NATIONAL GREENHOUSE GAS EMISSION INVENTORY REPORT 2011 OF THE REPUBLIC OF LITHUANIA

(REPORTED INVENTORY 1990-2009)

Annual report under the UN Framework
Convention on Climate Change

aplinkos apsaugos politikos centras
center for environmental policy

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ES.1.1 Background Information on Climate Change

Lithuania has signed the United Nations Convention on Climate Change (UNFCCC) as an Annex I Party in 1992 and ratified it in 1995, signed the Kyoto Protocol in 1998 and ratified in 2002. Lithuania undertook to reduce its greenhouse gas emissions by 8% below 1990 levels during the first commitment period 2008-2012.

As a Party to the UNFCCC and in accordance with Article 5, paragraph 2 of the Kyoto protocol Lithuania is required to develop and periodically update national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by Montreal Protocol.

ES.1.2 Background information on greenhouse gas inventories

The greenhouse gas inventory presented here contains information on anthropogenic emissions by sources and removals by sinks for the following direct (CO_2, CH_4, N_2O, HFCs and SF_6) and indirect (CO, NOx, SO_2, NMVOCs,) greenhouse gases. Greenhouse gas inventory covers the years 1990-2009. For the preparation of the inventory CRF Reporter v.3.4.3 software has been used. The NIR includes a description of the methodologies and data sources used for estimating emissions by sources and removals by sinks, and a discussion of their trends.

The greenhouse gas inventory is prepared in accordance with the UNFCCC "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories (following incorporation of the provisions of decision 13/CP.9)"(FCCC/SBSTA/2004/8). Greenhouse gas inventory is compiled in accordance with the methodology recommended by the Intergovernmental Panel on Climate Change (IPCC) in its Revised 1996 Guidelines for National Greenhouse gas Inventories (IPCC, 1997), Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000) and Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC, 2003), the Annotated outline of the National Inventory Report including elements under the Kyoto protocol (UNFCCC, 2009) and taking into account remarks by the UNFCCC expert tem, provided in the Reports of the individual review of the annual submission of Lithuania submitted in 2009 and 2010.

ES.2 Summary of national emission and removal related trends

An overview of estimated GHG emissions is presented in Table 0-1, which shows GHG emissions by sectors, expressed in CO_2 equivalent for the years 1990-2009.

Table 0-1. Trends of GHG emissions by sectors, CO2 equivalent, Gg

GHG source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1. Energy	33,700	35,831	20,179	16,230	15,337	14,267	14,728	14,262	15,025	12,594	10,987
2. Industrial Processes	4,265	4,292	2,488	1,569	1,641	1,995	2,461	2,393	2,803	2,762	2,978
3. Solvent and other product use	198	196	194	192	189	186	184	181	179	176	174
4. Agriculture	9,875	9,061	6,046	5,019	4,319	4,177	4,584	4,613	4,408	4,224	4,001
5. LULUCF	-4,331	-4,671	-4,678	-4,702	-4,702	-4,714	-4,725	-4,745	-4,133	-4,129	-4,122
6. Waste	1,612	1,532	1,393	1,385	1,348	1,341	1,347	1,384	1,413	1,316	1,373
Total including LULUCF	45,319	46,241	25,622	19,693	18,132	17,251	18,578	18,088	19,695	16,944	15,390
Total excluding LULUCF	49,649	50,912	30,299	24,395	22,834	21,965	23,303	22,833	23,828	21,072	19,512

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2009/1990, %
1. Energy	11,675	11,740	11,706	12,324	13,003	13,155	13,340	13,053	11,876	-64.8%
2. Industrial Processes	3,207	3,400	3,209	3,599	3,982	4,252	6,034	5,375	2,305	-45.9%
3. Solvent and other product use	171	169	167	164	162	131	122	96	100	-49.2%
4. Agriculture	4,206	4,436	4,631	4,617	4,636	5,155	4,747	4,656	4,666	-52.8%
5. LULUCF	-4,316	-4,520	-3,672	-3,798	-3,270	-3,432	-3,960	-3,958	-3,757	-13.2%
6. Waste	1,383	1,316	1,377	1,388	1,363	1,383	1,403	1,451	1,443	-10.5%
Total including LULUCF	16,326	16,541	17,418	18,294	19,875	20,644	21,685	20,672	16,633	-63.3%
Total excluding LULUCF	20,642	21,061	21,090	22,092	23,145	24,076	25,646	24,631	20,390	-58.9%

ES.3 Overview of source and sink category emission estimates and trends

Upon its independence from the Soviet Union in 1990, after 50 years of annexation, Lithuania inherited an economy with high energy intensity. A blockade of resources, imposed by USSR during 1991–1993 led to a sharp fall in economic activity, as reflected by the decrease of the Gross Domestic Product (GDP) in the beginning of nineties. The economic situation improved in the middle of the last decade and GDP has been increasing until 1999 (during 1999-2000, GDP decreased due to the economic crisis in Russia) and GDP continued increasing from 2001 to 2008 (in 2009-2010 GDP decreased due to the world economical crisis). These fluctuations were reflected in the country's emissions of greenhouse gases.

Between 1990 and 2000 greenhouse gas (GHG) emissions decreased significantly as a consequence of the decline in industrial production and associated fuel consumption. Once the economy started growing again, emission rose but this was in part compensated by reductions achieved through energy efficiency and measures taken to reduce emissions.

PART 1: ANNUAL INVENTORY SUBMISSION

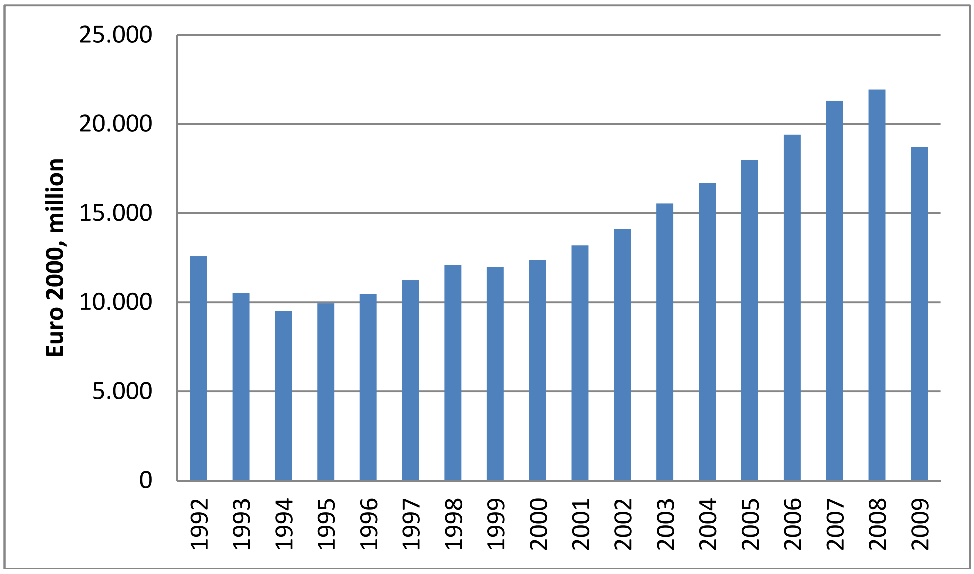
1 Introduction

Lithuania has signed the United Nations Convention on Climate Change (UNFCCC) as an Annex I Party in 1992 and ratified it in 1995, signed the Kyoto Protocol in 1998 and ratified in 2002. Lithuania undertook to reduce its greenhouse gas emissions by 8% below 1990 levels during the first commitment period 2008-2012.

As a Party to the UNFCCC and in accordance with Article 5, paragraph 2 of the Kyoto protocol Lithuania is obliged to develop and periodically update national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by Montreal Protocol.

Lithuanian economics have declined substantially after declaration of independence in 1990. In 1994 GDP dropped to 54% of 1989 level but later started to increase again (Fig. 1-1).GDP growth reached 7.3% in 1998 but, as a result of banking crisis in Russia, decreased again in 1999. Since 2000, GDP is growing continuously, average annual increase in 2000-2005 was 7%, average GDP change from 1995 to 2005, including the decline during the banking crisis in Russia, was 5.7%.

As a result of the global economical crisis Lithuania's economic development has slowed down by the end of 2008. In 2008 GDP growth has decreased to 2.9% and in 2009 GDP contracted by -14.7%.



Source: Statistics Lithuania

Fig. 1-1. GDP variations in Lithuania from 1992

As it is shown in the following Chapters, between 1990 and 2000, greenhouse gas (GHG) emissions decreased significantly as a consequence of the reconstruction of economy: the decline in industrial production engendered a sharp decrease in fuel consumption and, as a result, in greenhouse gas emissions. Once rehabilitation of the economy started, reductions were also achieved through energy efficiency and measures taken to reduce emissions.

Energy consumption intensity is decreasing continuously (Fig. 1-2) but energy intensity per unit GDP is still 2.5 times higher than the EU average.

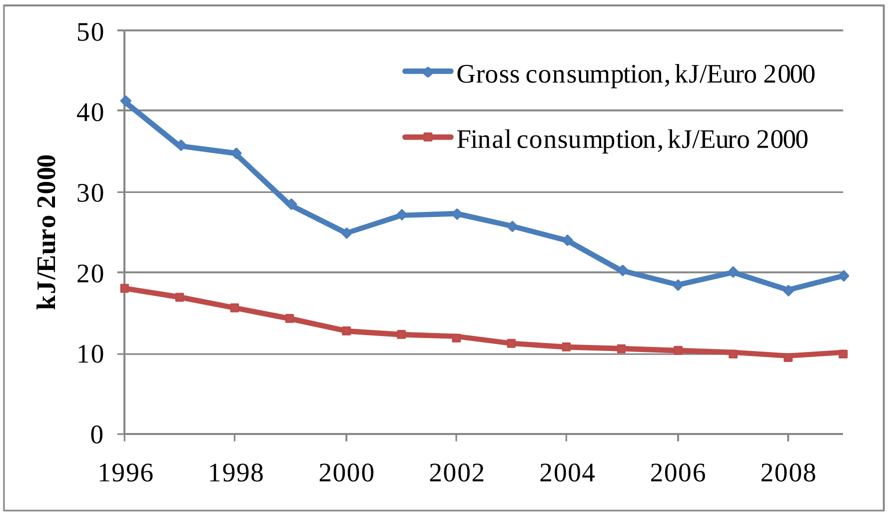


Fig. 1-2. Energy intensity variations in 1996-2009, kJ/Euro 2000

In May 2004, Lithuania became a member state of the European Union. A major policy priority is now to strengthen our membership implementing the EU requirements.

1.1 Background information on greenhouse gas inventory

Since 2004, inventory is prepared in common reporting format (CRF). From 2006 inventory is being prepared using *CRF Reporter* software, developed by UNFCCC. In 2006 for the first time complete time series 1990-2004 has been developed and submitted to the European Commission and the UNFCCC together with Lithuania's Initial Report under the Kyoto protocol.

This National Inventory Report (NIR) covering the inventory of greenhouse gas emissions of Lithuania is being submitted to the secretariat of the UNFCCC, in compliance with the decisions of the Conference of the Parties 3/CP.5 and 11/CP.4. It also was submitted to the European Commission and complies with the Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto protocol.

The greenhouse gas inventory presented here contains information on anthropogenic emissions by sources and removals by sinks for the following direct (CO_2, CH_4, N_2O, HFCs and SF_6) and indirect (CO, NOx, SO_2 ,NMVOCs,) greenhouse gases. Greenhouse gas inventory covers the years 1990-2009. For the preparation of the inventory CRF Reporter v.3.5.2 software has been used. The NIR includes a description of the methodologies and data sources used for estimating emissions by sources and removals by sinks, and a discussion of their trends.

The greenhouse gas inventory is prepared in accordance with the UNFCCC "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories (following incorporation of the provisions of decision 13/CP.9)"(FCCC/SBSTA/2004/8). Greenhouse gas inventory is compiled in accordance with the methodology recommended by the Intergovernmental Panel on Climate Change (IPCC) in its Revised 1996 Guidelines for National Greenhouse gas Inventories (IPCC, 1997), Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000), Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC, 2003) and Annotated outline of the National Inventory Report including elements under the Kyoto protocol (UNFCCC, 2009).

The NIR accompanies the GHG inventory for 2009. The NIR includes a description of the methodologies and data sources used for estimating emissions by sources and removals by sinks, and a discussion of their trends.

1.2 Institutional Arrangement and Process for Inventory Preparation

The principle diagram showing institutions responsible for the preparation of the GHG inventory in Lithuania and their interaction is shown in Fig. 1-3.

In order to strengthen the institutional arrangements for the functioning of the National system and ensuring consistent long-term-financing, continuity of its inventory experts and a proper data collection the new National system with re-defined responsibilities was designed. Further information on it is provided in Chapter 13 “Information on changes in National system” and in the Plan of Improvements for Lithuania’s GHG inventory, submitted to the UNFCCC Secretariat and European Commission in January 2011.

The final responsibility for the preparation of the annual GHG inventory report and its submission to the European Commission and the Secretariat of the UNFCCC is placed on the Ministry of Environment. Compilation of the report is coordinated by the Climate Change and Hydrometeorology Division of the Pollution Prevention Department within the Ministry of Environment.

1.2.1 Ministry of Environment

The Ministry of Environment is responsible for:

- Overall coordination of GHG inventory process;
- Final checking and approval of GHG inventory procedures;
- Approval of QA/QC plan and procedures;
- Checking of consistency of data, documenting, processing, archiving;
- Preparation of legal basis necessary for National system functioning;
- Timely submission of GHG inventory to the UNFCCC Secretariat and the European Commission;
- Coordination of the UNFCCC inventory reviews in Lithuania;
- Keeping of archive of official submissions to the UNFCCC and the European Commission;
- Informing the inventory compilers about relevant requirements for the National system

The Ministry of Environment annually submits GHG inventory reports to the European Commission and the UNFCCC secretariat.

The Ministry of Environment establishes and operates GHG inventory database and archive. The Ministry of Environment is a single location where archives of GHG submissions and all supporting reference material is stored and maintained. Backups are prepared on regular basis following the MoE information management procedures.

