | | | |
| Food, beverages and tobacco | | | | | | | | | 44 | 7 | | | | | | |
| Commercial and public services | 5 | 14 | 15 | 15 | 15 | 13 | 16 | 16 | 16 | 15 | | | | | | |
| Residential | 74 | 95 | 123 | 222 | 84 | 123 | 143 | 112 | 71 | 146 | | | | | | |

## Charcoal (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous production | 1 | 1 | 1 | 1 | 5 | 4 | 4 | 3 | 4 | 4 | 3 | 3 | 3 | 3 | 2 | 2 |
| Total imports (balance) | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 4 | 4 | 3 | 2 | 2 | 4 | 4 | 6 | 8 |
| Inland consumption (calculated) | 1 | 1 | 1 | 1 | 8 | 7 | 7 | 7 | 8 | 7 | 5 | 5 | 7 | 7 | 8 | 10 |
| Commercial and public services | 0.5 | 0.5 | 0.5 | 0.5 | 1.0 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 4 | 4 | 4 | 5 |
| Residential | 0.5 | 0.5 | 0.5 | 0.5 | 1.0 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 4 | 4 | 4 | 5 |

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous production | 2 | 4 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | |
| Imports | 8 | 9 | 10 | 10 | 10 | 11 | 11 | 11 | 11 | 12 | | | | | | |
| Inland consumption (calculated) | 10 | 13 | 13 | 11 | 11 | 12 | 12 | 12 | 12 | 13 | | | | | | |
| Commercial and public services | 5 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 7 | | | | | | |
| Residential | 5 | 6 | 6 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | | | | | | |

## Biogases (kt)

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous production | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 78 | 209 | 274 | 448 | 476 | 466 | 475 | 471 |
| Imports | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 78 | 209 | 274 | 448 | 476 | 466 | 475 | 471 |
| Inland consumption (calculated) | | | | | | | | | | | | | | | | -1 | -1 |
| Commercial and public services | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 12 | 11 | 11 | 11 | 11 | 11 |
| Agriculture/Forestry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 78 | 198 | 262 | 437 | 465 | 455 | 464 | 460 |

## IV2. $CO_2$ emissions: Reference Vs. Sectoral approach

### Crude oil (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 1,972.87 | 2,314.09 | 2,255.15 | 2,422.66 | 2,810.41 | 2,568.46 | 2,357.52 | 3,235.39 | 3,356.36 | 3,660.36 | 3,638.65 | 3,585.91 | 3,368.77 |

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 3,012.04 | 862.356 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

### Gasoline (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 125.87 | 150.43 | 214.90 | 230.25 | 181.13 | 236.39 | 288.58 | 162.71 | 150.43 | 165.78 | 181.13 | 257.88 | 230.25 |
| Road Transport | 500.41 | 521.90 | 528.04 | 518.83 | 552.60 | 561.81 | 571.02 | 586.37 | 598.65 | 623.21 | 632.42 | 672.33 | 699.96 |

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 353.05 | 752.15 | 1003.89 | 939.42 | 1059.15 | 1,169.67 | 1,160.46 | 1,206.51 | 1,154.32 | 1,117.48 | 1,059.15 | 1,043.80 | 1,068.36 |
| Road Transport | 773.64 | 865.74 | 930.21 | 991.61 | 1080.64 | 1145.11 | 1175.81 | 1197.30 | 1181.95 | 1142.04 | 1071.43 | 1046.87 | 1,059.15 |

### Jet Kerosene (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 155.06 | -68.62 | -52.52 | 55.33 | 564.24 | 105.01 | 148.77 | 30.07 | 43.46 | 13.25 | 15.01 | 61.91 | 4.74 |
| International Aviation | 733.2 | 869.9 | 845.0 | 717.6 | 736.3 | 807.7 | 773.5 | 761.1 | 801.5 | 820.1 | 832.6 | 975.5 | 938.2 |
| Domestic Aviation | 11.0 | 13.0 | 12.7 | 10.8 | 11.0 | 12.1 | 11.6 | 11.4 | 12.0 | 12.3 | 12.5 | 14.6 | 14.1 |
| Non specified/stationary | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 20.90 | 37.68 | 66.58 | 41.37 | 25.98 | 25.64 | 99.12 | 32.82 | 19.95 | 46.77 | 14.07 | 10.92 | 34.19 |
| International Aviation | 1003.4 | 916.4 | 845.6 | 850.4 | 836.6 | 867.5 | 818.7 | 835.8 | 861.4 | 832.2 | 775.8 | 776.4 | 751.79 |
| Domestic Aviation | 15.0 | 13.7 | 12.5 | 10.5 | 9.4 | 8.9 | 7.2 | 7.7 | 2.3 | 1.5 | 1.0 | 0.6 | 0.9 |
| Non specified/stationary | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.15 | 3.15 | 6.31 | 3.15 | 6.31 | 6.31 | 3.15 |

### Other kerosene (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 0.00 | 0.00 | 9.44 | 0.00 | 0.00 | 15.74 | 0.00 | 0.00 | -6.30 | NO,NA | 15.74 | NO,NA | NO,NA |
| Non-specified Industry | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other sectors/residential | 37.79 | 37.79 | 53.54 | 50.39 | 53.54 | 53.54 | 56.69 | 62.98 | 66.13 | 62.98 | 75.58 | 75.58 | 97.63 |

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | NO,NA | 9.44 | 44.07 | 31.48 | 44.07 | 50.36 | 59.81 | 25.18 | 47.22 | 47.22 | 40.92 | 40.92 | 37.77 |
| Non-specified Industry | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.30 | 0.00 |
| Other sectors/residential | 97.63 | 75.58 | 50.39 | 50.39 | 50.39 | 44.09 | 59.84 | 44.09 | 50.39 | 53.54 | 37.79 | 28.34 | 44.09 |

### Gas/ Diesel oil (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 299.38 | 38.22 | 512.76 | 490.47 | 232.50 | 436.33 | 636.97 | 379.00 | 445.88 | 283.45 | 461.81 | 474.55 | 522.32 |
| Electricity | 0.00 | 0.00 | 32.62 | 10.79 | 6.09 | 25.45 | 18.39 | 17.83 | 35.91 | 64.97 | 57.89 | 11.48 | 4.91 |
| Non-ferrous metals | 2.20 | 2.45 | 2.96 | 3.07 | 3.16 | 3.43 | 3.61 | 3.79 | 4.04 | 4.15 | 4.29 | 4.33 | 4.15 |
| Chemicals | 2.20 | 2.45 | 2.96 | 3.07 | 3.16 | 3.43 | 3.61 | 3.79 | 4.04 | 4.15 | 4.29 | 4.33 | 4.15 |
| Food Processing, Beverages and Tobacco | 6.60 | 7.34 | 8.89 | 9.22 | 9.49 | 10.30 | 10.84 | 11.38 | 12.12 | 12.45 | 12.86 | 12.99 | 12.45 |
| Non-Metallic Minerals | 6.60 | 7.34 | 8.89 | 9.22 | 9.49 | 10.30 | 10.84 | 11.38 | 12.12 | 12.45 | 12.86 | 12.99 | 12.45 |
| Mining (excluding fuels) and Quarrying | 10.99 | 12.23 | 14.81 | 15.37 | 15.82 | 17.17 | 18.06 | 18.96 | 20.19 | 20.76 | 21.43 | 21.65 | 20.76 |
| Construction | 10.99 | 12.23 | 14.81 | 15.37 | 15.82 | 17.17 | 18.06 | 18.96 | 20.19 | 20.76 | 21.43 | 21.65 | 20.76 |
| Non-specified Industry | 6.60 | 7.34 | 8.89 | 9.22 | 9.49 | 10.30 | 10.84 | 11.38 | 12.12 | 12.45 | 12.86 | 12.99 | 12.45 |
| Road Transport | 666.93 | 641.52 | 781.26 | 809.84 | 828.89 | 905.11 | 946.40 | 997.21 | 1060.73 | 1079.40 | 1113.51 | 1129.77 | 1084.74 |
| Urea-based catalysts | 1.00 | 0.96 | 1.17 | 1.21 | 1.24 | 1.35 | 1.42 | 1.49 | 1.59 | 1.61 | 1.67 | 1.69 | 1.62 |
| International water-borne navigation | 76.47 | 63.73 | 66.91 | 44.61 | 38.24 | 47.79 | 79.66 | 86.03 | 111.52 | 146.57 | 159.32 | 149.76 | 105.15 |
| Domestic water-borne navigation | 2.20 | 2.11 | 2.57 | 2.67 | 2.73 | 2.98 | 3.12 | 3.29 | 3.50 | 3.94 | 1.69 | 1.37 | 1.79 |
| Other sectors/commercial | 35.18 | 39.13 | 47.39 | 49.19 | 50.62 | 54.93 | 57.80 | 60.67 | 64.62 | 66.42 | 68.57 | 69.29 | 66.42 |
| Other sectors/residential | 167.12 | 185.88 | 225.11 | 233.63 | 240.45 | 260.92 | 274.56 | 288.20 | 306.96 | 315.49 | 325.72 | 329.13 | 315.49 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Other sectors/agriculture/stationary | 46.18 | 51.36 | 62.20 | 64.56 | 66.44 | 72.10 | 75.87 | 79.64 | 84.82 | 87.17 | 90.00 | 90.94 | 87.17 |
| Other sectors/agriculture/fishing | 6.60 | 7.34 | 8.89 | 9.22 | 9.49 | 10.30 | 10.84 | 11.38 | 12.12 | 12.45 | 12.86 | 12.99 | 12.45 |
| Non specified/stationary | 10.99 | 12.23 | 14.81 | 15.37 | 15.82 | 17.17 | 18.06 | 18.96 | 20.19 | 20.76 | 21.43 | 21.65 | 20.76 |

| | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 681.56 | 1493.70 | 1652.95 | 1519.18 | 1662.50 | 1,672.06 | 1,710.27 | 1,888.63 | 1,812.19 | 2,016.02 | 1,834.48 | 1,474.59 | 1,430.01 |
| Electricity | 15.73 | 26.14 | 50.60 | 21.28 | 49.72 | 70.98 | 284.84 | 490.53 | 336.65 | 676.13 | 743.85 | 387.23 | 280.73 |
| Non-ferrous metals | 4.26 | 3.84 | 3.57 | 3.64 | 3.03 | 2.73 | 2.73 | 2.12 | 2.43 | 3.19 | 0.00 | 0.00 | 0.00 |
| Chemicals | 4.26 | 3.84 | 3.57 | 3.64 | 3.03 | 2.73 | 2.73 | 2.12 | 2.43 | 3.19 | 3.19 | 3.19 | 3.19 |
| Food Processing, Beverages and Tobacco | 12.79 | 11.51 | 10.70 | 10.92 | 9.10 | 8.19 | 8.19 | 6.37 | 7.28 | 9.56 | 6.37 | 3.19 | 9.56 |
| Non-Metallic Minerals | 12.79 | 11.51 | 10.70 | 10.92 | 9.10 | 8.19 | 8.19 | 6.37 | 7.28 | 9.56 | 3.19 | 3.19 | 3.19 |
| Mining (excluding fuels) and Quarrying | 21.32 | 19.19 | 17.83 | 18.21 | 15.17 | 13.66 | 13.66 | 10.62 | 12.14 | 15.93 | 6.37 | 3.19 | 6.37 |
| Construction | 21.32 | 19.19 | 17.83 | 18.21 | 15.17 | 13.66 | 13.66 | 10.62 | 12.14 | 15.93 | 15.93 | 15.93 | 9.56 |
| Non-specified Industry | 12.79 | 11.51 | 10.70 | 10.92 | 12.29 | 8.19 | 8.19 | 6.37 | 13.66 | 15.93 | 9.56 | 6.37 | 6.37 |
| Road Transport | 1117.02 | 1126.05 | 1100.13 | 1027.39 | 1071.79 | 1049.06 | 1018.05 | 1045.28 | 994.49 | 864.68 | 734.53 | 711.95 | 767.90 |
| Urea-based catalysts | 1.67 | 1.68 | 1.65 | 1.54 | 1.60 | 1.57 | 1.52 | 1.56 | 1.49 | 1.29 | 1.10 | 1.07 | 1.15 |
| International water-borne navigation | 114.71 | 86.03 | 213.48 | 337.75 | 331.38 | 280.39 | 232.60 | 168.87 | 184.81 | 219.85 | 264.46 | 254.90 | 238.97 |
| Domestic water-borne navigation | 1.37 | 1.90 | 2.33 | 1.78 | 2.00 | 2.42 | 4.75 | 3.02 | 2.83 | 1.99 | 1.51 | 1.46 | 1.56 |
| Other sectors/commercial | 68.21 | 61.39 | 57.05 | 60.54 | 57.35 | 63.73 | 60.54 | 73.28 | 63.73 | 50.98 | 54.17 | 47.79 | 60.54 |
| Other sectors/residential | 324.02 | 291.61 | 264.46 | 312.26 | 283.58 | 248.53 | 264.46 | 223.04 | 254.90 | 242.16 | 197.55 | 181.62 | 207.11 |
| Other sectors/agriculture/stationary | 89.53 | 80.58 | 76.26 | 79.75 | 79.53 | 73.28 | 63.73 | 60.54 | 70.10 | 66.91 | 66.91 | 60.54 | 70.10 |
| Other sectors/agriculture/fishing | 12.79 | 11.51 | 9.77 | 9.46 | 9.69 | 9.56 | 12.75 | 12.75 | 9.56 | 9.56 | 6.37 | 6.37 | 6.37 |
| Non specified/stationary | 21.32 | 19.19 | 17.83 | 12.75 | 19.12 | 41.42 | 15.93 | 15.93 | 19.12 | 15.93 | 15.93 | 28.68 | 19.12 |

**Residual Fuel Oil (kt)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 1331.51 | 1444.03 | 1600.31 | 1553.43 | 1712.84 | 1319.01 | 1762.85 | 1256.50 | 1419.03 | 1309.63 | 1578.43 | 1444.03 | 1756.59 |
| Electricity | 1675.77 | 1738.05 | 1999.05 | 2154.48 | 2252.60 | 2050.47 | 2178.47 | 2303.72 | 2514.78 | 2654.91 | 2792.51 | 2771.63 | 2886.54 |
| Petroleum refining | 34.40 | 37.52 | 40.65 | 40.65 | 43.78 | 53.16 | 50.03 | 43.78 | 46.90 | 50.03 | 50.03 | 0.00 | 0.00 |
| Chemicals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pulp, Paper and Print | 4.82 | 16.16 | 15.37 | 13.03 | 14.33 | 12.64 | 14.46 | 9.12 | 8.86 | 8.86 | 9.12 | 7.04 | 7.17 |
| Food Processing, Beverages and Tobacco | 57.85 | 193.87 | 184.49 | 156.35 | 171.98 | 151.66 | 173.55 | 109.44 | 106.32 | 106.32 | 109.44 | 84.43 | 85.99 |
| Non-Metallic Minerals | 28.92 | 96.94 | 92.25 | 78.17 | 85.99 | 75.83 | 86.77 | 54.72 | 53.16 | 53.16 | 54.72 | 42.21 | 43.00 |
| Non-specified Industry | 19.28 | 64.62 | 61.50 | 52.12 | 57.33 | 50.55 | 57.85 | 36.48 | 35.44 | 35.44 | 36.48 | 28.14 | 28.66 |
| International water-borne navigation | 106.32 | 112.57 | 118.82 | 112.57 | 156.35 | 168.86 | 203.25 | 222.01 | 197.00 | 337.71 | 447.16 | 453.41 | 328.33 |
| Other sectors/commercial | 4.82 | 16.16 | 15.37 | 13.03 | 14.33 | 12.64 | 14.46 | 9.12 | 8.86 | 8.86 | 9.12 | 7.04 | 7.17 |

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 2444.23 | 2744.29 | 3200.63 | 3760.11 | 3882.01 | 4,119.56 | 3,897.64 | 3,491.31 | 3,428.80 | 2,875.56 | 2,116.04 | 2,588.01 | 2,719.28 |
| Electricity | 3102.16 | 3231.64 | 3421.25 | 3632.10 | 3751.94 | 3896.32 | 3707.63 | 3377.47 | 3373.38 | 2869.80 | 2085.88 | 2553.09 | 2742.3 |
| Petroleum refining | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemicals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.13 |
| Pulp, Paper and Print | 8.08 | 8.86 | 5.15 | 3.49 | 4.97 | 4.60 | 3.13 | 3.68 | 6.25 | 3.50 | 3.00 | 3.13 | 3.13 |
| Food Processing, Beverages and Tobacco | 96.94 | 106.32 | 61.80 | 41.94 | 59.60 | 55.18 | 37.52 | 44.15 | 75.05 | 28.14 | 25.02 | 40.65 | 59.41 |
| Non-Metallic Minerals | 48.47 | 53.16 | 115.70 | 109.44 | 118.82 | 118.82 | 93.81 | 78.17 | 46.90 | 40.65 | 25.02 | 21.89 | 25.02 |
| Non-specified Industry | 38.57 | 51.07 | 39.36 | 35.87 | 76.15 | 65.30 | 53.16 | 45.98 | 37.52 | 9.38 | 15.63 | 15.63 | 4.00 |
| International water- | 275.17 | 84.43 | 703.57 | 594.12 | 534.71 | 515.95 | 456.54 | 419.01 | 440.90 | 400.25 | 490.93 | 478.42 | 528.46 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| borne navigation | | | | | | | | | | | | | |
| Other sectors/commercial | 8.08 | 8.86 | 3.13 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 12.51 | 12.51 | 6.25 | 9.38 |

**Liquefied Petroleum Gases (kt)**

| | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 71.59 | 59.66 | 80.54 | 71.59 | 44.75 | 62.64 | 68.61 | 50.71 | 59.66 | 29.83 | 41.76 | 59.66 | 59.66 |
| Non-ferrous metals | 2.71 | 2.71 | 3.04 | 2.82 | 2.76 | 2.82 | 2.82 | 2.87 | 2.76 | 2.71 | 2.93 | 2.93 | 2.98 |
| Food Processing, Beverages and Tobacco | 8.12 | 8.12 | 9.12 | 8.46 | 8.29 | 8.46 | 8.46 | 8.62 | 8.29 | 8.12 | 8.79 | 8.79 | 8.95 |
| Non-Metallic Minerals | 2.71 | 2.71 | 3.04 | 2.82 | 2.76 | 2.82 | 2.82 | 2.87 | 2.76 | 2.71 | 2.93 | 2.93 | 2.98 |
| Other sectors/commercial | 35.21 | 35.21 | 39.52 | 36.64 | 35.93 | 36.64 | 36.64 | 37.36 | 35.93 | 35.21 | 38.08 | 38.08 | 38.80 |
| Other sectors/residential | 94.79 | 94.79 | 106.40 | 98.66 | 96.72 | 98.66 | 98.66 | 100.59 | 96.72 | 94.79 | 102.53 | 102.53 | 104.46 |
| Other sectors/agriculture/stationary | 2.71 | 2.71 | 3.04 | 2.82 | 2.76 | 2.82 | 2.82 | 2.87 | 2.76 | 2.71 | 2.93 | 2.93 | 2.98 |

| | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 80.54 | 131.25 | 152.14 | 158.10 | 152.14 | 155.12 | 152.14 | 146.17 | 164.07 | 155.12 | 155.12 | 143.19 | 161.08 |
| Non-ferrous metals | 3.21 | 3.10 | 2.93 | 2.98 | 2.98 | 0.00 | 2.98 | 2.98 | 2.98 | 2.98 | 0.00 | 0.00 | 2.98 |
| Food Processing, Beverages and Tobacco | 9.62 | 9.29 | 8.79 | 8.95 | 8.95 | 8.95 | 8.95 | 8.95 | 11.94 | 14.92 | 11.94 | 8.95 | 5.97 |
| Non-Metallic Minerals | 3.21 | 3.10 | 2.93 | 2.98 | 2.98 | 2.98 | 2.98 | 2.98 | 2.98 | 2.98 | 2.98 | 0.00 | 2.98 |
| Other sectors/commercial | 41.67 | 40.24 | 38.08 | 38.80 | 38.80 | 41.78 | 38.80 | 38.80 | 41.78 | 41.78 | 35.82 | 32.83 | 35.82 |
| Other sectors/residential | 112.20 | 108.33 | 102.53 | 104.46 | 107.45 | 101.48 | 107.45 | 101.48 | 113.42 | 110.43 | 98.49 | 92.52 | 101.48 |
| Other sectors/agriculture/stationary | 3.21 | 3.10 | 2.93 | 2.98 | 2.98 | 2.98 | 2.98 | 2.98 | 2.98 | 2.98 | 2.98 | 0.00 | 5.97 |