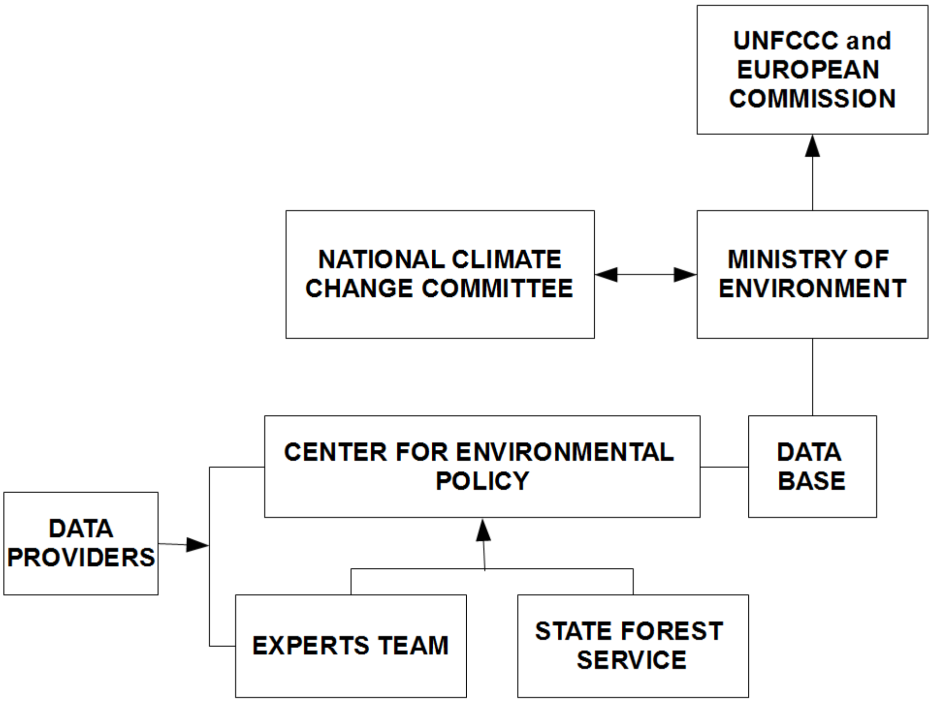


Fig. 1-3. Institutional set-up for GHG inventory

1.2.2 National Climate Change Committee

Before submission, reports are forwarded to the **National Climate Change Committee** for final approval. The National Committee on Climate Change was set up in 2001 in the first instance and renewed in April 2010. It consists of experts from, government institutions, academia and non-governmental organizations (NGOs) and has an advisory role. The main objective of the Committee is to ensure attainment of the goals related to the restriction of GHG emissions as set in the National Sustainable Development Strategy and implementation of the measures for attaining such goals. Also, the Committee has to coordinate the issues related to formulation and implementation of the national policy on climate change management, to advise on the implementation of the provisions of the UNFCCC and coordinate compliance with the requirements of the Kyoto Protocol and the EU legal acts related to the UNFCCC.

1.2.3 The Center For Environmental Policy

The Center of Environmental Policy is contracted by the Ministry of Environment as the coordinator of the GHG inventory from 2008. It has the following functions and responsibilities:

- Forming of GHG inventory experts team (except for LULUCF sector);
- Participation in the identification of data providers for specific information and in the selection of methods (complying with IPCC Good Practice Guidance) for calculation of emissions;
- Checking and archiving of supplied input data, prepared inventory and used materials;
- Key categories analysis;
- Uncertainty assessment;
- Preparation of Common Reporting Format (CRF) tables and compilation of National Inventory Report (NIR);

- Development and implementation of QA/QC plan and specific QA/QC procedures;
- Providing the final inventory (CRF tables and NIR) for the Ministry of Environment;
- Evaluating requirements for new data, based on internal and external reviews.

1.2.4 GHG Inventory Experts Team

The GHG Inventory Experts Team is formed from the leading Lithuanian specialists in areas related to GHG emissions. Functions and responsibilities of the expert team as a whole are defined as follows:

- evaluating requirements for new data, based on internal and external reviews
- identification of data providers for specific information,
- formulation of requests to provided needed data,
- selection of (= complying with IPCC Good Practice Guidance) methods (complying with IPCC Good Practice Guidance) for calculation of emissions giving the priority to key categories and categories with high uncertainty,
- determination of activity data,
- determination of appropriate emission factors,
- calculation of emissions,
- data quality control,
- filling sectoral CRF tables.

The team is made of technical experts responsible for GHG inventory in separate sectors. The group has to meet in decided periods but at least two times per year to discus new items related to GHG inventory.

The main functions and responsibilities of the persons participating in the inventory process are as follows:

- Team Leader: responsible for all aspects of the inventory preparation including supervision, evaluation of uncertainties, coordination of actions, etc.
- Sectoral experts: responsible for preparation of the inventory for specific sectors assigned to them, taking decisions regarding collection and processing of data related to their specific sectors and for supervision of other persons involved in data collection and processing in corresponding sector.
- QA/QC Manager: responsible for management and implementation of the QA/QC plan and procedures, for reviewing and checking reports provided by the sectoral experts, as well as for personnel involved in QA/QC process.
- External experts: independent specialists providing data for the GHG inventory (data providers) may also be involved during the inventory process in preparation and upgrading of methodologies, data review and evaluation, they can also perform expertise of the whole inventory or of its separate parts.

1.2.5 State Forest Service

The State Forest Service (SFS) compiles the National Forest Inventory and the forest information system, carries out monitoring of the status of the Lithuanian forests, collects and manages statistical data etc. The Service functions under the Ministry of Environment.
Since year 2010 State Forest Service in the GHG inventory preparation process is responsible for LULUCF (forestry part) sector and Kyoto protocol 3.3 and 3.4 removals and emission calculations for the LULUCF sector. In this framework, the State Forest Service has the following responsibilities:

- Collection of activity data and emission factors used to calculate emissions and removals for LULUCF sector and KP-LULUCF;
- Selection of methods (complying with IPCC Good Practice Guidance for LULUCF) for calculation of emissions and removals giving the priority to key categories and categories with high uncertainty;
- Emission and removals estimates for LULUCF sector and KP-LULUCF;
- Uncertainty assessment;
- Checking and archiving of input data, prepared estimates and used materials;
- Preparation of Common Reporting Format (CRF) tables and National Inventory Report (NIR) parts for LULUCF and KP-LULUCF;
- Implementation of QA/QC plan and specific QA/QC procedures related to LULUCF;
- Providing the final estimates (CRF tables and NIR part) for the Environmental Protection Agency;
- Evaluating requirements for new data, based on internal and external reviews.

1.3 Inventory Preparation

Inventory preparation is coordinated by the Center for Environmental Policy, which is responsible for the compilation of the final report based on the sectoral reports provided by experts/consultants. The Center for Environmental Policy in cooperation with sectoral experts develops data management system for the collection of data from different sectors and their generalization. The sectoral experts evaluate and provide recommendations for the indispensable scientific researches and required data collection. Initial data for the sectoral reports is supplied by data providers and processed by the experts/consultants. Unprocessed data provided by the data providers is stored in the database before being handed over to experts/consultants for processing. Processed data are also stored in the database. The database is established and operated by the Ministry of Environment.

1.3.1 Data providers

Data providers are responsible for:

- collection of activity data,
- applying QC procedures (documentation in checklists to be provided to Center for Environmental Policy),
- evaluation of uncertainties of the initial data.

The most important data providers for the Lithuanian GHG inventory preparation are the Statistics Department of Lithuania, the Environmental Protection Agency, the State Forest Service, the Lithuanian Forest Research Institute, the Institute of Physics, the Centre of Information and Rural Business of Ministry of Agriculture, the Geological Survey of Lithuania, The National Land Service under the Ministry of Agriculture, the Institute of Animal Science, industry companies etc.

1.3.2 Data Input

The specialists who compile the inventory (experts team and Center for Environmental Policy) must observe the following principles:

- To avoid transcription and copying errors, all data shall be entered only once and after that used with the help of formulas.

- The formulas shall not contain any specific factor values, since these shall be entered into individual cells of the spreadsheet as input data.
- The worksheets or cells with the input data or formulas shall be protected with a password in order to prevent any potential modification.
- If identical data is used under the categories of different sectors, the same electronic file shall be used for the calculations of both or several sectors.
- Confidential data shall be concealed from reading and protected by a password.

1.3.3 Data Documentation

Inventory documentation must be sufficiently comprehensive and clear for independent experts to be able to obtain and review the references used and to restore the emission calculations. Complete and accessible documentation of the methods, data and data sources, spreadsheets, telephone recordings and other data contacts is very important for compilation and provision of a correct and exhaustive inventory.

It is necessary to ensure that the information, including the sources of data references used for the emission calculations in relation to the inventory, is sufficient for independent experts to reproduce the inventory calculations. The documentation shall also contain information on all changes made with respect to the data sources or methodological modifications in the current year. Both the inventory spreadsheets and the inventory document must be thoroughly checked to be able to judge the completeness, accuracy and consistency of the references. The analyst of the inventory and QC personnel should be well acquainted with the below-listed procedures that enable ensuring high quality of the inventory.

In the spreadsheets, all input data (activity data, emission factors, carbon coefficients, etc.) must have references to the published or unpublished data sources. The spreadsheets may not contain any uncountable data without any references, except for standard conversion factors or similar information:

- In the spreadsheets, references to the sources used shall be entered as Excel comments, or another marking system should be used. Abbreviated references may be given only when a comprehensive reference list is presented in a separate worksheet.
- Each reference in the spreadsheet (published or unpublished) shall have a documented copy either in the current inventory file or in the archive of former inventories.
- Oral references shall be based on the *Contact Report* which shall provide information on the date of the respective phone call or meeting.
- Each reference given in the spreadsheets shall also be indicated in the list of the references of the inventory document using the same form of presentation of the reference in question.
- All information (records, contact reports, comments, and, especially, printouts from the spreadsheets) must be dated.
- References or short logical clarifications, or assumptions and criteria used by personnel responsible for individual sectors with respect to selection of the activity data and emission factors must be documented in a specified place of the spreadsheet or in comment cells.
- Changes in assumptions, methodologies or data sources as compared to the previous year may be given in comments.

When checking the spreadsheets, the following should be checked:

- Spreadsheet books: are there sufficient data for primary data sources;
- All references in the spreadsheets and the inventory documents: is the list given complete; are all documents referred to in the spreadsheets also given in the inventory;

- Documents listed in the reference section: do all these documents actually exists (in archives or in the current inventory file);
- All contact sheets, fax messages, other storages, printed documents or other information of unpublished documents shall be carefully checked;
- The inventory and spreadsheet references shall be randomly checked to make sure that correct information is presented from the document indicated in the reference and that there are no transcription errors;
- Assumptions and criteria for selection of the activity data: have they been discussed and documented in respective comment cells of the spreadsheets.

If possible, all references in the inventory documents and spreadsheets should be presented in the same form. The proposed types of references are listed below.

Telephone or meeting contacts. Individual persons, organisations, and companies that provide information shall be identified giving their full name, telephone and fax numbers as well as indicating the date of the provision of information.

Fax messages, letters, electronic messages and other written or unpublished information. Such information shall be presented together with complete contact information of the provider, i.e. name, address, telephone and fax numbers, email address, etc.

Published data. This information shall be provided together with complete bibliographical source data, including the author, title, publisher, town, publication date, etc. as well as the number of pages.

Electronic data. The name, abbreviation, address, telephone, and email address of the data provider as well as other important information shall be indicated. The source information of the data obtained from the internet shall be as comprehensive as possible, including the webpage address and the date when the data was downloaded.

Comments. Here it is very useful to indicate the date of the comment as well as the name or the initials of the person who has made the comment (tip – set the Excel program on automatic display of the *User Name* in the comment).

1.3.4 Documentation, and Archiving Procedures

Inventory data as well as background information on activity data and emission factors are archived by the Center for Environmental Policy. Backups of each year data and supportive material are kept in the external hard disc.

Information on QA/QC activities, decisions reached by the experts group, reviews, results of key category analysis and uncertainty analysis as well as inventory development is documented and archived in the data base at the Ministry of Environment.

The Ministry of Environment (MoE) is a single location where archives of GHG submissions and all supporting reference material is stored and maintained. Backups are prepared on regular basis following the MoE information management procedures.

1.3.5 Quality Assurance and Quality Control

In order to improve further data integrity, correctness, and completeness, QA/AC plan was developed and implemented. The plan includes Tier 1 General Inventory Level QC Procedures outlined in Table 8.1 of *IPCC Good Practice Guidance*, and a peer review of the inventory estimates.

The QA/QC plan establishes *good practice* consistent with the *IPCC Good Practice Guidance* aimed at improving transparency, consistency, comparability, completeness, and confidence in the national inventory of emissions estimates.

The Quality Assurance and Quality Control (QA/QC) Plan has been prepared in order to improve transparency, consistency, comparability and completeness of Lithuania's GHG inventory. The QA/QC Plan describes the quality objectives of the GHG inventory, the national system for inventory preparation, tasks and responsibilities. A description is provided of various formal procedures already implemented in the development of the GHG inventory and of planned improvements. The Center for Environmental Policy is responsible for co-ordination and implementation of the Plan.

As the Lithuanian National System for the preparation of the GHG inventory is under enhancement for essential changes and improvements, QA/QC plan was updated in 2011. The Ministry of Environment and the Environment Protection Agency was responsible for the development of the updated QA/QC Plan. The Environment Protection Agency will be responsible for the coordination and implementation of the Plan with a supervision performed by the Ministry of Environment.

1.3.5.1 Good Practice

Good Practice is a set of procedures intended to ensure that greenhouse gas inventories are accurate in the sense that they are systematically neither over nor underestimates so far as can be judged, and that uncertainties are reduced so far as possible.
Good Practice covers choice of estimation methods appropriate to national circumstances, quality assurance and quality control at the national level, quantification of uncertainties and data archiving and reporting to promote transparency.