**Bitumen (kt)**

| | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Reference | -3.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 155.23 | 0.00 | 0.00 | 0.00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

### Lubricants (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2.95 | -2.95 | 0.00 | 0.00 |

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

### Petroleum coke (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 96.13 | 255.42 | 173.03 | 313.09 | 307.60 | 343.30 | 403.73 | 417.46 | 411.97 | 422.95 | 387.25 | 365.28 | 381.75 |
| Non-Metallic Minerals | 109.86 | 255.42 | 233.45 | 313.09 | 307.60 | 343.30 | 403.72 | 417.46 | 411.96 | 422.95 | 387.25 | 365.27 | 381.75 |

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 376.26 | 400.98 | 422.95 | 420.34 | 420.21 | 443.52 | 438.92 | 352.70 | 304.52 | 277.75 | 406.02 | 493.88 | 386.62 |
| Non-Metallic Minerals | 376.26 | 400.98 | 422.95 | 420.34 | 420.21 | 443.53 | 438.92 | 352.70 | 301.51 | 277.74 | 406.01 | 493.87 | 383.00 |

### Other Oil (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 14.74 |
| Petroleum Refining | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 47.15 |
| Non-specified Industry | 0.00 | 14.73 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.95 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 14.74 | 17.69 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Petroleum Refining | 47.15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non-specified Industry | 0.00 | 17.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

### Other Liquid Fossil (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | NO | NO | NO | 2.95 | NO | 2.95 | 2.95 | 2.95 | NO | NA,NO | NO | 2.95 | NO |
| Non-specified Industry | 0.00 | 0.00 | 0.00 | 2.95 | 0.00 | 2.95 | 2.95 | 2.95 | 0.00 | 2.95 | 0.00 | 2.95 | 0.00 |

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | NO | NO | 2.95 | 2.95 | 2.95 | NO | NO | NO | NO | NO | NO | NO | NO |
| Non-specified Industry | 0.00 | 0.00 | 2.95 | 2.95 | 2.95 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

### Other bituminous coal (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 248.35 | 248.35 | 66.57 | 79.37 | 69.13 | 51.21 | 46.09 | 48.65 | 66.57 | 76.81 | 125.46 | 131.72 | 129.56 |
| Non-Metallic Minerals | 231.74 | 231.74 | 62.12 | 74.06 | 64.51 | 47.78 | 43.00 | 45.39 | 62.12 | 71.67 | 117.06 | 126.62 | 126.62 |

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 133.98 | 151.06 | 137.81 | 149.40 | 116.25 | 110.63 | 56.87 | 65.95 | 28.77 | NO | NO | 9.15 | 14.69 |
| Non-Metallic Minerals | 126.62 | 136.18 | 151.12 | 149.47 | 117.33 | 109.44 | 57.64 | 69.61 | 29.37 | 0.00 | 0.00 | 9.15 | 14.69 |

### Lignite (kt)

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Non specified/stationary | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | NO | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | NO | NO |
| Non specified/stationary | 0.00 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 0.00 | 0.00 |

**Waste (non-biomass fraction) (kt)**

| | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 2.57 | NO |
| Non-Metallic Minerals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.57 | 0.00 |

| | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 2.15 | 10.15 | 19.73 | 10.44 | 41.18 | 34.18 | 39.47 | 42.76 | 8.04 | 3.30 | 6.45 | 55.85 | 4.54 |
| Non-Metallic Minerals | 2.15 | 10.15 | 19.73 | 10.44 | 41.18 | 34.18 | 39.47 | 42.76 | 8.04 | 3.30 | 6.45 | 55.85 | 4.54 |

**Solid biomass (kt)**

| | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 29.02 | 26.52 | 26.32 | 26.22 | 75.44 | 71.04 | 69.54 | 58.93 | 64.23 | 50.80 | 53.23 | 56.84 | 63.03 |
| Chemicals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food Processing, Beverages and Tobacco | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non-Metallic Minerals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.10 | 7.00 | 9.00 |
| Other sectors/commercial | 3.51 | 3.19 | 3.17 | 3.15 | 4.40 | 12.73 | 13.31 | 12.46 | 14.04 | 12.69 | 9.26 | 9.29 | 12.51 |
| Other sectors/residential | 14.44 | 12.26 | 12.08 | 12.00 | 11.01 | 20.53 | 24.45 | 18.70 | 19.97 | 20.27 | 15.80 | 15.97 | 19.05 |
| Non specified/stationary | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | 71.84 | 63.63 | 60.02 | 60.52 | 94.54 | 105.95 | 95.15 | 85.74 | 88.34 | 66.62 | 62.31 | 74.22 | 80.63 |
| Chemicals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.20 | 5.20 |
| Food Processing, Beverages and Tobacco | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.4 | 0.7 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Non-Metallic Minerals | 21.10 | 12.70 | 3.80 | 6.10 | 13.30 | 28.10 | 30.40 | 34.70 | 30.60 | 2.9 | 2.8 | 11.6 | 9.5 |
| Other sectors/commercial | 12.42 | 14.00 | 17.26 | 17.02 | 24.53 | 24.63 | 21.32 | 21.32 | 21.12 | 21.42 | 21.42 | 21.42 | 24.63 |
| Other sectors/residential | 18.44 | 19.71 | 23.05 | 25.40 | 31.09 | 33.894 | 40.195 | 26.395 | 33.89 | 35.89 | 32.79 | 28.69 | 39.79 |
| Non specified/stationary | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**Liquid biomass (kt)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Road Transport | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | NO | NO | NO | NO | 0.00 | 41.89 | 44.51 | 44.51 | 47.13 | 52.37 | 44.51 | 28.80 | 28.80 |
| Road Transport | 0.00 | 0.00 | 0.00 | 0.00 | 2.62 | 41.91 | 44.53 | 44.53 | 47.15 | 47.15 | 44.53 | 28.82 | 28.82 |

**Gas biomass (kt)**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Other sectors/commercial | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other sectors/agriculture/stationary | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | NO | NO | NO | NO | 0.82 | 4.26 | 11.42 | 14.97 | 24.48 | 26.01 | 25.46 | 25.95 | 25.73 |
| Other sectors/commercial | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.60 | 0.66 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| Other sectors/agriculture/stationary | 0.00 | 0.00 | 0.00 | 0.00 | 0.82 | 4.26 | 11.41 | 14.96 | 24.46 | 25.99 | 25.44 | 25.33 | 25.12 |

# Annex IV: Cyprus' QA/QC and verification system manual

# Cyprus'

# QA/QC and verification system manual

**Nicosia, 2016**

**Department of Environment**

**Ministry of Agriculture, Rural Development and Environment**

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# 1 Introduction

This is a manual for the Quality Control (QC) and Quality Assurance (QA) procedures for the Cyprus' greenhouse gas emission inventory performed by the Department of Environment, Ministry of Agriculture, Rural Development and Environment (DoE). The quality procedure is continuously improved as part of the on-going process of improving the emission inventory. The manual is thus periodically updated when the need arises.

This is the second version of the Quality Control (QC) and Quality Assurance (QA) procedures of Cyprus, updating the first version that was prepared in 2012. The manual is in accordance with the guidelines provided by the UNFCCC (UNFCCC, 2007), the 2006 IPCC guidelines for the preparation of greenhouse gas emissions inventories (IPCC, 2006) and the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000). This manual sets up guidelines for the work by inventory team. The inventory team is located in the Department of Environment, Ministry of Agriculture, Rural Development and Environment, Cyprus.

First, the concept of quality is defined using conventional terminology and the interaction between different elements is briefly outlined. The quality goal is defined and from that, a listing of basic factors to take into account is made. This forms the basis for tasks to be performed to fulfil the quality goal. Finally a reporting structure is outlined in which each task is addressed.

The present manual is based on the *Quality Manual for the Danish Greenhouse Gas Inventory (version 2)*, prepared by the Department of Environmental Science, Aarhus University (Nielsen *et al*., 2012).