Quality Control (QC) is a system of routine technical activities, to measure and control the quality of the inventory as it is being developed. The QC system is designed to:

(I) Provide routine and consistent checks to ensure data integrity, correctness, and completeness;
(II) Identify and address errors and omissions;
(III) Document and archive inventory material and record all QC activities.

QC activities include general methods such as accuracy checks on data acquisition and calculations and the use of approved standardized procedures for emission calculations, measurements, estimating uncertainties, archiving information and reporting. Higher tier QC activities include technical reviews of source categories, activity and emission factor data, and methods.

Quality Assurance (QA) activities include planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process to verify that data quality objectives were met, ensure that the inventory represents the best possible estimate of emissions and sinks given the current state of scientific knowledge and data available, and support the effectiveness of the quality control (QC) program.

1.3.5.2 Quality Control Procedure

Analysts of the inventory must adopt adequate procedures for development and modification of the spreadsheets to minimise emission calculation errors. Checks ensure compliance with the established procedures as well as allow detecting the remaining errors.

Parameters, emission units and conversion factors used for the calculations must be clearly singled out and specified. Also, additional procedures should be followed to ensure that the parameters and emission factors are correctly written down and that relevant conversion factors are used.

- Emission units, parameters and conversion factors shall not be directly included in the formulas; any value used for the calculations more than once shall be given in the spreadsheets (preferably at the top of the page and in bold) and in the calculations, where they should be taken from one cell as a reference.
- Units shall be properly marked and correctly maintained during the entire calculation.
- Correct conversion factors shall be used.
- Temporary coefficients shall be used correctly.

The analysts must ensure data consistency in the databases and spreadsheets.

- Confirm that respective data processing steps have been correctly represented in the spreadsheets (e.g. correct formulas have been used);
- Confirm that data relations have been properly presented (e.g. that the data is of the same year and given in the same units);
- Clearly distinguish between the input data and the calculable data in the spreadsheets (e.g. by setting a respective colour coding system).

The managers of sectors (experts team) shall present the spreadsheets with the input data, calculation results and descriptions of the respective chapters of the NIR to the Manager of the Inventory and to the Manager of Quality Control (Center for Environmental Policy).

Quality control involves the following:

Evaluation of the data collection procedure, to establish whether:

- the necessary methods, activity data and emission factors (i.e. those in conformity with the IPCC Good Practice Guidance) have been used;
- the calculations have been made correctly;
- all time series data has been provided and calculated;
- the data and results for the current year have been compared with the data and results of the previous years;
- the notes and comments contain all necessary information on the data sources, calculation methods, etc.

Evaluation of the emission calculation, to establish:

- consistency of the emission factors used;
- correctness of the emission parameters, units, conversion factors used;
- correctness of the data transferred from spreadsheets to CRF tables;
- correctness of repeat calculations.

Evaluation of the preparation of respective chapters of the National Inventory Report, to establish:

- integrity of the structures of the inventory data;
- completeness of the inventory;
- consistency of time series;
- whether the emission estimates have been compared with previous estimates;
- whether the data tables of the National Inventory Report correspond to the text;
- whether all necessary information on the data sources, assumptions and calculation methodology have been provided.

After the check, the protocol is given back to the sector managers who respond to the comments of the QC Manager and, if necessary, correct the data, calculation methodology or the report (NIR) accordingly.

1.3.5.3 Quality Assurance

Quality assurance includes an objective review to assess the quality of the inventory, and also to identify areas where improvements could be made. The objective in QA implementation is to involve reviewers that can conduct an unbiased review of the inventory. In general, reviewers that have not been involved in preparing the inventory should be used. Preferably these reviewers would be independent experts from other agencies or a national or international expert or group not closely connected with national inventory compilation.

A basic review of the draft GHG emission and removal estimates and the draft report takes place before the final submissions to the EU and UNFCCC (January to March) by the involved institutions on GHG inventory preparation process: the final draft of the NIR is coordinated with the Climate Change and Hydrometeorology Division at MoE, National Climate Change Committee, the relevant departments of the Ministry of Environment (e.g. Department of Waste, Department of Water, Department of Forestry and other) and it's subordinated institutions (e. g. Environmental Protection Agency, Lithuanian Environmental Investment Fund who is administrator of the National GHG Registry, etc.) before the submission to the European Commission and the UNFCCC secretariat.
Received corrections were incorporated into the NIR.

In February 2011 the European Commission's (EC) consistency report of Lithuania's GHG inventory was received. The number of corrections were elaborated in Lithuania's GHG inventory in response to EC quality checks and comments. The most of them were done in LULUCF and KP-LULUCF sectors. Lithuania was improving accounting on KP-LULUCF during February-March 2011 with assistance of the experts from the European Environment Agency and the EC Joint Research Center before the inventory submission to UNFCCC secretariat in April.

It is considered that UNFCCC reviews performed by the ERTs are also help to fulfil requirements of the Quality Assurance of the GHG inventory. UNFCCC review reports indicate issues where inventory needs improvements. The improvement plan for GHG inventory (presented in the QA/QC plan) is compiled based on the findings of the UNFCCC, EC, internal reviews and other recommendations. GHG Inventory Expert Team shall be guided by the Plan and shall take into consideration recommendations provided by the ERT to ensure that all estimates or explanations as indicated by the ERT will be corrected and included in the next submissions.

1.4 Methodologies and Data Sources

The greenhouse gas inventory presented here contains information on anthropogenic emissions by sources and removals by sinks for the following direct (CO_2, CH_4, N_2O, HFCs and SF_6) and indirect (CO, NOx, NMVOCs, SO_2) greenhouse gases. Greenhouse gas inventory covers the years 1990-2009.

The GHG inventory is prepared in accordance with the methodology recommended by the IPCC in its publications:

- *Revised 1996 Guidelines for National Greenhouse Gas Inventories*, IPCC, 1997 (hereinafter – *Revised IPCC 1996 Guidelines*),
- *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, IPCC, 2000 (hereinafter – IPCC *GPG 2000*),
- *Good Practice Guidance for Land Use, Land-Use Change and Forestry*, IPCC, 2003 (hereinafter – IPCC GPG *LULUCF Guidance 2003*).

The main sources for emission factors for Lithuania‘s GHG inventory are:
- Revised IPCC 1996 Guidelines;
- IPCC GPG 2000;

- IPCC GPG LULUCF 2003;
- IPCC Guidelines for GHG inventories 2006 (hereinafter – IPCC Guidelines 2006);
- EMEP/CORINAIR Guidebook 2007 and EMEP/EEA 2009;
- National studies for country specific parameters and emission factors (e.g. EFs for fuel combustion, plant specific industrial parameters etc.)

Lithuania's GHG emission inventory includes all major emission sources identified by the *IPCC GPG 2000* with some exceptions, which supposed to have minor effect on the total GHG emissions. All Lithuania's territory is covered by GHG inventory.

If possible, the activity data required for calculating GHG emissions is taken from various publications meanwhile unpublished data are collected from relevant institutions (institutes, industrial enterprises, etc.) on a request of the Ministry of Environment.

The main providers of the data for the GHG inventory are:

- Statistics Lithuania publishes Lithuanian annual statistical publications (annual statistical data on energy balance, agriculture, production and commodities);
- State Forest Service under the Ministry of Environment publishes annual statistical data on forestry (*Lithuanian Statistical Yearbook of Forestry (2001-2009)*; *Lithuanian Country Report on Global Forest Resources Assessment (2005, 2010));*
- The National Land Service under the Ministry of Agriculture provides data on the Lithuanian Land Fund including data on forest land area;
- Environmental Protection Agency collects data and maintains database on wastewater and waste, F-gases;
- Industrial companies (AB Achema (ammonia, nitric acid production data and natural gas consumption data, AB „Orlen Lietuva“ (CO2 EFs for fuel combustion), AB „Akmenes cementas“ (activity data and CaO/MgO content), AB „Naujasis Kalcitas“ (limestone composition data), glass production companies (dolomite, soda ash, potash and chalk, UAB „Paroc“ (rock wool production data, etc.));
- Institute of Physics is annually calculating precursors (NOx, SO2, CO, NMVOC) emissions under Convention of Long-range Transboundary Air Pollution;
- Centre of Information and Rural Business of Ministry of Agriculture (data on livestock)

The main indicators of sustainable development are published annually by Statistics Lithuania, observing the established procedure, in statistical yearbooks of Lithuania meanwhile specific indicators are given in other publications.

The State Forest Service compiles the National Forest Inventory and the forest information system, carries out monitoring of the status of the Lithuanian forests, collects and manages statistical data, etc. This Service functions under the Ministry of Environment.

The Environmental Protection Agency (EPA) is subordinated to the Ministry of Environment. Its responsibilities include monitoring of environmental quality, collection and storage of environmental data and information as well as assessment and forecasting of environmental quality. One of the main tasks of the EPA is to manage, process, and provide information. Starting from 2011 year, EPA under the Ministry of Environment was nominated as an entity responsible for GHG inventory preparation by the Order of Minister of Environment No D1-1017. More explicit information on planned improvements of the National System of the preparation of GHG inventory is presented in the Plan of Improvements for Lithuania's GHG inventory, submitted to the UNFCCC Secretariat and European Commission in January 2011.
The inventory compilation process involves many institutions, organisations and other persons that contribute, directly or indirectly, to the preparation of the inventory data, however, only some of them directly participate in the development of the inventory itself. Further investigations concerning new sources of data and involving more institutions for GHG inventory preparation are envisaged in 2011.

1.5 Key Source Categories

Key source categories analysis for the GHG inventory for the years 1990 (base year) and 2009 were performed according to the *Good Practice Guidance* (2000). Both level assessment and trend assessment of the key source categories including and excluding LULUCF were conducted, following the Tier 1 approach. Any source category that met the 95% threshold was identified as a key source category.

The results of the analyses are provided in Table 1.1. More detailed information on key categories calculations is provided in the Annex I.

Table 1-1. Key sources categories analysis (years 1990, 2009, 1990-2009)

KEY category	Green house Gas	Level with LULUCF 1990	Level without LULUCF 1990	Level with LULUCF 2009	Level without LULUCF 2009	Trend (1990-2009) with LULUCF	Trend (1990-2009) without LULUCF
Stationary Combustion, liquid fuel, CO2	CO2	x	x	x	x	x	x
Stationary Combustion, gaseous fuel, CO2	CO2	x	x	x	x	x	x
Road transportation, CO2	CO2	x	x	x	x	x	x
Stationary Combustion, solid fuel, CO2	CO2	x	x	x	x	x	x
Enteric Fermentation domestic livestock, CH4	CH4	x	x	x	x	x	
Direct Soil Emissions, N2O	N2O	x	x	x	x	x	x
Other transportation	CO2	x	x	x	x	x	x
Indirect Emissions, N2O	N2O	x	x	x	x		x
Cement Production, CO2	CO2	x	x	x	x	x	x
Manure Management, CH4	CH4	x	x	x	x		
Ammonia Production, CO2	CO2	x	x	x	x	x	x
Nitric Acid Production, N2O	N2O	x	x	x	x	x	x
Manure Management, N2O	N2O	x	x	x	x		
Waste-water Handling, CH4	CH4	x	x	x	x	x	x
Solid Waste Disposal on Land, CH4	CH4	x	x	x	x	x	x
Pasture, Range and Paddock Manure	N2O	x		x			
Fugitive Emissions from Oil and Gas Operations	CH4			x	x	x	x
Forest Land	CO2	x		x		x	
Other land	CO2			x		x	
Other industries	CO2					x	x
Settlements	CO2					x	
Lime production	CO2					x	
Consumption of HFCs							x

1.6 Completeness and Time-Series Consistency

Lithuania's GHG emission inventory includes all major emission sources identified by the IPCC Good Practice Guidance 2000 with some exceptions reported as "not estimated" (NE) (see Table 1-2), which supposed to have minor effect on the total GHG emissions. Emissions are not estimated mainly due to lack of activity data and/or methodology.

Activity data and emission factors/parameters used for estimations are consistent and adequate through the 1990-2009. 1995 was taken as the base year for estimating emissions of F-gases.

Table 1-2. Summary of completeness of GHG inventory

IPCC source and sink categories	CO_2	CH_4	N_2O	HFCs	PFC	SF_6
1 Energy						
A Fuel combustion	All	All	All			
1 Energy industries	All	All	All			
2 Manufacturing industries and construction	All	All	All			
3 Transport	All	All	All			
4 Other sectors	All	All	All			
5 Other	All	All	All			
B Fugitive emissions from fuels						
1 Solid fuels	NO	NO	NO			
2 Oil and natural gas	All	All	All			
2 Industrial processes						
A Mineral products	Part	NE	NE			
B Chemical industry	All	All	All			
C Metal production	All	NO	NO		NO	NO
D Other production	NE					
E Production of halocarbons and SF_6				NO	NO	NO
F Consumption of halocarbons and SF_6				Part	NO	All
G Other production	NO	NO	NO	NA	NA	NA
3 Solvent and other product use	Part	NA	Part	NA	NA	NA
4 Agriculture						
A Enteric fermentation		All				
B Manure management		All	All			
C Rice cultivation		NO				
D Agricultural soils		NA	All			
E Prescribed burning of savannas		NO	NO			
F Field burning of agricultural residues		NO	NO			
G Other		NO	NO			
5 Land use, land use change and forestry						
A Forest land	Part	Part	Part			
B Cropland	NE	NE	NE			
C Grassland	NE	NE	NE			
D Wetlands	Part	NE	NE			
E Settlements	Part	NE	NE			
F Other land	Part	NE	NE			
G Other	NE	NE	NE			
6 Waste						
A Solid waste disposal on land	NA	All				
B Wastewater handling		All	All			

C	Waste incineration	All	NE	All			
D	Other	NO	NO	NO			

All - Emissions of the gas are covered for all sources under the source category
NA - Emissions of the gas not applicable to the source category
NO - Emissions of the gas does not occur in Lithuania for the source category
NE - Emissions on the gas not estimated for the source category
Part - Emissions of the gas estimated for some activities in the source category

1.7 Uncertainty Evaluation

Uncertainty estimation was performed using Tier 1 approach of *IPCC Good Practice Guidance*. Quantitative uncertainties assessment was carried out for the emission level 2009 and for 1990-2009 (1995-2009 for F-gases) trend in emissions for all source categories (except Solvents use) comprising emissions of CO_2, CH_4, N_2O, HFC and SF_6 gases (in CO_2 equivalents). The GHG uncertainty estimates do not take into account the uncertainty of the GWP factors. The sources included in the uncertainty estimate cover 99.9% of the total greenhouse gas emission.

Uncertainties were estimated using combination of available default factors proposed in IPCC Good Practice Guidance with uncertainties based on expert judgment, consultation with statistical office.
Tier I uncertainty evaluation analysis (including and excluding LULUCF) is presented in Annex 2.

1.7.1 Energy

There is a certain level of uncertainty for the fuel combustion sector. Data on fuel consumption are collected by the Lithuanian Statistical Department which prepares the annual report “Energy balance”. Some categories defined in the CRF do not exactly match the categories of energy commodities and economic sectors identified in the national statistics. Therefore the final figures for fuel consumption and respective emissions have had to be calculated by grouping data selected from the Energy Balance, using expert judgment. Based on recommendations provided by 2006 IPCC Guidelines for GHG inventories (IPCC, 2006) the default uncertainty range for fossil fuel combustion data should be assumed to be plus or minus 5%. Since data on biomass as fuel are not well developed as for fossil fuel, the uncertainty range for biomass is plus or minus 50% as recommended by (IPCC, 2006).

1.7.2 Industrial processes

1.7.2.1 Mineral industries

The data on clinker production provided by the single production company should be considered reliable and it was assumed that uncertainty in this case is 2%. The data on lime production was taken from the Statistics Lithuania publications and it was assumed that uncertainty of these data is about 5%.

Limestone and dolomite use was evaluated only for iron production. Bearing in mind that some other uses may not been taken into account, it was assumed that uncertainty limestone and dolomite use data may be about 10%.

Soda ash use was evaluated as difference of data provided by the Statistics Lithuania and evaluated other uses. As each of these components contains certain uncertainty, the total uncertainty in soda ash use was assumed to be 10%.

CO_2 emissions in glass production were calculated from the data on use of raw materials containing carbonates. The data were obtained from the production companies but only for the second half of the period under consideration (1999-2009). Detailed data on composition of raw materials were available only for the last 4 years. In addition, only very limited data were obtained from cathode ray tubes producer JSC Ekranas which got bankrupt in 2006. In view of these considerations it was assumed that activity data uncertainty for glass production was about 7%.

The data on rock wool production and raw materials consumption obtained from the production company are reliable and precise, however, they cover only the period after reconstruction of the plant (from 1997). Historic data for 1990-1996 are expert evaluation and may contain significant error. It was assumed that overall uncertainty of rock wool production activity data is about 7%.

Emission factor uncertainty for production of mineral products was assumed to be 5%.

1.7.2.2 Chemical industry

Uncertainty of activity data for chemical industry was assumed to be 2%. Emission factor uncertainty for CO_2 emissions from ammonia production and CH_4 emissions from methanol production was assumed to be 10%, and 30% for N_2O emissions from nitric acid production.

1.7.2.3 Iron production

The data on the total cast iron production were taken from the Statistics Lithuania and the data on cast iron production in blast furnaces were provided by the production companies. It was assumed that the overall uncertainty of activity data is about 4%. Default emission factors were used. Bearing in mind that cast iron is produced only from iron scrap while emission factors are established for production from iron ores, it should be expected that uncertainties in emission factors are comparatively large. It was assumed that uncertainty for emission factors are 10%.

1.7.2.4 F- gases

It was assumed that uncertainty in establishing activity data may reach about 20%. Uncertainty of emission factors was assumed to be 20%.

1.7.3 Agriculture

1.7.3.1 Enteric fermentation

Relevant animal head counts

The data on cattle population provided in the statistical data bases are reliable. In Lithuania cattle are marked individually. In the groups of cattle and sheep the average annual number of animals was used. However the precision of calculated data of emission is influenced by the fact that it is impossible to divide the cows into sub-groups. The weight of cattle for meat and their weight gain is established only in accordance with those conclusions of experts and the indices of registers, the data can have actual data error. The ratio of variation of animal number given by the Department of Statistics for animals is 2%.

Tier 1 methodology used for other animal categories is limited by factors such as weight, age, gender, and feeding system are assumed similar within a given animal category.

Emission factors

Emission factors estimated using the Tier 1 method may be uncertain to ±50%.[1] or ±20%[2]. Emission factor estimates using the Tier 2 method are likely to be in the order of ± 20% [3].

[1] IPCC 2006. Emissions from Livestock and Manure management. P. 10.33

1.7.3.2 Manure management

The ratio of animal number variation given by the Department of Statistics for animals is 2%, for poultry - 3%. 2006 IPCC Guidelines for National Greenhouse Gas Inventories refers that for the Tier 1 method was larger uncertainty range for the default factors. For Tier 1 method uncertainty for CH_4 is estimated to be ±30%. Improvements achieved by Tier 2 methodologies are estimated to reduce uncertainty ranges in the emission factors to ±20%[4]

Animal number uncertainties and uncertainties related with manure management systems number were the same as for enteric fermentation. GPG 2000 (table 4.13) refers that for Tier 1 method the uncertainty range for the default factors for Tier 1 method is estimated to be +50%/-100%[5].

1.7.3.3 Agricultural soils

Direct emissions

The animal number variation ratio given by the Department of Statistics is 2% for animals, and 3% for poultry. Uncertainties in estimates of direct emissions of N_2O from agricultural soils are caused by uncertainties related to the emission factors.

Indirect emissions

Information about emission factors, leaching and volatilisation fractions are sparse and highly variable. Expert judgement indicates that emission factor uncertainties are at least in order of magnitude and volatilisation fractions of about +/−50%[6].

1.7.4 LULUCF

1.7.4.1 Forest land

Growing stock volume of all Lithuanian forests per 1 ha, was estimated with 0.8% accuracy (under probability 0.683). The lowest standard error was estimated in pine (dominant species in Lithuania) stands – 1.3%, the highest in ash and oak stands – 5.1%.

Gross volume increment estimation errors are close to growing stock volume errors – gross volume increment was estimated with 0.7% accuracy, while the least error was estimated in pine stands – 1.2%, the highest in ash stands – 4.8% and oak stands – 4.4%.

For forest land remaining forest land it was assumed that overall uncertainty of activity data is 1%. Emission factor uncertainty was assumed to be about 5%.

For land converted to forest land it was assumed that overall uncertainty of activity data is 40%. Emission factor uncertainty was assumed to be about 10%.

1.7.4.2 Cropland

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[2] IPCC 1996. Agriculture. P. 4.10
[3] IPCC 2000. Agriculture. P.4.28
[4] IPCC 2006. Emissions from Livestock and Manure management. P. 10.48
[5] IPCC. 2000. Agriculture. Table4.13. P. 4.44.
[6] IPCC 2000. Agriculture. P. 4.75.

It was assumed that uncertainty of activity data is 30%. Emission factor uncertainty was assumed to be about 10%.

1.7.4.3 Wetlands

CO_2 emissions from wetlands were evaluated as a result of forest land conversion to wetlands. Converted areas are very small and it was assumed that uncertainty of activity data can be about 80%. Emission factor uncertainty was assumed to be about 20%.

1.7.4.4 Settlements

CO_2 emissions from settlements were evaluated as a result of forest land conversion to settlements. Converted areas are relatively very small and it was assumed that uncertainty of activity data can be about 80%. Emission factor uncertainty was assumed to be about 20%.

1.7.4.5 Other land

CO_2 emissions from other land were evaluated as a result of forest land conversion to other land. Converted areas are relatively very small and it was assumed that uncertainty of activity data can be about 80%. Emission factor uncertainty was assumed to be about 20%.

1.7.5 Waste management

1.7.5.1 Solid waste disposal on land

It was assumed that uncertainty in establishing activity data was about 30% and uncertainty in emission factors was about 50%.

1.7.5.2 Wastewater

It was assumed that uncertainty in establishing activity data was about 30% and uncertainty in emission factors was about 50%.

1.7.5.3 Waste incineration

It was assumed that uncertainty in establishing activity data was about 25% and uncertainty in emission factors were about 30% for CO_2 and about 100% for N_2O.

1.7.6 Overall uncertainty

The estimated uncertainties for total GHG and for CO_2, CH_4, N_2O and F-gases are presented in Annex III.

The uncertainties as % of total national emissions including LULUCF in 2009 by different gases are as follows:

CO_2	±3.3%
CH_4	±4.4%
N_2O	±10.5%

The total GHG emission in the year 2009 is estimated with an uncertainty of ±11.9% and the trend of GHG emission 1990-2009 has been estimated to be ±2.5%.

The uncertainties as % of total national emissions excluding LULUCF in 2009 by different gases are as follows:

CO_2	±1.8%
CH_4	±3.6%
N_2O	±8.6%

The total GHG emission in the year 2009 is estimated with an uncertainty of ±9.5% and the trend of GHG emission 1990-2009 has been estimated to be ±1.9%.

2 Trends in GHG emissions

2.1 Emission trends for aggregated greenhouse gas emissions

Aggregated emissions of GHG expressed in Gg CO_2 equivalent (without CO_2 removals and emissions from the LULUCF sector) in 2009 have decreased by approximately 56% compared to the base year (Fig.2-1) Reduction of net emissions including LULUCF was even higher.

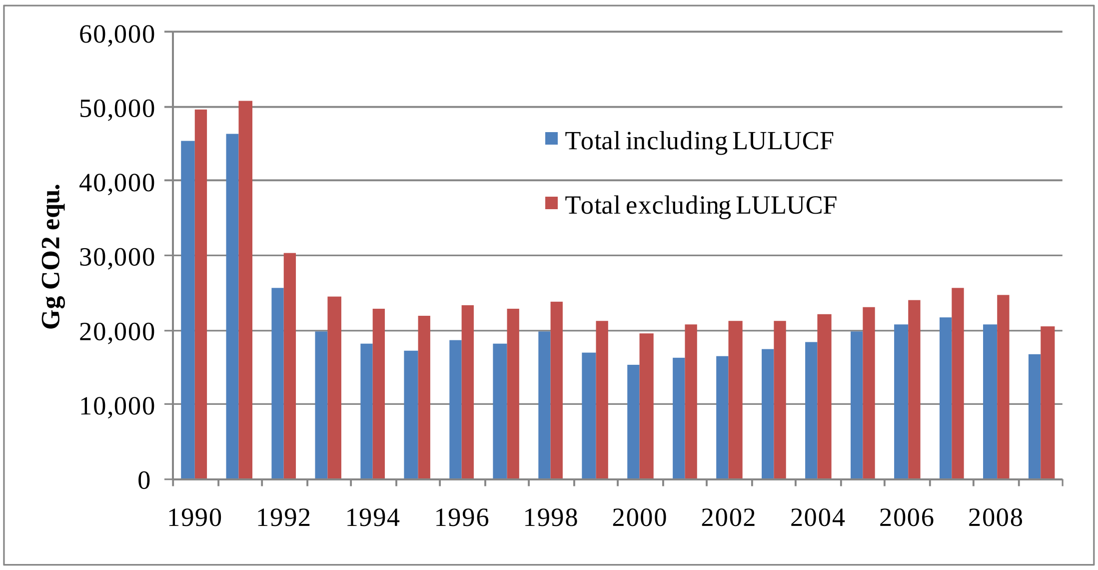


Fig. 2-1. Emission trends for aggregated GHG (Gg CO2 eqv.)

Variations of emissions of the main greenhouse gases between 1990 and 2009 are shown in Fig. 2-2.

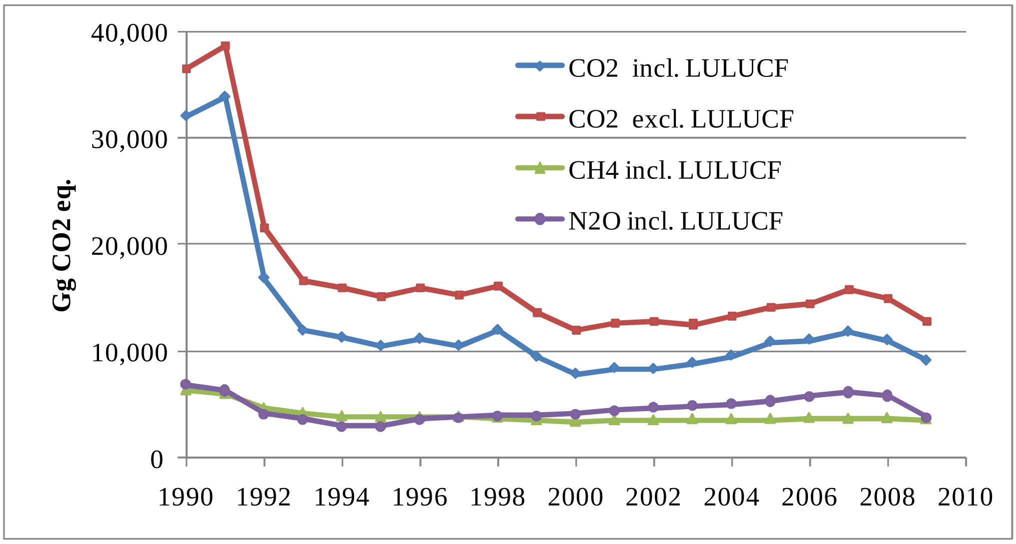


Fig. 2-2. Trends of GHG emissions by gas in CO_2 equivalent, Gg

Emissions of all three gases were increasing continuously from 2000 to 2007 but some reduction of emissions was observed in 2008-2009. Emission variations actually follows fluctuation of industrial output as reflected by the growth of GDP.

2.1.1 Carbon dioxide emissions

Overall CO_2 emissions in 2009 compared to 2008 decreased by 1923 Gg including LULUCF (-17.4%) or 2124 Gg excluding LULUCF (-14.1%). Overall CO_2 emissions (excluding LULUCF) from 1990 have been reduced by 22,967 Gg (71.6%).