## 2 Concepts of quality work

*Quality*, according to ISO 9000, is defined as the degree to which a set of inherent characteristics fulfils requirements. Requirements are the need or expectation that is stated, generally implied, or obligatory. The quality planning is based on the following definitions as outlined by the UNFCCC and the IPCC Guidelines:

*Quality management (QM)* co-ordinate activities with regard to the quality system

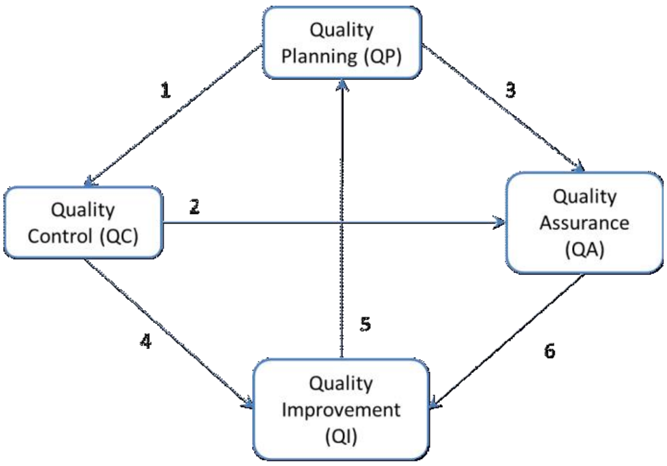
*Quality Planning (QP)* defines quality objectives including specification of necessary operational processes and resources to fulfil the quality objectives

*Quality Control (QC)* fulfils quality requirements

*Quality Assurance (QA)* provides confidence that quality requirements will be fulfilled

*Quality Improvement (QI)* increases the ability to fulfil quality requirements

The activities are inter-related in the manner shown in Figure 1.




1. The QP sets up the objectives and from these measurable properties valid for the QC.
2. The QC investigates the measurable properties that are communicated to the QA for assessment in order to ensure sufficient quality.
3. The QP identifies and defines measurable indicators for the fulfilment of the quality objectives. They form the basis for the QA and have to be supported by the input coming from the QC.
4. The result from QC will highlight the degree of fulfilment for every quality objective. It will thus be a good basis for suggestions of improvements of the inventory to meet the quality objective.
5. Suggested improvements in the quality may induce changes in the quality objectives and their measurability.
6. The evaluation carried out by external authorities is important input when improvements in quality are considered.

**Figure 1** The Inter-relation between the activities with regard to quality.

## 3 Process oriented QC

The strategy is based on a process-oriented principle and the first step is thus to set up a system for the process of the inventory work. The product specification for the inventory is a data set of emission figures and the process is thus identical with the data flow in the preparation of the inventory.

The flow of data has to take place in a transparent way by making the transformation of data detectable. It needs to be easy to find the original data background for any calculation and to trace the sequence of calculations from the raw data to the final emission result. Realistic uncertainty estimates are necessary for securing accuracy, but they can be difficult to make, due to the uncertainty of the uncertainty estimates itself. It is therefore important to include the uncertainty calculation procedures into the data structure as much as possible. The QC needs to be supported to as wide an extent as possible by the data structures, otherwise the procedure can easily become difficult.

Both data processing and data storage forms the data structure. The data processing is done using mathematical operations or models. It may be complicated models for human activity or simple summations of disaggregated data. The data storage includes databases and file systems of data that are either calculated using the data processing at the lower level or using input to new processing steps or even both output and input in the data structure. The measure for quality is basically different for processing and storage so this needs to be kept separate in a well-designed quality manual.

The data storage takes place for the following types of data:

- External Data: a single numerical value of a parameter derived from an external source. This is thus basic input, as the inventory team does not measure any new data. These data govern the calculation of Activity-Release Data.
- Activity-Release Data: Data for input to the final emission calculation in terms of data for release source strength and activity. The data is directly applicable for use in the standardised forms for calculation. These data are calculated using external data or represent a direct use of External Data when they are directly applicable for Emission Calculations.
- Emission Data: Estimated emissions based on the Activity Release Data.
- Emission Reporting: Reporting of emission data in requested formats and aggregation level.

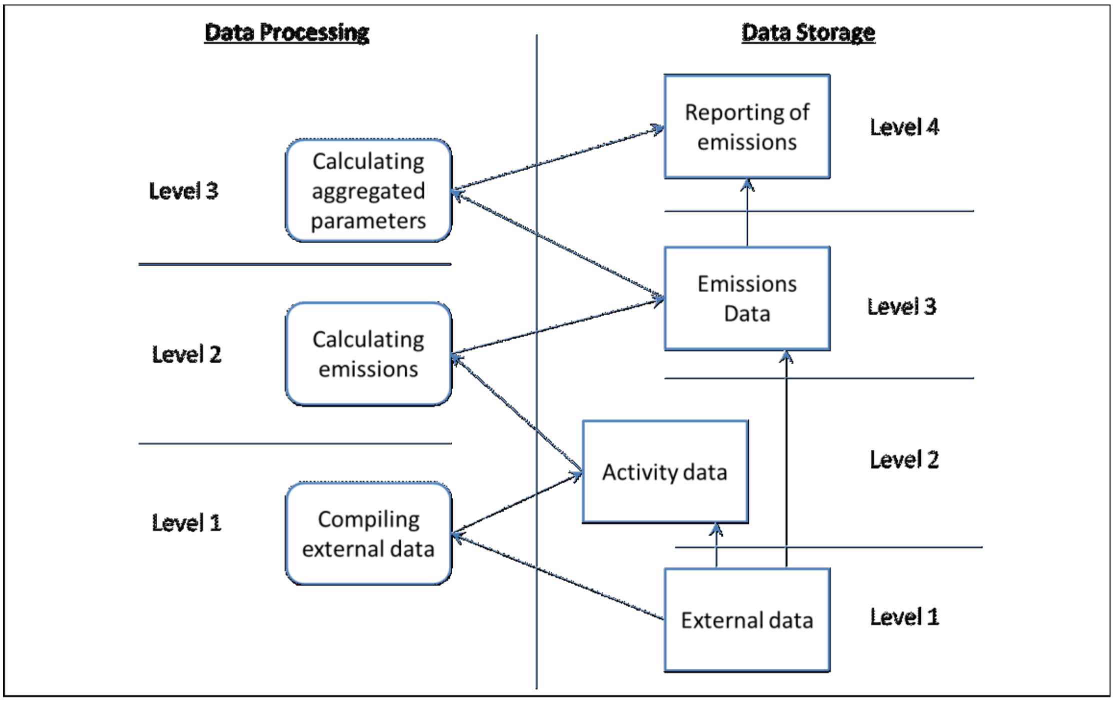



**Figure 2** The general data structure for the emission inventory

Key levels are defined in the data structure (Figure 2) as:

- Data storage Level 1, External data: Collection of external data sources from different sectors and statistical surveys typically reported on an annual basis. The data consist of raw data, having identical format as the data received and gathered from external sources. Level 1 data acts as a base set, on which all subsequent calculations are based. If alterations in calculation procedures are made they are based on the same data set. When new data are introduced they can be implemented in accordance with the QA/QC structure of the inventory.
- Data storage Level 2, Data directly usable for the inventory: This Level represents data that have been prepared and compiled in a form that is directly applicable for calculation of emissions. The compiled data are structured in a database for internal use as a link between more or less raw data and data that are ready for reporting. The data are compiled in a way that explains the different approaches in emission assessment: (1) Directly, on estimated emissions for large point sources. (2) Based on activities and emission factors, where the value setting of these factors are stored at this level.
- Data storage Level 3, Emission data: The emission calculations are reported by the most detailed figures and divided in sectors. The unit at this level is typically mass per year for the country.
- Data storage Level 4, Final reports for all subcategories: The complete GHG emission inventory is reported to the European Commission and the UNFCCC secretariat at this level by summing up the results from every subcategory.
- Data processing Level 1 compilation of external data: Preparation of input data for the emission inventory based on the external data sources. Some external data may be used directly as input to the data processing at level 2, while others need to be interpreted using more or less complicated models, which takes place at this level. The interpretation of activity data is to be seen in connection to availability of emission factors. These models are compiled and processed as an integrated part of the inventory work.

- Data processing Level 2 Calculation of inventory figures: The emission for every subcategory is calculated, including the uncertainty for all sectors and activities. The summation of all contributions from subcategories makes up the inventory.
- Data processing Level 3 Calculation of aggregated parameters: Some aggregated parameters need to be reported as part of the final reporting. This will not be complicated calculations but the results will be important.

## 4 Critical Control Points (CCP)

A Critical Control Point (CCP) is an element or an action, which needs to be taken into account in order to fulfil the quality objective. The list of CCPs will form the condition for assessing the performance in relation to the quality objective.

The objectives for the QM as formulated by IPCC Good Practice Guidance are to improve elements of transparency, consistency, comparability, completeness and confidence. In the UNFCCC reporting guidelines the element "confidence" is replaced by "accuracy" and in this manual "accuracy" is used. The following explanation is given by UNFCCC reporting guidelines (UNFCCC, 2007) for each CCP:

- Accuracy is a relative measure of the exactness of an emission or removal estimate. Emission figures shall not systematically neither overestimate nor underestimate the true emissions, as far as it can be judged, and uncertainties have to be reduced as far as practicable. Appropriate methodologies should be used in accordance with the IPCC good practice guidance, to promote accuracy in inventories.
- Comparability means that estimates of emission and removals reported by Annex I Parties in inventories should be comparable among Annex I Parties. For this purpose, Annex I Parties should use the methodologies and formats agreed upon by the COP for estimating and reporting inventories. The allocation of different source/sink categories should follow the split of Revised 1996 IPCC Guidelines for national Greenhouse Gas Inventories at the level of its summary and sectoral tables.
- Completeness means that an inventory covers all sources and sinks as well as all gases included in the IPCC Guidelines, as well as other existing relevant source/sink categories, which are specific to individual Annex I Parties and, therefore, may not be included in the IPCC Guidelines. Completeness also means full geographic coverage of sources and sinks of an Annex I Party.
- Consistency means that an inventory should be internally consistent in all its elements with inventories of other years. An inventory is consistent if the same methodologies are used for the base and subsequent years and if consistent data sets are used to estimate emissions or removals from sources or sinks. Under certain circumstances an inventory using different methodologies for different years can be considered to be consistent if it has been recalculated in a transparent manner in accordance with the Intergovernmental Panel on Climate Change (IPCC).
- Transparency means that the assumptions and methodologies used for an inventory should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information. The transparency of the inventories is fundamental to the success of the process for the communication and consideration.