CO_2 emissions in energy sector in 2009 decreased by 9.0% compared to 2008 mainly due to reduction of fuel consumption in transport and manufacturing sectors in which CO_2 emissions were reduced by 17.4% and 19.4% accordingly.

As a result of significant contraction of industrial output caused by economic recession, CO_2 emissions in mineral products manufacturing sector in 2009 decreased by 41.6% compared to 2008. Corresponding reduction of CO_2 emissions in chemical industries reached 59.9%.

2.2.2 Methane emissions

Overall methane emissions in 2009 compared to 2008 decreased by 5.1 Gg (2.8%) mainly due to reduction of number of cattle.

2.2.3 Nitrous oxide emissions

Overall N_2O emissions in 2009 compared to 2008 decreased by 6.5 Gg (34.8%) mainly due to contracted nitric acid production and installed emission reduction measures in nitric acid plant.

2.3 Emission trends by source

The trends of GHG emissions by sectors are presented in Table 2-1 showing GHG emissions by sectors, expressed in CO_2 equivalent and taking into account GHG emissions/removals from LULUCF.

The most significant reduction in GHG emissions was observed immediately after declaration of independence from 1991 to 1993 when the total emissions decreased by more than 50% mainly due to sharp decline of activities in energy and industrial sectors. The decrease was noticeable in all subsectors but especially sharp in manufacturing and construction where GHG emissions decreased approximately 3 times.

Reduction of GHG emissions in agriculture was less dramatic but still reached about 40% in two years.

Another reduction of GHG emissions in energy and agriculture sectors occurred in 1998-2000 though emissions from industrial processed were continuously increasing from 1995. From the year 2000 GHG emissions are slightly increasing in all sectors except waste.

The major source of GHG has been energy sector though its share in the total emissions decreased from 68% in 1990 to 58% in 2009 (excluding LULUCF) (Fig. 2-3)

Table 2-1. Trends of GHG emissions by sectors, CO_2 equivalent, Gg

GHG source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1. Energy	33,700	35,831	20,179	16,230	15,337	14,267	14,728	14,262	15,025	12,594	10,987
2. Industrial Processes	4,265	4,292	2,488	1,569	1,641	1,995	2,461	2,393	2,803	2,762	2,978
3. Solvent and other product use	198	196	194	192	189	186	184	181	179	176	174
4. Agriculture	9,875	9,061	6,046	5,019	4,319	4,177	4,584	4,613	4,408	4,224	4,001
5. LULUCF	-4,331	-4,671	-4,678	-4,702	-4,702	-4,714	-4,725	-4,745	-4,133	-4,129	-4,122
6. Waste	1,612	1,532	1,393	1,385	1,348	1,341	1,347	1,384	1,413	1,316	1,373
Total including LULUCF	45,319	46,241	25,622	19,693	18,132	17,251	18,578	18,088	19,695	16,944	15,390
Total excluding LULUCF	49,649	50,912	30,299	24,395	22,834	21,965	23,303	22,833	23,828	21,072	19,512

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2009/1990, %
1. Energy	11,675	11,740	11,706	12,324	13,003	13,155	13,340	13,053	11,876	-64.8%
2. Industrial Processes	3,207	3,400	3,209	3,599	3,982	4,252	6,034	5,375	2,305	-45.9%
3. Solvent and other product use	171	169	167	164	162	131	122	96	100	-49.2%
4. Agriculture	4,206	4,436	4,631	4,617	4,636	5,155	4,747	4,656	4,666	-52.8%
5. LULUCF	-4,316	-4,520	-3,672	-3,798	-3,270	-3,432	-3,960	-3,958	-3,757	-13.2%
6. Waste	1,383	1,316	1,377	1,388	1,363	1,383	1,403	1,451	1,443	-10.5%
Total including LULUCF	16,326	16,541	17,418	18,294	19,875	20,644	21,685	20,672	16,633	-63.3%
Total excluding LULUCF	20,642	21,061	21,090	22,092	23,145	24,076	25,646	24,631	20,390	-58.9%

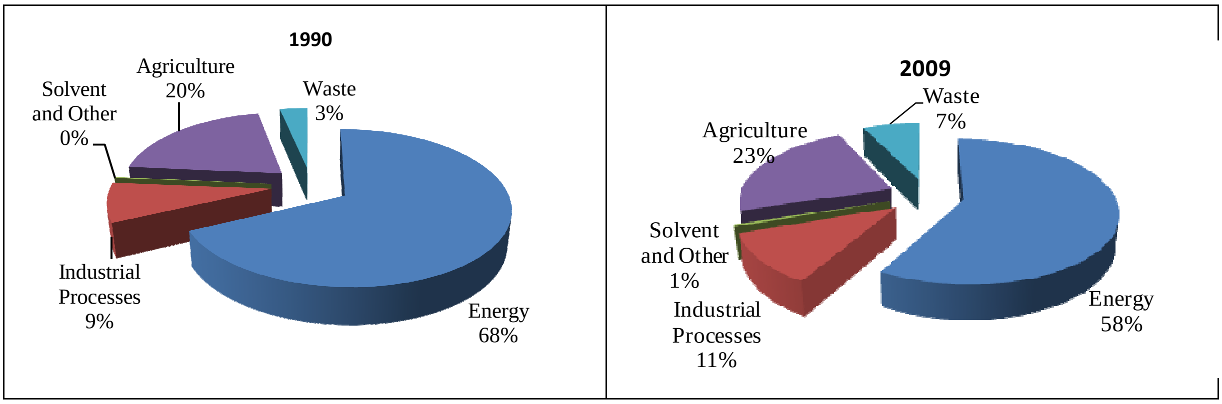


Fig. 2-3. Shares of GHG emissions by sector in 1990 and 2009 in CO_2 equivalent

3 Energy (CRF sector 1)

3.1 Overview of energy sector

The extensive energy sector inherited from the Soviet period does not conform to the current requirements of the energy market (in terms of efficiency, management principles, structure, etc.). Therefore the recent national policy relating to this sector has focused primarily on its substantial reorganisation and privatization, as well as the implementation of the relevant the European Union (EU) Directives.

When the national economy started to recover between 1995 and 2000, decrease of final energy consumption continued at average annual rate of 3.8%. This was already predetermined by structural changes in the national economy, introduction of new technologies replacing energy-consuming technologies inherited from the past, as well as implementation of other measures improving energy efficiency.

After 2000, the national economy manifested particularly rapid growth. In 2000 – 2007, gross domestic product GDP) (at current prices) of Lithuania increased by 2.1 times and amounted to EUR 28 billion in 2007. In the same time, final energy consumption grew by 4.7% on average and increase only 1.4 times, primary energy consumption 1.3 times.

As a result of economic recession which started after restoration of independence of Lithuania in 1991, energy consumption decreased considerably in all branches of economy (Fig. 3-1, Fig. 3-2). In 1991–1994, both primary and final energy consumption decreased approximately by 2.1 times. From 1995 GDP has been increasing until 1999 (during 1999-2000, GDP decreased due to the economic crisis in Russia) and GDP continued increasing from 2001 to 2008. In 2005-2008 GDP increased by 21,7%, but in 2009 decreased by 14,8% comparing with 2008. Energy consumption changed accordingly. During 2005-2007 period final energy consumption increased by 11,7%, but in 2009 decreased by 12,1% comparing with 2007.

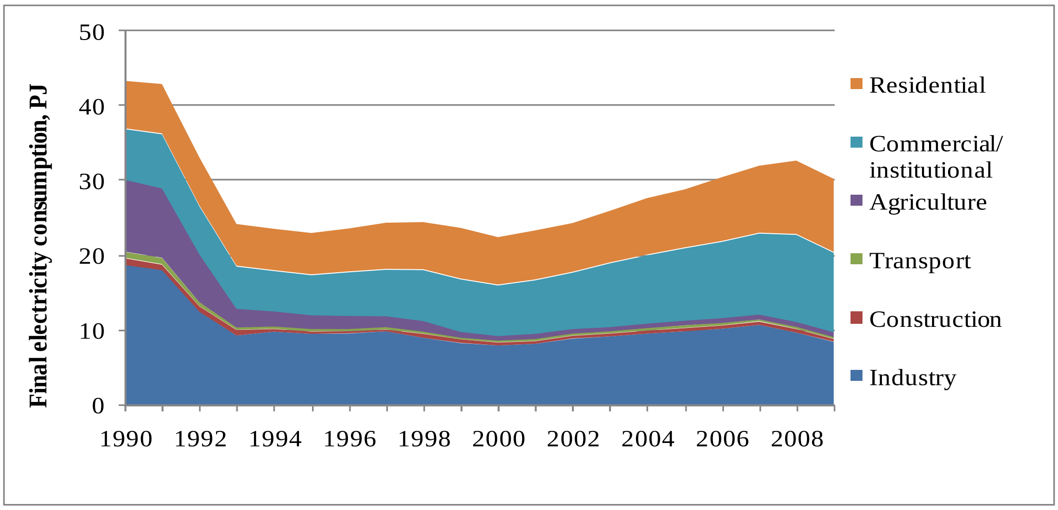


Fig. 3-1. Final electricity consumption by sectors in 1990-2009, PJ
(Source: Statistics Lithuania)

Lithuania has developed heating system with around 65% of consumed heat produced in centralized systems. The share of centralized heating in the whole heating sector remained fairly constant over the last years.

The major problem in the heating system is inefficiency at the point of consumption – the average yearly heat consumption of Lithuanian buildings is 220 kWh/m², which is substantially higher than the average of Nordic countries (128 kWh/m²). Reducing this inefficiency can bring substantial savings of heating costs and would lower emissions of greenhouse gas.

In addition, the heat is being produced mainly from fossil fuels – approximately 70% is produced from gas, which is imported from a single source. Increasing energy production from renewable energy sources can diversify energy sources for heat production and reduce negative impact of the heating sector on the environment.

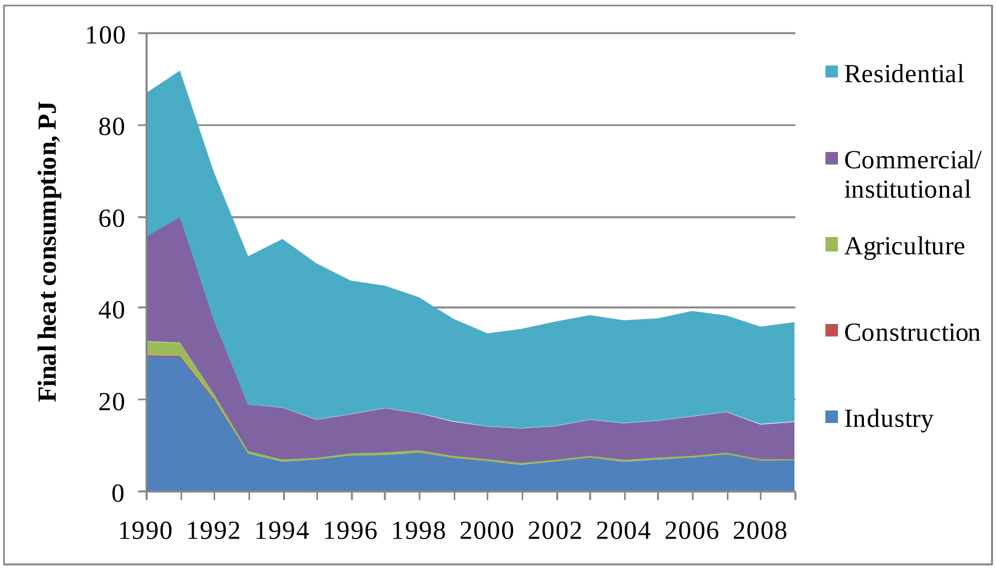


Fig. 3-2. Final heat consumption by sectors in 1990-2009, PJ

(Source: Statistics Lithuania)

The Ignalina Nuclear Power Plant (NPP) played a key role in the Lithuanian energy sector producing up to 70-80% of the electricity until its closure by the end on 2009. It had installed capacity of 3000MW in two RB MK-1500 (large power channel reactor) reactors. The structure of electricity generation in 1990-2009 is shown in (Fig. 3-3).

Capacity of the NPP far exceeded Lithuanian requirements and substantial portion of produced electricity was exported depending on market conditions (Fig. 3-4).

Following the Accession Agreement to the EU, Lithuania closed the first reactor on the 31st December 2004, and the second reactor was closed 31st December 2009.The share of electricity produced in Ignalina NPP has been taken over mainly by the Lithuanian Thermal Power Plant and the largest combined heat and power plants at Vilnius and Kaunas. Thus, the projected energy demand after the decommissioning of Ignalina NPP has been met by using the existing generating capacities.

After shutdown of Ignalina NPP, Lithuania turned from net electricity exporter into net electricity importer. Consequently, Lithuania is facing major shortcomings in electricity production. Around half of the electricity consumed is imported from neighbouring countries, mostly from Russia. The country is also very dependent on electricity produced from fossil fuels which are imported from the single source.