## 5 Point of Measurements (PM)

The CCP's have to be based on clear measurable factors. Otherwise the QP will end up being a loose declaration of intent. Thus in Table 1 below a series of Point of Measurement (PM) is identified as building blocks for a solid QM. The Table is based on Table 8.1 in the Good Practice Guidance that provides a listing of such PM's.

Given that it is not be possible to check all aspects of inventory input data, parameters and calculations every year, checks are performed every year on selected sets of data and processes, such that identified key source categories. Checks on other source categories are be conducted less frequently. However, a sample of data and calculations from every sector is included in the QC process each year to ensure that all sectors are addressed on an ongoing basis. In establishing criteria and processes for selecting the sample data sets and processes, QC checks on all parts of the inventory are performed every five years.

The documentation of the PMs performed in a given year is reported in the National Inventory Report (NIR). The PMs that are specific to the sectors are reported as part of the sectoral chapters in the NIR (Chapters 3-8), while the documentation of the general PMs are included in Chapter 1 of the NIR.

**Table 1** A list of the Point of Measurements

| Level | CCP | ID | Description | |
|---|---|---|---|---|
| Data storage level 1 | 1. Accuracy | DS.1.1.1 | General level of uncertainty for every dataset including the reasoning for the specific values. | Sectoral |
| | 2. Comparability | DS.1.2.1 | Comparability of the emission factors/calculation parameters with data from international guidelines, and evaluation of major discrepancies. | Sectoral |
| | 3. Completeness | DS.1.3.1 | Ensuring that the best possible national data for all sources are included, by setting down the reasoning behind the selection of datasets. | Sectoral |
| | 4. Consistency | DS.1.4.1 | The original external data has to be archived with proper reference. | Sectoral |
| | 5. Transparency | DS.1.5.1 | Listing of all archived datasets and external contacts. | Sectoral |
| | | DS.1.5.2 | The archived datasets shall be easily accessible for any person within the emission inventory team. | General |
| Data Processing level 1 | 1. Accuracy | DP.1.1.1 | Uncertainty assessment for every data source not part of DS.1.1.1 as input to Data Storage level 2 in relation to type and scale of variability. | Sectoral |
| | 2. Comparability | DP.1.2.1 | The methodologies have to follow the international guidelines suggested by UNFCCC and IPCC. | Sectoral |
| | 3. Completeness | DP.1.3.1 | Identification of data gaps with regard to data sources that could improve quantitative knowledge. | Sectoral |
| | 4. Consistency | DP.1.4.1 | Documentation and reasoning of methodological changes during the time series and the qualitative assessment of the impact on time series consistency. | Sectoral |
| | | DP.1.4.2 | Identification of parameters (e.g. activity data, constants) that are common to multiple source categories and confirmation that there is consistency for these parameters in the emission calculations. | General |

| Level | CCP | ID | Description | |
|---|---|---|---|---|
| | 5. Transparency | DP.1.5.1 | The calculation principle, the equations used and the assumptions made must be described. | Sectoral |
| | | DP.1.5.2 | Clear reference to dataset at Data Storage level 1 | Sectoral |
| | | DP.1.5.3 | Verification of calculation results using time-series | Sectoral |
| Data Storage level 2 | 1. Accuracy | DS.2.1.1 | Check if a correct data import to level 2 has been made | Sectoral |
| | 4. Consistency | DS.2.4.1 | All persons in the inventory team must be able to handle all data at level 2. | General |
| | 5. Transparency | DS.2.5.1 | The time trend for every single parameter must be available and any major dips/jumps in the time series are investigated and documented. | General |
| | | DS.2.5.2 | Check if a correct data import to level 2 has been made | Sectoral |
| Data Processing level 2 | 1. Accuracy | DP.2.1.1 | Documentation of the methodological approach for the uncertainty analysis. | General |
| | 2.Comparability | DP.2.2.1 | The inventory calculation shall follow the international guidelines suggested by UNFCCC and IPCC | General |
| | 4. Consistency | DP.2.4.1 | Any calculation at level 2 must be anchored to two responsible persons who can replace each other in performing the calculations. | General |
| | 5. Transparency | DP.2.5.1 | Reporting of the calculation principle and equations used | General |
| | | DP.2.5.2 | The reasoning for the choice of methodology for uncertainty analysis needs to be explicitly reported. | General |
| Data Storage level 3 | 1. Accuracy | DS.3.1.1 | Quantification of uncertainty | General |
| | | DS.3.1.2 | Comparison with inventories of the previous years on the level of the categories of the CRF<br>Any major changes are checked, verified, etc. | General |
| | | DS.3.1.3 | Checking of time-series of the CRF. Considerable trends and changes are checked and explained. | General |
| | 5. Transparency | DS.3.5.1 | The databases and other software used shall be clearly documented.<br>The documentation should include a description that the appropriate data processing steps are correctly represented in the database; that data relationships are correctly represented in the database and that data fields are properly labelled and have the correct design specifications. | General |
| | | DS.3.5.2 | The documentation referred to under DS.3.5.1 should be archived at the same network folder as the program is located in. | General |
| Data Processing level 3 | 4. Consistency | DP.3.4.1 | The process of generating the official submissions must be anchored by at least two responsible persons who can replace each other in generating CRF tables | General |
| | 5. Transparency | DP.3.5.1 | The databases and other software used shall be clearly documented. The documentation should include a description that the appropriate data processing steps are correctly represented in the database; that data relationships are correctly represented in the database and that data fields are properly labelled and have the correct design specifications. | General |
| | | DP.3.5.2 | The documentation referred to under DS.3.5.1 should be archived | General |

| Level | CCP | ID | Description | |
|---|---|---|---|---|
| | | | at the same network folder as the program is located in. | |
| Data Storage level 4 | 2. Comparability | DS.4.2.1 | National and international verification for the methodological approach, activity data and implied emission factors. | General |
| | 3. Completeness | DS.4.3.1 | National and international verification including explanation of the discrepancies. | General |
| | | DS.4.3.2 | Check that no sources where a methodology exists in the IPCC guidelines are reported as NE. | General |
| | 4. Consistency | DS.4.4.1 | The inventory reporting shall follow the international guidelines suggested by UNFCCC and IPCC. | General |
| | | DS.4.4.2 | The IEFs from the CRF are checked both regarding level and trend. The level is compared to relevant emission factors to ensure correctness. Large dips/jumps in the time-series are explained. | Sectoral |
| | | DS.4.4.3 | The reporting to the UNFCCC must be anchored to two responsible persons who can replace each other in the technical issue of reporting to and communicating with the UNFCCC secretariat. | General |

## 6 Structure and responsibilities of work and reporting

The final inventory report sums up the emission from a series of subcategories of human activity, such as large point sources, agriculture, etc. Each sub-category needs to have an individual reporting in order to include all necessary details adding up into complete inventory reports. The structure of reporting is explained in the following paragraphs.

Five types of reporting activities are undertaken: (1) Annual reporting of the emission inventory (NIR), (2) Data content and Structure (DCS), (3) Methodological Description (MD), (4) Quality Reporting (QR) and (5) Quality Manual (QM). The reporting of NIR and QR present specific data sets and must thus be done every year, while reporting of DCS, MD and QM are process oriented and thus linked to changes in methods and procedures, which are not necessarily changed from one year to another.

The DCS, MD and QR are done as part of the annual reporting of the emission inventory, i.e. in the NIR. The DCS reporting and QR is included both in the general part of the NIR and in the sectoral chapters. The MD reporting is included in the sectoral chapters of the NIR. The QM has been chosen to be published as a separate report in order to optimise transparency.

The responsibility for the sector-specific QC activities is with the sectoral experts. The general QC checks and all the checks that are done at an aggregated level are the responsibility of the team leader. The team leader works closely with the person in the team responsible for data management to ensure the highest possible degree of automatism in the QC checks. The overall responsibility for the QA/QC system for Cyprus' emission inventory rests with the team leader. The sectoral experts for the different IPCC source categories for the 2017 submission are shown in Table 2.

**Table 2.** List of inventory experts responsible for sectoral QC

| **Sector** | **Responsible expert** |
|---|---|
| Team leader | Nicoletta Kythreotou (nkythreotou@environment.moa.gov.cy) |
| Energy | Nicoletta Kythreotou (nkythreotou@environment.moa.gov.cy) |
| IPPU | Nicoletta Kythreotou (nkythreotou@environment.moa.gov.cy) |
| Agriculture | Nicoletta Kythreotou (nkythreotou@environment.moa.gov.cy) |
| LULUCF | Melina Menelaou (mmenelaou@environment.moa.gov.cy) |
| KP - LULUCF | Melina Menelaou (mmenelaou@environment.moa.gov.cy) |
| Waste | Nicoletta Kythreotou (nkythreotou@environment.moa.gov.cy) |

The inventory team at the DoE is responsible for the QC of the final reporting and is elaborating the emission inventory for all sectors for the areas under the effective control of the Republic of Cyprus.

DoE receives data and documentation input from all the external contributors and is responsible for the QC of the data received and the data enters the QC system as described in this manual on data storage level three. All the external organisations contributing are also carrying out QC according to their own internal procedures.

The QC checks are done manually in databases or spreadsheets were outliers are flagged for follow-up. This is done both in terms of emission trends and emission recalculations.

# 7 Quality assurance procedures

The objective of QA procedures is to ensure an independent qualified review to assess the quality of the inventory and to provide suggestions for further improvements.

The QA procedures for Cyprus' greenhouse gas inventory can be separated in two main activities: international reviews of the whole inventory and reviews of the single sectors or subsectors of the inventory.

Cyprus' greenhouse gas inventory is reviewed annually by an expert review team composed of experts nominated by Parties to the UNFCCC Roster of Experts and by an expert review team composed of experts nominated by the European Commission.

## 7.1 International reviews of Cyprus' inventory

Cyprus' greenhouse gas inventory is annually subjected to several different types of review under both the European Union (EU) and the UNFCCC.

### 7.1.1 UNFCCC reviews

The key element is the UNFCCC/KP reviews consisting of an initial check, synthesis and assessment report (SAR) and finally an in-depth review. While the initial checks are an aggregated overview of completeness, both the SAR and the in-depth review are providing valuable checks regarding the transparency, accuracy, completeness, comparability and consistency.

The outcome of the UNFCCC review process is published annually in reports available from the UNFCCC website. On the website all reports dating back to the first UNFCCC review can be found. As of 2016, Cyprus has been reviewed 2 times under the UNFCCC process. The first review took place as a centralised review in 2013. Since then Cyprus has had another review in 2016 that was an in-country review.

The recommendations made by the expert review team are tracked by the inventory team and the progress is reported annually in chapter 10 of the National Inventory Report (NIR). This process ensures that all recommendations are registered and it is documented what actions have been undertaken to resolve the issues identified by the UNFCCC Expert Review Team (ERT).

In general, it is sought to address all issues identified by the ERT during the following annual submission. However, due to the timing of the reviews and the late availability in some years of the draft review report, it is sometimes not possible. In these cases the issues are tracked in the NIR and implemented in the following submissions.

### 7.1.2 EU reviews

The internal quality control of Member States (MS) reporting serves as a QA of Cyprus' greenhouse gas emission inventory. Cyprus is obligated to annually report a full emission inventory to the European Commission by 15$^{th}$ of January.

*Annual reviews*

As part of the annual reporting cycle, Cyprus receives detailed comments from EU experts related to our January 15 submission. The comments are received by February 28. This provides Cyprus with the opportunity to address the identified issues either in the CRF or the NIR before the final submission deadline to the UNFCCC on 15$^{th}$ of April.

The checks carried out by the EU addresses all the quality parameters as included in the IPCC guidelines (TACCC – Transparency, Accuracy, Completeness, Consistency and Comparability). An example of the structure and nature of the questions are included in the screenshot of the online QA/QC communication tool, see Figure 3.

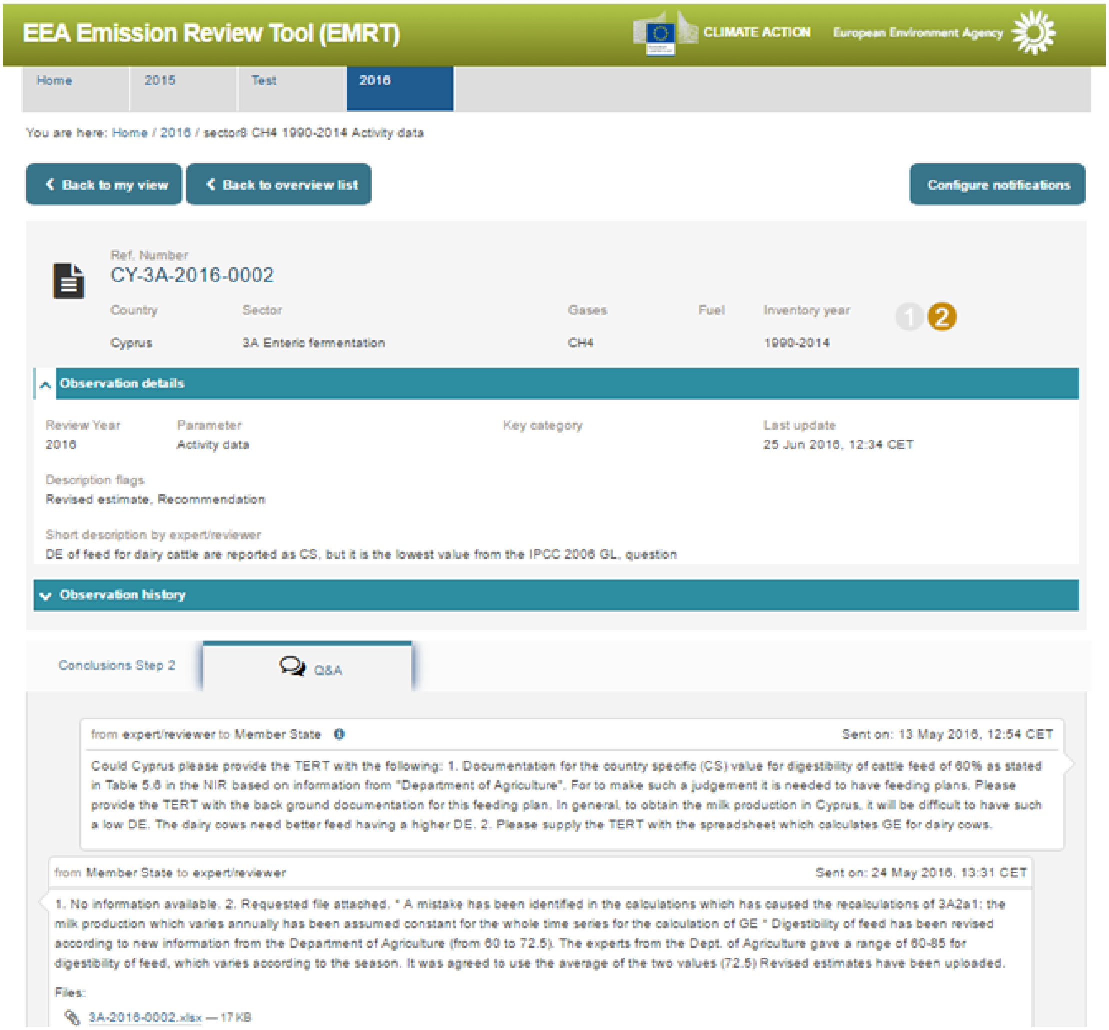



**Figure 3** Screenshot of the QA procedure website used by EU experts.

For the 2016 submission the EU internal review identified 73 questions related to different aspects of Cyprus' greenhouse gas emission inventory. All but 4 issues were addressed and resolved prior to the final reporting to the UNFCCC.

*Other activities*

In 2012 and in 2016 a separate in-depth review was carried out for all EU MS as part of the implementation of the Effort Sharing Decision (ESD). The in-depth review consisted of a desk review of all MS inventories followed by a centralised review. During this very comprehensive review additional questions were raised and this led to further improvements of Cyprus' greenhouse gas inventory.

# 8 Relationship between Cyprus' QA/QC plan and UNFCCC and IPCC definitions and requirements

The requirements to perform and report on QA/QC activities are included in UNFCCC reporting guidelines (UNFCCC, 2007) as well as in decisions under the Kyoto Protocol (e.g. decision 19/CMP.1). The technical guidance to Parties on how to address QA/QC is provided by the IPCC in the IPCC good practice guidance (IPCC, 2000) and in the 2006 IPCC guidelines (IPCC, 2007).

## 8.1 UNFCCC and KP requirements

The requirements associated with reporting of QA/QC procedures under the convention are included in the UNFCCC reporting guidelines (UNFCCC, 2007). According to the reporting guidelines (§ 17), it is mandatory for each Party to elaborate a QA/QC plan and implement general inventory QC procedures. In addition, it is encouraged that category-specific QC procedures are implemented for key categories and for those individual categories in which significant methodological changes and/or data revisions have occurred. Also, it is encouraged that Parties implement QA procedures by conducting a basic expert peer review of their inventories.

These requirements are also included in decision 19/CMP.1 (UNFCCC, 2005) specifying the requirements for National Systems under the Kyoto Protocol. An overview of the mandatory and non-mandatory requirements of decision 19/CMP.1 is provided in Table 3.

**Table 3** UNFCCC requirements for QA/QC of the greenhouse gas inventory

| Element | Par. | Legal text | Status |
|---|---|---|---|
| QA/QC plan | 12(d) | Elaborate an inventory QA/QC plan which describes specific QC procedures to be implemented during the inventory development process, facilitate the overall QA procedures to be conducted, to the extent possible, on the entire inventory and establish quality objectives. | Mandatory |
| Basic QC | 14(g) | Implement general inventory QC procedures (tier 1) in accordance with its QA/QC plan following the IPCC good practice guidance. | Mandatory |
| Source specific QC | 15(a) | Apply source-category-specific QC procedures (tier 2) for key source categories and for those individual source categories in which significant methodological and/or data revisions have occurred, in accordance with the IPCC good practice guidance. | Non-mandatory |
| Basic QA | 15(b) | Provide for a basic review of the inventory by personnel that have not been involved in the inventory development, preferably an independent third party, before the submission of the inventory, in accordance with the planned QA procedures referred to in paragraph 12 (d) above. | Non-mandatory |
| Source specific QA | 15(c) | Provide for a more extensive review of the inventory for key source categories, as well as source categories where significant changes in methods or data have been made. | Non-mandatory |
| QA follow-up | 15(d) | Based on the reviews described in paragraph 15 (b) and (c) above and periodic internal evaluations of the inventory preparation process, re-evaluate the inventory planning process in order to meet the established quality objectives referred to in paragraph 12 (d). | Non-mandatory |
| Archiving of QA/QC information | 16(a) | Archive inventory information for each year in accordance with relevant decisions of the COP and/or COP/MOP. This information shall also include internal documentation on QA/QC procedures, external and internal reviews, documentation on annual key sources and key source identification and planned inventory improvements. | Mandatory |

The QA/QC plan as required is documented in this report. As mentioned this plan is periodically updated but since the QA/QC system is operating, it is not necessary to update the plan with high frequency. The results of the specific QA/QC activities are reported annually in the NIR.

All the QC requirements, both mandatory and non-mandatory, are covered by the PMs described in Chapter 5. The basic QC activities (tier 1) are carried out mostly as general PMs across all sectors. The source-specific QC activities (tier 2) are carried out at sectoral or sub-sectoral level and reported accordingly in the NIR.

All QA activities are non-mandatory. However, this is a vital component to ensure the on-going improvement. The QA processes are described in Chapter 7 and the results of the QA are reported annually in the NIR.