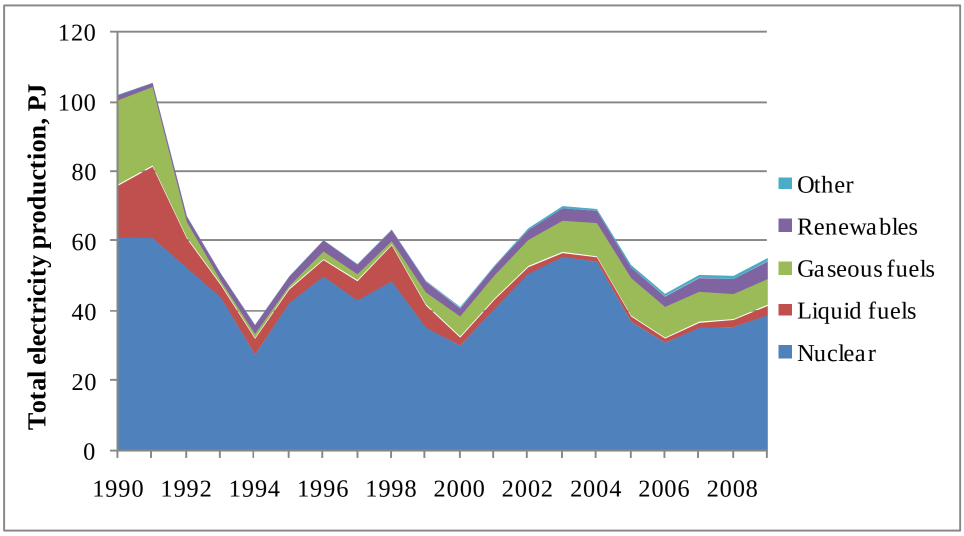


Fig. 3-3. Structure of electricity generation in 1990-2009 by fuel types, PJ

(Source: Statistics Lithuania)

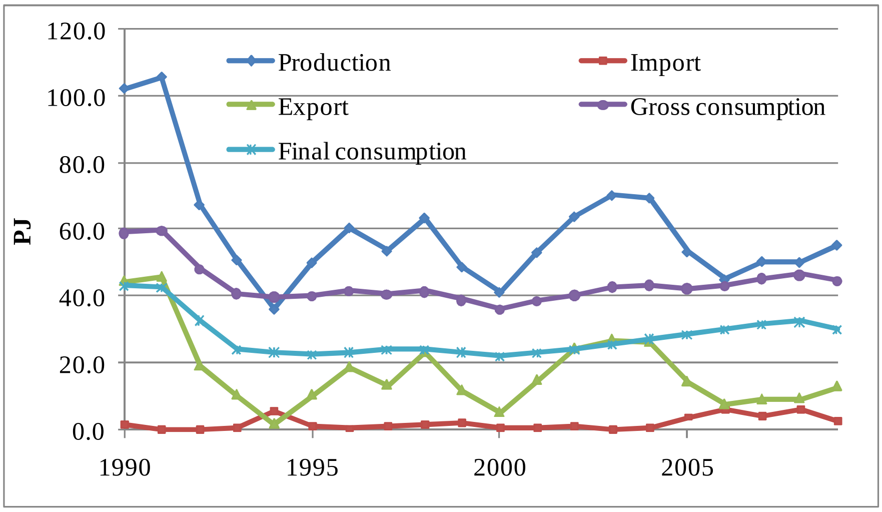


Fig. 3-4. Electricity production and consumption in 1990-2009, PJ

(Source: Statistics Lithuania)

Currently, the share of renewable energy sources in the final energy consumption amounts to around 14%. The largest part of it is covered by biomass, which will continue to play a leading role in the energy production from renewable energy sources. Given Lithuania's natural conditions, the potential of wind and hydro energy is also not fully exploited yet (Fig. 3-5).

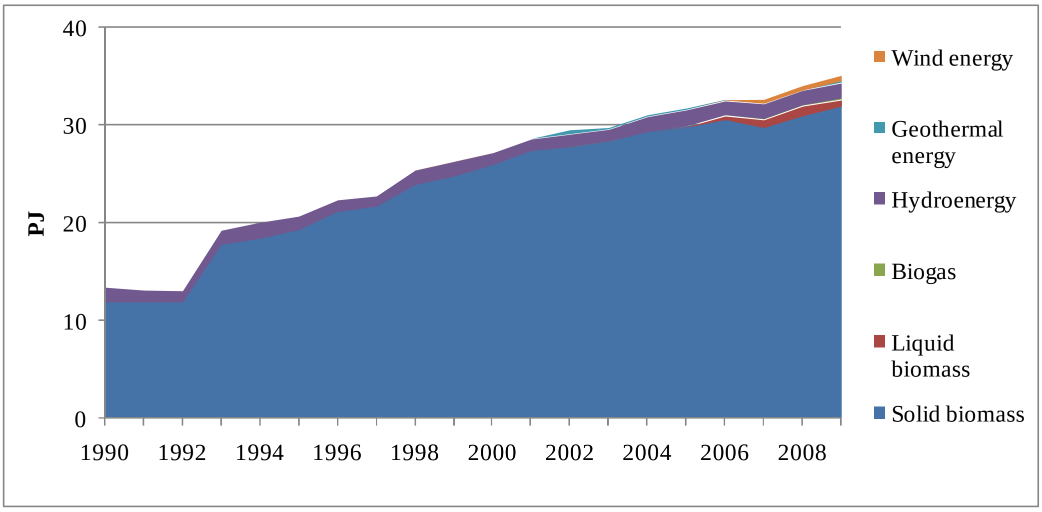


Fig. 3-5. Consumption of renewable resources in 1990-2009, PJ

(Source: Statistics Lithuania)

Though primary and final energy consumption intensity has decreased approximately 50% during the period 1996-2009 (Fig. 3-6), energy intensity per unit of GDP is 2.5 times higher than the EU average. This reveals vast untapped potential for energy efficiency, especially in heating and transport sectors.

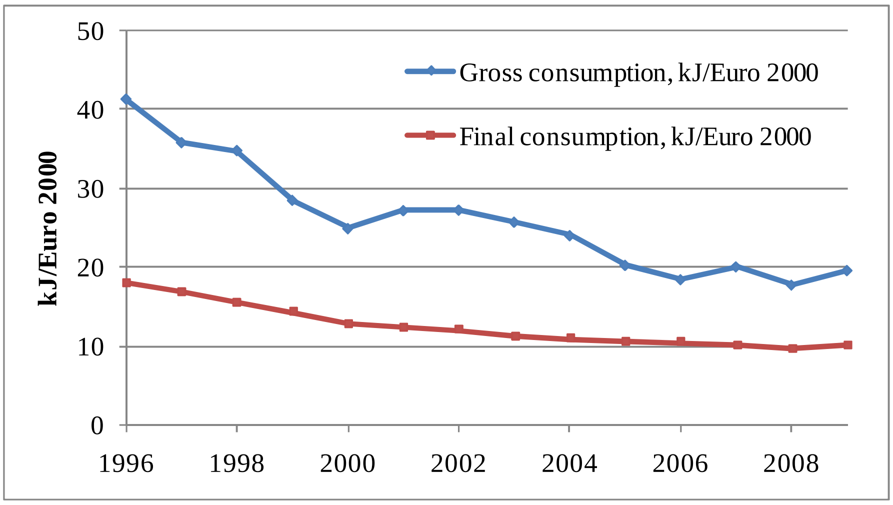


Fig. 3-6. Energy intensity variations in 1996-2009, kJ/Euro 2000

(Source: Statistics Lithuania)

Lithuania's dependence on fossil fuels has caused CO_2 emissions to increase, especially after the closure of the Ignalina NPP. This creates additional difficulties for sustainable development of the energy sector.

The National Energy Strategy was adopted by the Lithuanian Parliament in 2007. The main objectives of the strategy is to diversify energy sources including nuclear power and to expand input of renewable energy sources. The Strategy foresees construction of the new regional nuclear power plant in cooperation with other Baltic States and Poland which should start operating in 2015 however the recent events related with the preparations for the construction show that construction may be more problematic as thought initially. In 2010 The National Energy Independence Strategy was adopted by the Lithuanian Government. In the Strategy it is planned that new regional nuclear power plant will be built in 2020. The National Energy Independence Strategy will enter into force after it's approval by the Parliament later this year.

3.2 Fuel combustion (CRF 1.A)

3.2.1 Fuel consumption

Crude oil and natural gas are mainly imported from Russia. In 2008 Lithuania imported 9.13 million tonnes of crude oil and 3.12 billion m^3 of natural gas. In 2009, because of economic recession, imports were a bit lower, 8.38 million tonnes of crude oil and 2.74 billion m^3 of natural gas. Small quantities of high quality oil is extracted in Lithuania which is mainly used in manufacturing of lubricants and other petroleum derivatives. Together with oil and natural gas, major source of energy production in Lithuania was nuclear power (Fig. 3-7).

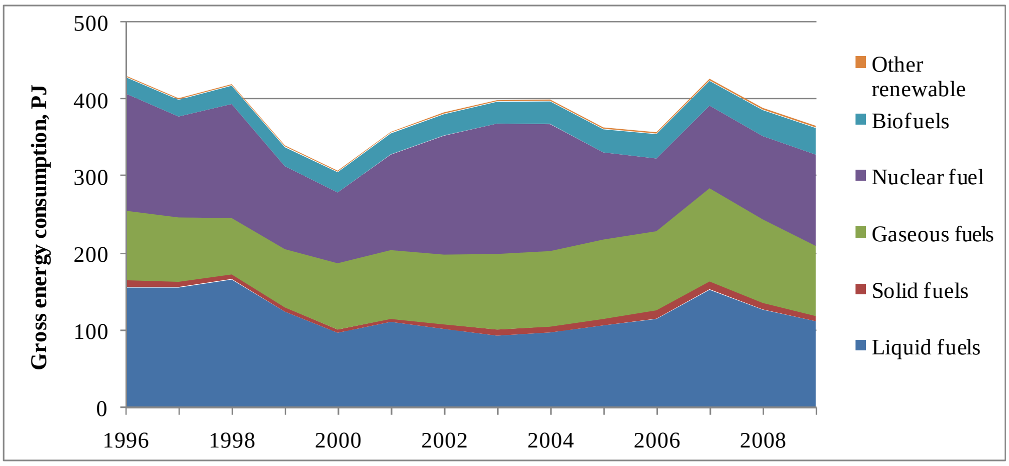


Fig. 3-7. Gross fuel consumption by fuel type in 1996-2009, PJ

(Source: Statistics Lithuania)

Fuel consumption in public electricity and heat production decreased more than by half from 1991 to 1993 and then continued declining mainly due to substantial reduction of liquid fuel consumption (Fig. 3-8).

The total consumption decreased more than three times from 1991 to 2009 while liquid fuel consumption declined from 92 PJ in 1991 to 7 PJ in 2009. In the same period the share of gaseous fuels in the total fuel consumption increased from approximately 51% to 72% though the absolute gaseous fuel consumption decreased from 101 PJ to 45 PJ.

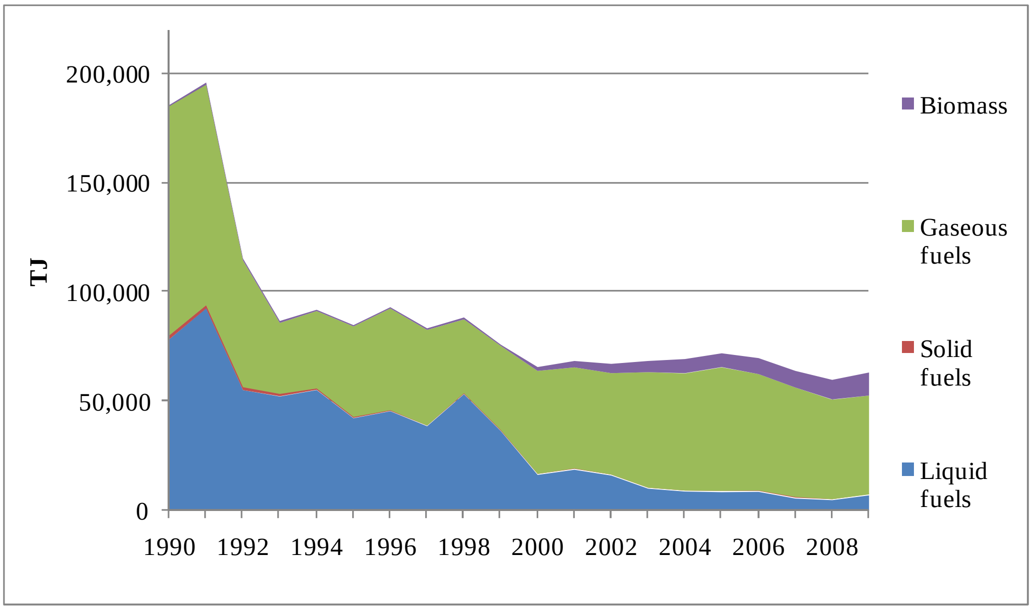


Fig. 3-8. Fuel consumption in public electricity and heat production sector 1990-2009.

(Source: Statistics Lithuania)

Fuel combustion in manufacturing industries and construction is shown in Fig. 3-9.Overall fuel consumption in the sector has declined approximately 5 times from 1991 to 1999 but started increasing again by approximately 6% annually from the year 2000. From 2006 to 2009 fuel combustion declined again from 24.8 PJ to 17.5 PJ.

Since 1990 fuel consumption declined substantially in all subsectors but the most dramatic reduction was observed in pulp and paper industry where decline was continuing actually throughout all the period and comprised only 25 TJ in 2004 compared to 4671 TJ in 1991.However, since 2004 fuel consumption in the sector started increasing again and reached 971 TJ in 2009.

Since 1990 the density of transport routes as well as the number of road vehicles has increased rapidly. Since 1995, the number of personal cars more than doubled. All passenger cars younger than 5 years with petrol engines have catalysers installed. 90% of the fuel in transportation sector is consumed by road transport (Fig. 3-10).There are plans to promote railway transport. Marine transport is developed in the only large Lithuanian port, Klaipeda.

All data on fuel consumption in transport sector are collected and provided by the Statistics Lithuania. Consumption in the transport sector includes fuel and energy consumed by all means of transport: railways, inland navigation (excluding fishing), air (international, domestic and military aviation), road (excluding energy used in stationary engines, for non-highway use in tractors and energy use in engines at construction sites), pipeline system and other transport. Consumed fuel is included in this sector irrespective of what kind of enterprise (industrial, construction, transport, agricultural, commercial and public service) the transport facility belongs to. Moreover, fuel consumed by personal transport facilities is included. Fuel which was provided to vehicles (cars, aircraft, ships, etc.) abroad is not accounted.