The documentation of the QA/QC procedures is archived as part of the general archiving system put in place as part of the mandatory requirements of Cyprus' National System. The majority of the documentation is included in the NIR on an annual basis to ensure the highest degree of transparency regarding the QA/QC procedures for Cyprus' greenhouse gas emission inventory.

### 8.2 IPCC guidance

The current IPCC guidelines for performing QA and QC activities are included in the IPCC good practice guidance (IPCC, 2000). This guidance has been modified during the preparation of the 2006 IPCC Guidelines (IPCC, 2006).

#### 8.2.1 Tier 1 QC

As part of the general QC procedures the IPCC good practice guidance recommends a number of standardised checks. These are included in Table 4.

**Table 4** IPCC recommended tier 1 QC procedures and the connection to PMs in Cyprus QC.

| QC Activity | Procedures | Related PMs |
|---|---|---|
| Check that assumptions and criteria for the selection of activity data and emission factors are documented. | Cross-check descriptions of activity data and emission factors with information on source categories and ensure that these are properly recorded and archived. | DS.1.3.1<br>DS.1.4.1<br>DS.1.5.1 |
| Check for transcription errors in data input and reference | Confirm that bibliographical data references are properly cited in the internal documentation.<br>Cross-check a sample of input data from each source category (either measurements or parameters used in calculations) for transcription errors. | DS.1.4.1<br>DP.1.5.2<br>DS.2.5.1 |
| Check that emissions are calculated correctly. | Reproduce a representative sample of emissions calculations.<br>Selectively mimic complex model calculations with abbreviated calculations to judge relative accuracy. | DP.1.5.3<br>DS.2.5.2<br>DS.3.1.2<br>DS.3.1.3 |
| Check that parameter and emission units are correctly recorded and that appropriate conversion factors are used. | Check that units are properly labelled in calculation sheets.<br>Check that units are correctly carried through from beginning to end of calculations.<br>Check that conversion factors are correct.<br>Check that temporal and spatial adjustment factors are used correctly. | DS.2.1.1<br>DS.3.1.2<br>DS.3.1.3 |
| Check the integrity of database files. | Confirm that the appropriate data processing steps are correctly represented in the database.<br>Confirm that data relationships are correctly represented in the database.<br>Ensure that data fields are properly labelled and have the correct design specifications. | DS.3.5.1<br>DS.3.5.2<br>DP.3.5.1<br>DP.3.5.2 |

| QC Activity | Procedures | Related PMs |
|---|---|---|
| | Ensure that adequate documentation of database and model structure and operation are archived. | |
| Check for consistency in data between source categories. | Identify parameters (e.g. activity data, constants) that are common to multiple source categories and confirm that there is consistency in the values used for these parameters in the emissions calculations. | DP.1.4.2 |
| Check that the movement of inventory data among processing steps is correct. | Check that emissions data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries.<br>Check that emissions data are correctly transcribed between different intermediate products. | DS.2.1.1 |
| Check that uncertainties in emissions and removals are estimated or calculated correctly. | Check that qualifications of individuals providing expert judgement for uncertainty estimates are appropriate.<br>Check that qualifications, assumptions and expert judgements are recorded. Check that calculated uncertainties are complete and calculated correctly. | DS.1.1.1<br>DP.1.1.1<br>DP.2.1.1<br>DP.2.5.2<br>DS.3.1.1 |
| Undertake review of internal documentation. | Check that there is detailed internal documentation to support the estimates and enable duplication of the emission and uncertainty estimates.<br>Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review.<br>Check integrity of any data archiving arrangements of outside organisations involved in inventory preparation. | DS.1.5.1<br>DS.1.5.2<br>DP.1.4.1<br>DP.1.5.1<br>DP.2.5.1 |
| Check methodological and data changes resulting in recalculations. | Check for temporal consistency in time series input data for each source category.<br>Check for consistency in the algorithm/method used for calculations throughout the time series. | DP.1.4.1<br>DS.2.5.1<br>DS.4.4.2 |
| Undertake completeness checks. | Confirm that estimates are reported for all source categories and for all years from the appropriate base year to the period of the current inventory.<br>Check that known data gaps that result in incomplete source category emissions estimates are documented. | DP.1.3.1<br>DS.4.3.1<br>DS.4.3.2 |
| Compare estimates to previous estimates. | For each source category, current inventory estimates should be compared to previous estimates. If there are significant changes or departures from expected trends, recheck estimates and explain any difference. | DS.3.1.2 |

All the general QC checks recommended in the IPCC good practice guidance have been considered in Cyprus' inventory as PMs and are therefore fully addressed.

### 8.2.2 Tier 2 QC

The IPCC good practice guidance considers source-specific QC as tier 2 in contrast to the general QC checks described in Chapter 8.2.1.

The IPCC good practice guidance considers three specific activities at the tier 2 level:

- Emission data QC
- Activity data QC
- QC of uncertainty estimates

The first bullet refers to QC checks of IPCC default emission factors, country-specific emission factors and plant-specific/measured emission factors.

The applicability of the chosen emission factors and comparison to international values including IPCC default emission factors are included in PM DS.1.2.1 and documented in the NIR. For country-specific emission factors these are checked against the IPCC defaults.

To the extent they are available plant-specific emission factors are used in Cyprus' inventory. When using plant-specific data these are based on strict monitoring guidelines (e.g. under the EU ETS). Further tier 2 QC checks includes emission comparisons, e.g. where the emission result is compared to previous estimates (PM DS.3.1.2) or where the trend is analysed and any outliers are identified and checked (PM DS.3.1.3). These checks are carried out at detailed source category level with priority given to key categories.

Regarding the use of activity data, Cyprus' inventory is based on official statistics (e.g. from Statistical Service, etc.) and from specific sites/companies. When using the official statistics, it is considered that these are of good quality and the responsible organisations have own QC systems in place. However, general (tier 1) QC checks are performed on the data in particular with respect to recalculation and/or dips and jumps in the time series.

For site-specific data, general QC checks are performed in comparing the values with those of pervious years to identify possible errors. When multiple data sources are available the data is cross-checked between the different data sources and any discrepancies are resolved by contact to the company in question.

The QC of the uncertainty estimates is carried out both in respect to the evaluation of the uncertainty assigned to the activity data and emission factors but also to the methodology for estimating the total uncertainty and the uncertainty of the trend. These issues are covered by several PMs on different levels of data handling (PMs DS.1.1.1, DP.1.1.1, DP.2.1.1, DS.3.1.1).

#### 9.2.3 QA procedures

The IPCC good practice guidance provides limited information on QA procedures. It distinguishes between expert peer-review and audits. According to the IPCC good practice guidance the peer-review can be conducted either for the inventory as a whole or in smaller parts. Furthermore, the IPCC good practice guidance states that it is considered good practice to involve reviewers that have not been directly involved in the inventory preparation and that these experts preferably should be independent experts from other agencies or a national or international expert or group not closely connected with national inventory compilation.

It is stated that prioritisation should be given to key categories and for any categories where significant methodological changes have occurred.

Cyprus' QA plan follows closely the guidance by the IPCC. Expert reviews are carried out both for the inventory as a whole (UNFCCC and EU reviews) and for specific source categories.

#### 9.2.4 Verification

The IPCC good practice guidance (IPCC, 2000) provides limited guidance concerning verification procedures.

The IPCC good practice guidance states that comparison of emission inventory data with other independently compiled, national emissions data are an option to evaluate completeness, approximate emission levels and correct source category allocations.

Furthermore, it is mentioned that the comparisons can be made for different greenhouse gases at national, sectoral, source category, and sub-source category levels.

According to the IPCC good practice guidance the verification techniques include internal quality checks, inventory inter-comparison, comparison of intensity indicators, comparison with atmospheric concentrations and source measurements, and modelling studies.

Specifically, the following activities are described:

- Comparisons with other national emissions data
- Comparison with national scientific and other publications
- Bottom-up, top-down comparisons
- Comparisons of national emission inventories with independently compiled, international datasets
- Comparisons of activity data with independently compiled datasets
- Comparisons of emission factors between countries
- Comparisons based on estimated uncertainties
- Comparisons of emission intensity indicators between countries
- Comparisons with atmospheric measurements at local, regional and global scales
- Comparisons with international scientific publications, global or regional budgets and source trends

These activities are of varying usefulness and consequently not all of these activities have been implemented as part of the QA/QC work on Cyprus' greenhouse gas inventory. More information on the verification activities undertaken by Cyprus' inventory team is included in Chapter 9.

## 9 Verification procedures

The verification process can help evaluate the uncertainty in emissions estimates, taking into account the quality and context of both the original inventory data and data used for verification purposes.

For many of the verification processes described in the IPCC good practice guidance, it is difficult to find suitable independent data. In many cases the alternative datasets are not completely independent since they to some extent are based on the same raw data. Nevertheless, these checks can be used to some degree to assess the completeness and the correctness of the emission inventory.

### 9.1 Comparisons with other national emissions data

There are very limited options for making comparisons with other national data. There are no regional emission inventories that can be used. All national statistical data have been used in the process of inventory preparation and there is therefore no possibility to compare with independent national emission estimates.

For large point sources there is in theory a possibility for verifying greenhouse gas emissions. Large point sources are obligated to report emissions under the European Union Emission Trading Scheme (EU ETS) and the European Union E-PRTR (Electronic Pollutant Release and Transfer Registry) Directive. However, Cyprus' inventory directly utilises the data reported under the EU ETS if the plants have based the reporting on plant/fuel specific measurements. For the remaining plants country-specific emission factors developed as part of the greenhouse gas inventory are used and hence there is no verification of the inventory in performing this comparison. Comparisons are made but mostly to identify erroneous reporting under the EU ETS.

Similarly, the data reported under the E-PRTR are of no use for verification. For CO2 the data are either identical to the EU ETS data or are based on the emission factors used in Cyprus' greenhouse gas inventory. For the other greenhouse gases the E-PRTR data are almost exclusively based on the emission factors published by DoE annually as part of the emission inventory work. Therefore, the comparisons usually serve to identify errors in the EPRTR reporting and not as a verification of Cyprus' greenhouse gas inventory.