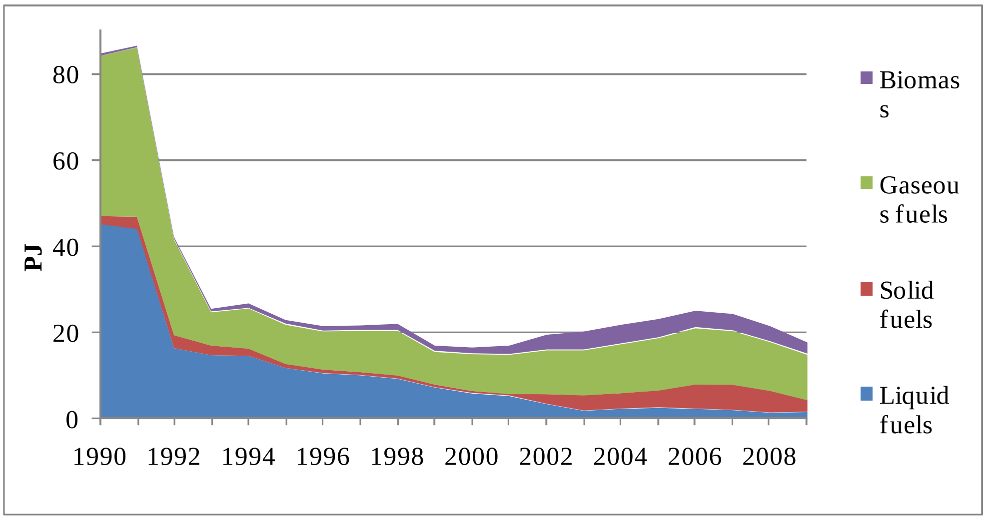


Fig. 3-9. Fuel combustion in manufacturing industries and construction sector 1990-2009

(Source: Statistics Lithuania)

Data on fuel consumption by off-road vehicles and machinery in industry, construction, agriculture, fishery and forestry are not collected separately by the Statistics Lithuania and not provided in the statistical reports but included in overall fuel consumption by separate sectors (industry, construction, agriculture). However, consumption of motor gasoline and diesel oil in these sectors as shown in Statistics Lithuania energy balances actually could be assigned to consumption by off-road machinery. Therefore consumption of motor gasoline and diesel oil was excluded from these sectors and added as a new source of off-road vehicles and other machinery in transportation sector.

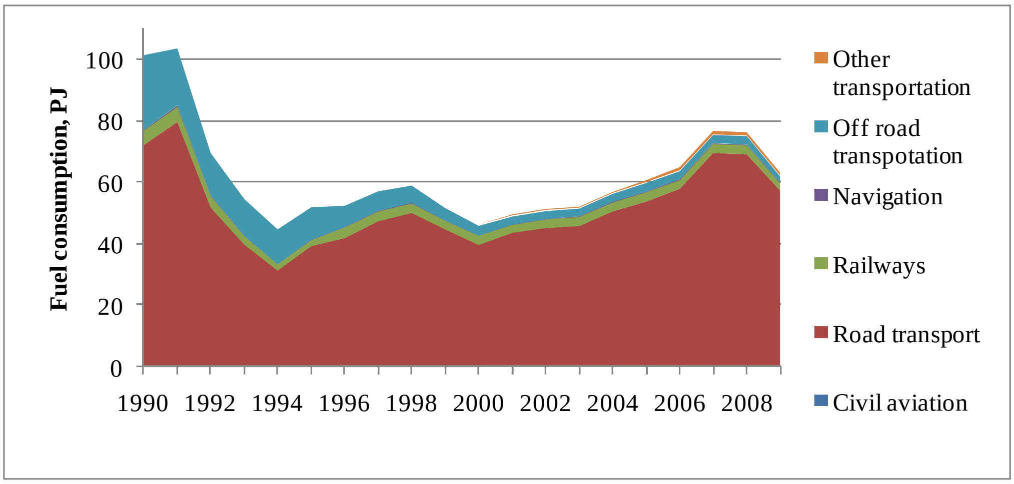


Fig. 3-10. Fuel consumption in transport sector 1990-2009

(Source: Statistics Lithuania)

Fuel consumption in road transportation sector is dominated by diesel oil (56%) and petrol (27%) (Fig. 3-11.). Passenger cars are mostly using petrol fuel, whereas buses and heavy duty vehicles run mainly on diesel fuel. The use of liquefied petroleum gas is strongly influenced by the fluctuation of fuel prices. In navigation diesel fuel and fuel oil are used. As regards aviation, aviation gasoline, kerosene type jet fuel and gasoline type jet fuel are used for aviation. Railways use diesel fuel.

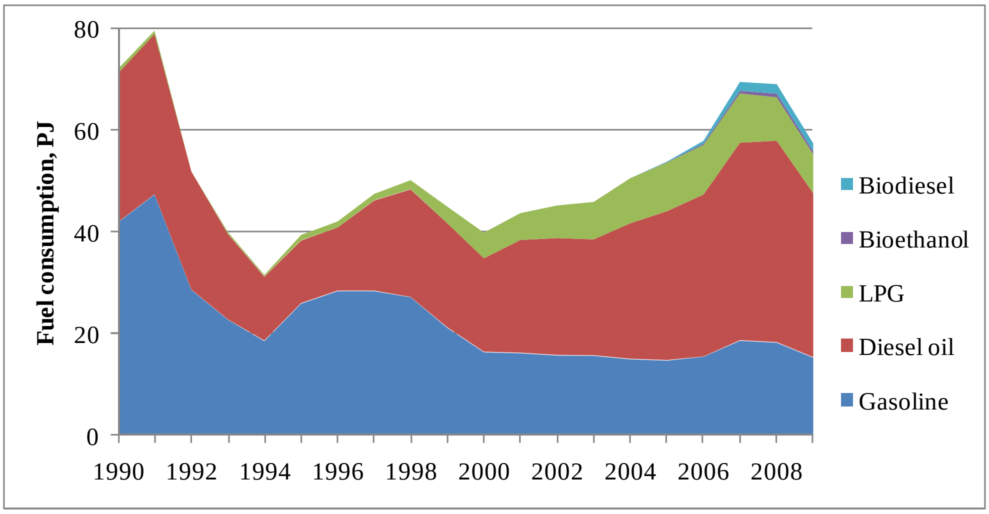


Fig. 3-11. Fuel consumption in road transport sector .

(Source: Statistics Lithuania)

Fuel combustion in other sectors consist of fuel combustion in commercial/institutional, residential and agriculture/forestry/fishing sectors. Fuel consumption in other sectors is presented in Fig. 3-12. Residential sector consumes about 76% of all fuels consumed in this sector. Since 2000 fuel consumption in other sectors remains stabile.

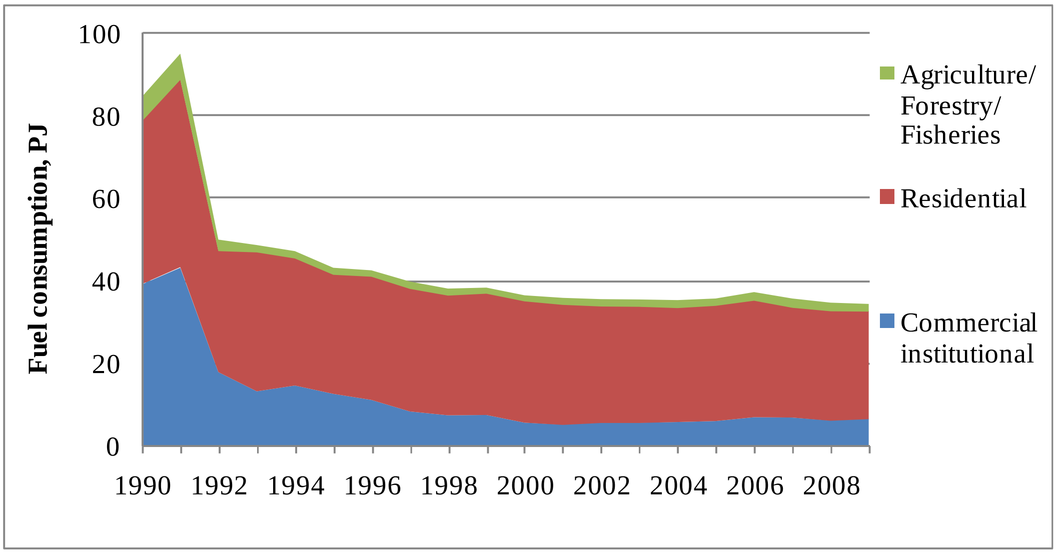


Fig. 3-12. Fuel consumption in other sectors 1990-2009 .

(Source: Statistics Lithuania)

The statistical reports provided by Statistics Lithuania are based on information submitted by fuel suppliers, and no statistical data are available for military stationary combustion. Data on fuel used for military stationary combustion is included in Commercial/Institutional category. Therefore notation key "IE" was used in CRF for emissions by military stationary sources

3.2.2 Comparison of sectoral approach with the reference approach

Carbon dioxide emissions from energy sector were calculated using both sectoral and reference approach. Reference approach is accounting for carbon, based mainly on supply of primary fuels and the net quantities of secondary fuels or fuel products brought into the country.

Differences between sectoral and reference approaches were estimated for fuel consumption and CO_2 emissions (separately for liquid, solid and gaseous fuels and for the total fuel consumption) are shown in Table. Emissions in case of reference approach include feedstocks which causes excessive difference compared to emissions evaluated in sectoral approach.

Use of fuels for feedstocks and non energy products is dominated by natural gas (Fig. 3-13).
Natural gas as feedstock is used for ammonia production and relevant emissions are accounted under the industrial processes sector. Coke used for cast iron production was subtracted from energy production in other non-specified category and added to cast iron production category in industrial processes sector.

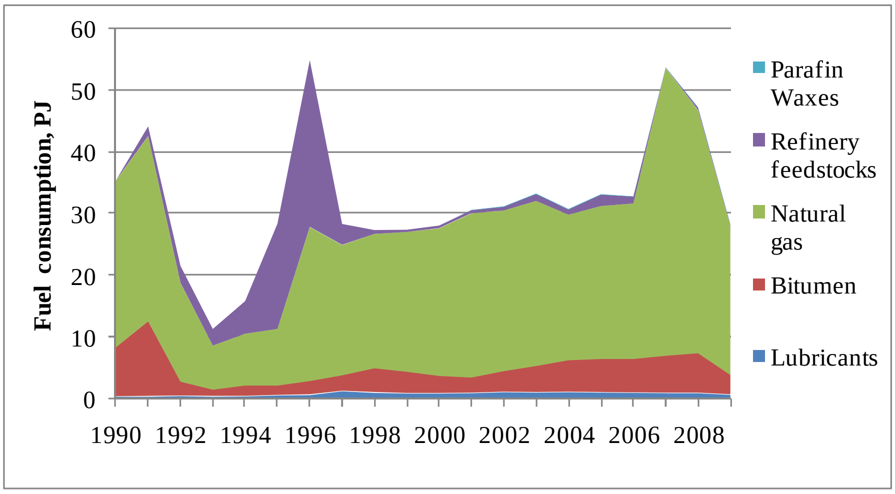


Fig. 3-13. Fuel consumption in feedstocks and non energy use of fuels 1990-2009 .

(Source: Statistics Lithuania)

In reference approach emissions are established by subtracting carbon stored in the final products from the total carbon content calculated from the apparent consumption. However, in case on non-energy use of natural gas, the amount of carbon stored in the final products are only 33% which means that in reference approach two thirds of carbon in natural gas allocated for non-energy use are added to CO_2 emissions increasing substantially their value. CO_2 emissions from feedstocks and non energy use of fuels, estimated on the basis of the amount of carbon not stored in the final products are presented in Fig. 3-14.

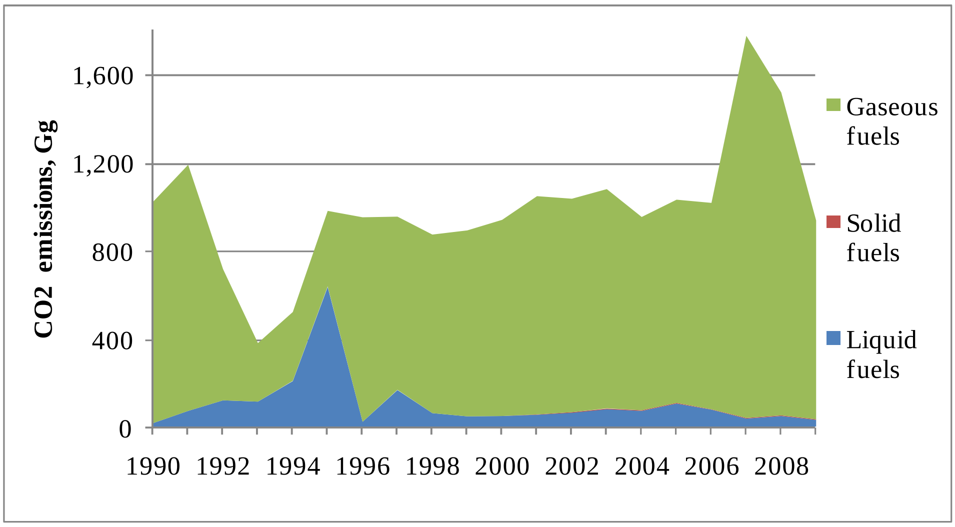


Fig. 3-14. CO_2 emissions from feedstocks and non energy use of fuels, estimated on the basis of the amount of carbon not stored in the final products 1990-2009

(Source: Statistics Lithuania)

Differences of fuel consumption between sectoral and reference approaches are due to statistical errors and the fact that fuel losses (transformation, transport etc.) are not taken into account in the reference approach.

Table 3-1. Differences between sectoral and reference approaches for fuel consumption 1990-2009.