### 9.2 Comparison with national scientific and other publications

DoE continuously monitor the publication of relevant information by other institutions. This includes e.g. the publication of research papers and dissertations from universities and research institutions. Also technical reports elaborated for e.g. the Energy Service are examined for any knowledge that can be used to verify or improve Cyprus' greenhouse gas emission inventory.

### 9.3 Bottom-up, top-down comparisons

Some checks of this nature are done annually as part of the mandatory reporting requirements. This is for instance the case for the comparison between the reference and sectoral approaches for CO2 emissions from fuel combustion. The result of the check is reported annually in the NIR and any major differences are investigated and explained.

Another check is done for road transport where the fuel consumption is calculated bottom-up annually based on a complex model taking into account vehicle stock data, mileage data and trip speeds (COBERT model). The bottom-up estimated emissions are compared to the estimated emissions as estimated for Cyprus' inventory. The result of the comparison is reported annually in the NIR.

### 9.4 Comparisons of national emission inventories with independently compiled, international datasets

There are available global databases of emissions. Examples are the CO2 emissions estimates from combustion of fossil fuels that are compiled by the International Energy Agency (IEA) and the Carbon Dioxide Information and Analysis Centre (CDIAC).

Global total anthropogenic inventories of all greenhouse gases are compiled by the Global Emission Inventory Activity (GEIA) and the Emission Database for Global Atmospheric Research (EDGAR).

Potentially, these comparisons can assist in checking completeness, consistency, source allocation and accuracy to within an order of magnitude. However, it must be noted that the data sources are not independent; e.g. the official national energy statistics are used in the greenhouse gas emission inventory and are also the basis of the reporting to the IEA which is the basis for the emission estimates made by IEA and EDGAR.

As a consequence of this weakness this area has not been prioritized for Cyprus' verification activities. There are currently no plans to implement a check of Cyprus' emission inventory with the international emission estimates prepared by GEIA or EDGAR.

### 9.5 Comparisons of activity data with independently compiled datasets

Similarly to the checks for emissions described in Chapter 9.4, checks can also be made concerning activity data, e.g. using IEA data for fuel consumption or FAO data for number of livestock. Checks can also be made using data published by Eurostat that is the statistical office of the European Union. Again there should not be any large differences as the activity data used in Cyprus' inventory are based on the official statistics also reported to international organisations, e.g. IEA, FAO and Eurostat.

The energy data reported by Cyprus in the CRF tables are annually compared to the IEA data as part of the standardised checks done by the UNFCCC during part II of the synthesis and assessment report.

FAO data has been used as verification of the activity data used for calculating emissions from the agricultural sector in Cyprus in cases where data is available from national sources.

### 9.6 Comparisons of emission factors between countries

This activity covers three main aspects: direct comparison of applied emission factors, comparison of implied emission factors (IEFs) and comparison with IPCC default values.

Comparing emission factors directly is difficult due to few countries reporting the applied emission factors. Therefore, the most feasible verification is to compare IEFs from the CRF reporting made by countries to the UNFCCC.

### 9.7 Comparisons based on estimated uncertainties

The work of collecting the uncertainties associated with specific emission factors for other countries has been deemed too excessive compared to the possible benefits. Therefore, this type of comparison is not considered to be feasible for implementation in Cyprus' quality work.

### 9.8 Comparisons of emission intensity indicators between countries

The most extensive verification work of Cyprus' greenhouse gas inventory is performed annually through the EU review process by comparing emission density indicators between countries of the European Union.

### 9.9 Comparisons with atmospheric measurements at local, regional and global scales

The IPCC good practice guidance mentions several options that can be used in comparing emission inventories with atmospheric measurements. These include: local and regional atmospheric sampling, continental plumes, satellite observations and global dynamic approaches.

Most of these options are more suited for regional or global verification than national verification, in particular for a small country like Cyprus. Both continental plumes and global dynamic approaches are not applicable for Cyprus. The use of satellite monitoring to estimate emissions is not feasible due to the cost of such verification and also the high uncertainty associated with such estimates.

There are no plans of using atmospheric measurements or inverse modelling as a means of verification of Cyprus' greenhouse gas inventory.

### 9.10 Comparisons with international scientific publications, global or regional budgets and source trends

No comparisons have been made with global or regional emission budgets. Furthermore, it is not believed that any such activities could contribute to the verification and/or improvement of Cyprus' greenhouse gas inventory. Therefore, there are no plans to undertake such activities.

# 10 Timing

Basic milestones of the QA/QC plan as part of the inventory preparation process are presented in Table 5 along with their timing.

This schedule will be tested for the first time for the 2018 submission and any revisions will be made after the 2018 submission.

**Table 5** Basic milestones of the QA/QC plan as part of the inventory preparation process

| Responsible | Activity | Deadline |
|---|---|---|
| All | Annual meeting: Assessment of previous inventory cycle, (what should be improved/ changed, new contracts, etc.) | |
| Sectoral experts | Notify the DoE of the planned methodological changes, reasons for changes and how they plan to incorporate the EU/UNFCCC review results to the next report | 15 October |
| All | Annual meeting: Sectoral experts notify the DoE of the planned methodological changes, reasons for changes, overview of the planning of the new inventory cycle and how they plan to incorporate the EU/UNFCCC review results to the next report. DoE give an overview of the new requirements, plans, etc. | 30 October |
| Data providers | Completion of data collection from involved institutions | 30 November |
| Sectoral experts | Completion of calculations | 15 December |
| Sectoral experts | Completion of data entry into CRF Reporter | 20 December |
| Inventory coordinator | QC checks and results are sent to the sectoral experts | 23 December |
| Sectoral experts | Send the necessary data for uncertainty analysis to Inventory coordinator | 27 December |
| Inventory coordinator | Compilation of CRF tables and their transfer to sectoral experts and independent experts for approval and opinion | 27 December |
| Sectoral experts | QC checks and documentation<br>Provide the draft NIR text to Inventory coordinator. | 30 December |
| Independent experts<br>Inventory coordinator | Carry out the QA procedures for the CRF tables and submit the documented results to Inventory coordinator.<br>Inventory coordinator forwards QA the results to sectoral experts | 30 December |
| Inventory coordinator | Carry out the QC procedures for the NIR and send the comments to the sectoral experts and independent experts for review | 5 January |
| Sectoral experts<br>Inventory coordinator | Send their comments and possible changes on the CRF tables according to the QA/QC to Inventory coordinator.<br>Inventory coordinator sends comments to independent experts | 10 January |
| Inventory coordinator | Key category analysis and uncertainty analysis<br>Send results to the sectoral experts and independent experts | 12 January |
| DoE | Provides the chapters on accounting of Kyoto units, changes on national system and minimization of adverse impacts in accordance with Article 3, paragraph 14, to the Inventory coordinator | 12 January |
| Inventory coordinator | Compiles the draft NIR and sends it to the sectoral experts and data providers for approval | 14 January |
| Inventory coordinator | Reporting to the EU (CRF tables and draft NIR) | 15 January |
| Inventory coordinator | Draft NIR is sent to involved institutions for approval | 15 January |
| Inventory coordinator | Draft NIR and CRF tables are uploaded to the DoE webpage for public review | 15 January |
| Independent experts<br>Inventory | QA of the NIR and submit the results to the Inventory coordinator.<br>Inventory coordinator submits the results to sectoral experts | 20 January |

| | | |
|---|---|---|
| coordinator | | |
| Involved institutions | Reports the results of QA of the CRF tables and NIR to the Inventory coordinator | 30 January |
| Inventory coordinator | Reports the results of QA of the CRF tables and NIR to the sectoral experts | 5 February |
| Sectoral experts | Send their comments and possible changes according to the QA/QC | 15 February |
| All | Annual meeting: The comments given during the inventory preparation and the last EU/UNFCCC review report will be looked through. Questions/problems that have been raised will be discussed before the submission to the EU | 1 March |
| All | Answers to the EU initial check and if necessary/possible corrections are made to the inventory | 28 February – 15 March |
| Inventory coordinator | Resubmission to the European Commission if necessary (CRF tables and NIR) | 15 March |
| All | Answers to the EU follow-up questions and if necessary/possible corrections are made to the inventory | 31 March – 7 April |
| DoE | Approval of final NIR & CRF tables | 11 April |
| Inventory coordinator | Submission to the UNFCCC secretariat | 15 April |
| Inventory coordinator | NIR & CRF tables uploaded to DoE website | 20 April |
| Sectoral experts | Submit complete archives to the Inventory coordinator | 2 May |

## 11 Future plans for the quality work

Cyprus' inventory team will continue to evaluate the QA/QC plan and this quality manual to ensure that it is kept up-to-date and it is modified to take into account any changes in requirements as well as the input received during the peer review of the inventory.

In the coming years the implementation of the present QA/QC plan will be assessed and identify any improvements that can be made both to the QA and QC processes described in this manual.

## References

IPCC, 2000: Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Available at: http://www.ipcc-nggip.iges.or.jp/public/gp/english/ (15-11-2016).

IPCC, 2006: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan. Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html (15-11-2016).

Nielsen, O.-K., Plejdrup, M.S., Winther, M., Gyldenkærne, S., Thomsen, M., Fauser, P., Nielsen, M. Mikkelsen, M.H., Albrektsen, R., Hjelgaard, K., Hoffmann, L. & Bruun, H.G. 2012. Quality manual for the Danish greenhouse gas inventory. Version 2. Aarhus University, DCE – Danish Centre for Environment and Energy, 44 pp. Scientific Report from DCE – Danish Centre for Environment and Energy No. 47, Available at: http://www.dmu.dk/Pub/SR47.pdf (15-11-2016)

UNFCCC, 2007: Updated UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of decision 14/CP.11 Available at: http://unfccc.int/resource/docs/2006/sbsta/eng/09.pdf (15-11-2016).