Year	REFERENCE APPROACH			SECTORAL APPROACH		DIFFERENCE	
	Apparent energy consumption (PJ)	Apparent energy consumption (excluding non-energy use and feedstocks) (PJ)	CO_2 emissions (Gg)	Energy consumption (PJ)	CO_2 emissions (Gg)	Energy consumption (%)	CO_2 emissions (%)
Liquid Fuels (excluding international bunkers)							
1990	285,39	276,98	20.181,11	265,54	20.310,22	4,31	-0,64
1991	304,87	290,72	20.946,13	285,01	21.845,41	2,00	-4,12
1992	163,76	158,15	11.737,17	162,09	12.358,67	-2,43	-5,03
1993	149,37	145,11	10.835,35	146,46	11.139,11	-0,92	-2,73
1994	133,82	126,32	9.716,38	134,90	10.340,88	-6,36	-6,04
1995	133,31	114,11	9.148,05	120,98	9.211,21	-5,68	-0,69
1996	132,95	130,12	9.735,97	125,85	9.595,41	3,39	1,46
1997	134,31	127,15	9.482,49	124,49	9.458,87	2,14	0,25
1998	153,23	147,62	10.912,78	143,09	10.905,38	3,16	0,07
1999	120,79	115,90	8.558,75	112,06	8.491,79	3,42	0,79
2000	89,11	84,94	6.120,94	88,08	6.512,36	-3,57	-6,01
2001	105,92	101,95	7.404,93	97,29	7.176,53	4,79	3,18
2002	102,29	97,18	7.039,85	95,06	6.938,11	2,23	1,47
2003	97,07	90,62	6.452,17	88,38	6.359,19	2,54	1,46
2004	104,88	97,79	6.896,74	95,35	6.837,58	2,56	0,87

Year	REFERENCE APPROACH			SECTORAL APPROACH		DIFFERENCE	
	Apparent energy consumption (PJ)	Apparent energy consumption (excluding non-energy use and feedstocks) (PJ)	CO_2 emissions (Gg)	Energy consumption (PJ)	CO_2 emissions (Gg)	Energy consumption (%)	CO_2 emissions (%)
2005	110,70	102,42	7.222,83	100,20	7.188,04	2,21	0,48
2006	110,15	102,62	7.134,65	98,86	7.113,40	3,80	0,30
2007	111,21	104,17	7.318,05	103,10	7.482,30	1,04	-2,20
2008	119,94	112,16	7.816,50	107,33	7.725,05	4,51	1,18
2009	103,10	99,07	7.057,62	95,25	6.878,57	4,01	2,60
Solid Fuels (excluding international bunkers) (5)							
1990	33,37	33,63	3.098,64	33,23	3.160,87	1,22	-1,97
1991	37,28	37,54	3.461,27	37,16	3.534,84	1,03	-2,08
1992	17,48	17,73	1.627,90	17,35	1.654,99	2,18	-1,64
1993	15,50	15,63	1.442,28	15,36	1.463,83	1,75	-1,47
1994	12,87	13,12	1.199,02	12,76	1.217,71	2,81	-1,54
1995	10,28	10,46	960,88	10,18	973,55	2,80	-1,30
1996	9,45	9,66	881,92	9,29	888,21	3,95	-0,71
1997	7,64	7,93	714,72	7,56	723,27	4,99	-1,18
1998	6,66	6,85	623,16	6,60	631,80	3,81	-1,37
1999	5,69	5,85	534,59	5,62	540,20	3,95	-1,04
2000	4,15	4,25	388,86	4,08	390,64	4,10	-0,45
2001	3,84	3,83	354,54	3,71	355,67	3,21	-0,32
2002	6,21	6,25	576,26	6,05	578,31	3,21	-0,35
2003	7,91	7,98	734,54	7,71	736,61	3,43	-0,28
2004	7,73	7,79	716,15	7,54	720,84	3,28	-0,65
2005	8,51	8,59	790,56	8,36	798,87	2,78	-1,04
2006	11,51	11,68	1.070,52	11,38	1.086,60	2,61	-1,48
2007	11,23	11,32	1.043,22	11,05	1.055,55	2,44	-1,17
2008	9,26	9,39	857,02	9,11	869,17	3,05	-1,40
2009	6,97	6,88	644,90	6,87	655,91	0,16	-1,68
Gaseous Fuels							
1990	195,86	168,92	10.436,39	167,24	9.515,67	1,01	9,68
1991	202,75	172,85	10.820,62	171,54	9.760,80	0,76	10,86
1992	115,83	99,88	6.202,82	99,60	5.667,07	0,29	9,45
1993	62,64	55,53	3.382,52	54,80	3.118,23	1,32	8,48
1994	72,47	64,11	3.910,82	57,68	3.281,94	11,14	19,16
1995	84,93	75,76	4.594,81	62,83	3.574,86	20,59	28,53
1996	90,80	65,90	4.632,68	65,72	3.739,74	0,26	23,88
1997	83,82	62,75	4.312,23	62,53	3.557,77	0,35	21,21
1998	73,42	51,70	3.716,69	51,59	2.935,68	0,20	26,60
1999	75,89	53,30	3.839,13	53,30	3.032,60	0,00	26,60
2000	86,42	62,58	4.406,68	62,51	3.556,54	0,12	23,90
2001	89,86	63,32	4.549,89	62,95	3.582,08	0,58	27,02

Year	REFERENCE APPROACH			SECTORAL APPROACH		DIFFERENCE	
	Apparent energy consumption (PJ)	Apparent energy consumption (excluding non-energy use and feedstocks) (PJ)	CO_2 emissions (Gg)	Energy consumption (PJ)	CO_2 emissions (Gg)	Energy consumption (%)	CO_2 emissions (%)
2002	90,86	64,92	4.593,86	64,46	3.667,94	0,70	25,24
2003	98,56	71,89	5.010,24	71,38	4.061,52	0,72	23,36
2004	98,31	74,79	5.054,33	74,21	4.222,38	0,79	19,70
2005	103,69	78,98	5.332,90	78,45	4.463,58	0,69	19,48
2006	102,75	77,66	5.273,17	77,27	4.396,38	0,51	19,94
2007	121,07	74,62	5.902,46	74,60	4.244,63	0,03	39,06
2008	108,67	69,42	5.343,00	68,44	3.894,29	1,43	37,20
2009	91,33	67,17	4.652,96	66,65	3.792,16	0,79	22,70
Total							
1990	514,61	479,53	33.716,15	466,00	32.986,76	2,90	2,21
1991	544,90	501,10	35.228,02	493,71	35.141,05	1,50	0,25
1992	297,07	275,77	19.567,90	279,04	19.680,73	-1,17	-0,57
1993	227,51	216,27	15.660,14	216,62	15.721,18	-0,16	-0,39
1994	219,16	203,55	14.826,22	205,34	14.840,52	-0,87	-0,10
1995	228,52	200,34	14.703,74	193,98	13.759,62	3,27	6,86
1996	233,19	205,68	15.250,57	200,87	14.223,35	2,39	7,22
1997	225,77	197,84	14.509,44	194,57	13.739,91	1,68	5,60
1998	233,31	206,16	15.252,62	201,28	14.472,86	2,43	5,39
1999	202,37	175,04	12.932,46	170,98	12.064,59	2,37	7,19
2000	179,68	151,76	10.916,48	154,66	10.459,54	-1,87	4,37
2001	199,62	169,10	12.309,36	163,95	11.114,28	3,14	10,75
2002	199,36	168,34	12.209,97	165,58	11.184,36	1,67	9,17
2003	203,55	170,49	12.196,96	167,47	11.157,32	1,80	9,32
2004	210,91	180,37	12.667,21	177,10	11.780,80	1,85	7,52
2005	222,89	189,99	13.346,29	187,00	12.450,49	1,60	7,19
2006	224,41	191,96	13.478,35	187,51	12.596,38	2,37	7,00
2007	243,51	190,11	14.263,73	188,74	12.782,48	0,73	11,59
2008	237,87	190,97	14.016,52	184,88	12.488,51	3,30	12,24
2009	201,40	173,12	12.355,48	168,76	11.326,64	2,58	9,08

3.2.3 International bunker fuels

The Lithuanian Statistical Yearbook provides data on marine bunkers. Data on gas/diesel oil and residual fuel oil is available, where the later makes about 82% of total GHG emissions from marine bunkers. National emissions factors are used to estimate CO_2, CH_4 and N_2O emissions.

Since 2001, statistical data on use of three types of aviation fuel are collected by Statistics Lithuania: aviation gasoline, gasoline type jet fuel and kerosene type jet fuel.

Following advice from experts[7] it was decided to distinguish GHG emissions from aviation bunkers in such a way that all aviation gasoline is used for domestic purposes and thus all the rest (gasoline type jet fuel and kerosene type jet fuel) is used for international flights – the latter could therefore be considered as aviation bunkers. The data on jet fuel (kerosene and aviation gasoline) split between domestic and international aviation is available only from 2001 therefore GHG emission are reported for 2001-2009. The data on jet kerosene used for military in Lithuania is available starting from 2003 therefore GHG emissions are reported for 2003-2009.

3.2.4 Feedstocks and non-energy use of fuels

The data on feedstocks and non-energy use of fuels were provided by the Statistics Lithuania (Energy balances). The amounts of non-emitted CO_2 were calculated in accordance with the methodology provided in IPCC Guidelines, 1996.

Use of fuels for feedstocks and non energy products is dominated by natural gas (Fig. 3-15).

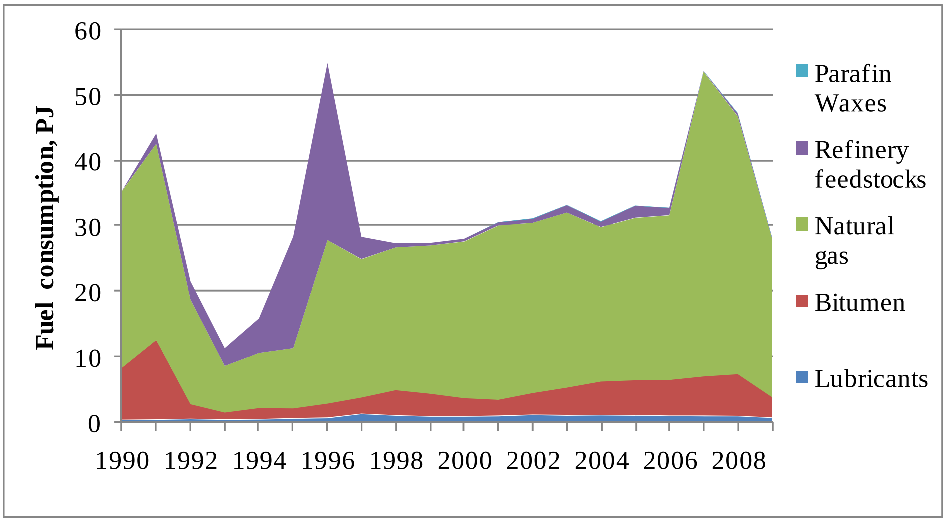


Fig. 3-15. Fuel consumption in feedstocks and non energy use of fuels 1990-2009.

(Source: Statistics Lithuania)

3.3 Source category description

3.3.1 Characteristics of sources

GHG emissions from the energy sector – fuel combustion and fugitive – constitute more than half (55% in 2009 excluding LULUCF) of the total GHG emissions. As the key source analysis has revealed, energy sector – fuel combustion activities are responsible for a number of key source categories (Table 3-2).

Table 3-2. Key GHG emission sources in energy sector in 2009 (including LULUCF)

Key Category	GHG emissions, Gg CO2 eq.	Level assessment
Road transportation, CO2	3,965.41	15.6%

[7] IDR Lithuania 17-21 May, 2004, Branca Americano (Brazil); consultant Domas Balandis (Lithuania).

Stationary Combustion, gaseous fuel, CO2	3,734.40	14.7%
Stationary Combustion, liquid fuel, CO2	2,556.65	10.0%
Stationary Combustion, solid fuel, CO2	655.91	2.6%
Fugitive Emissions from Oil and Gas Operations	269.84	1.1%
Other transportation	226.72	0.9%

The energy industries were responsible for 41.5% of the total GHG emissions from the energy sector in 2009 (4.93 Tg out of 11.88 Tg). About 60% of GHG emissions from the energy industries were from public electricity and heat production. The single petroleum refining company in Lithuania is UAB ORLEN Lietuva which is responsible for over 30% of the CO_2 emissions from the energy industries.

Shares of CO_2, CH_4, N_2O emissions from fuel combustion in energy industries are presented in Fig. 3-16. GHG emissions from manufacture of solid fuels and other energy industries are very small. Total GHG emissions from energy industries in 2009 were 4893.6 Gg CO_2, 0.428 Gg CH_4 and 0.079 Gg N_2O.

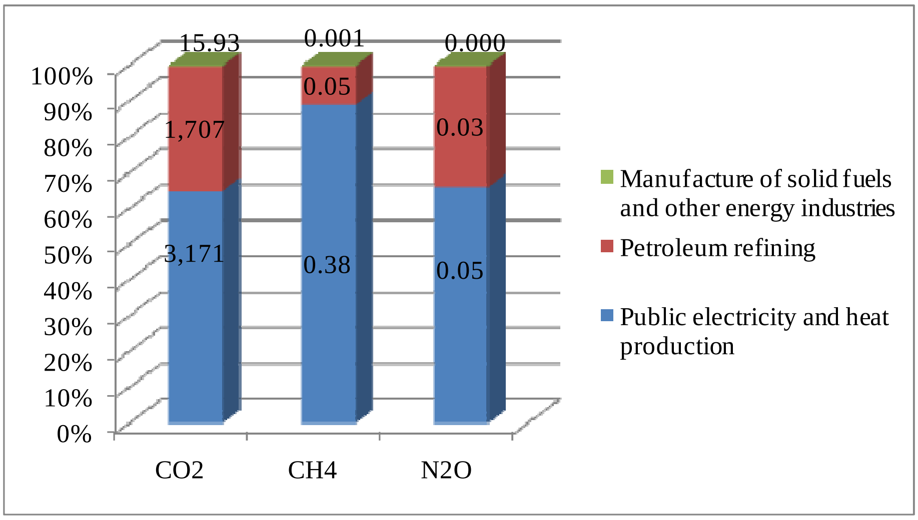


Fig. 3-16. CO_2, CH_4 and N_2O emissions (Gg) from fuel combustion in energy industry in 2009.

Manufacture and construction subsector includes emissions from fuel combustion in the following industries:

- Chemicals production;
- Pulp, paper and print industry;
- Food processing, beverages and tobacco production;
- Other industries.

As the manufacture and construction sectors mainly use gaseous fuels, the largest share of CO_2 emissions originate from this type of fuel. Shares of CO_2 emissions (in Gg) from different types of fuel combusted in manufacture and construction industries are presented in

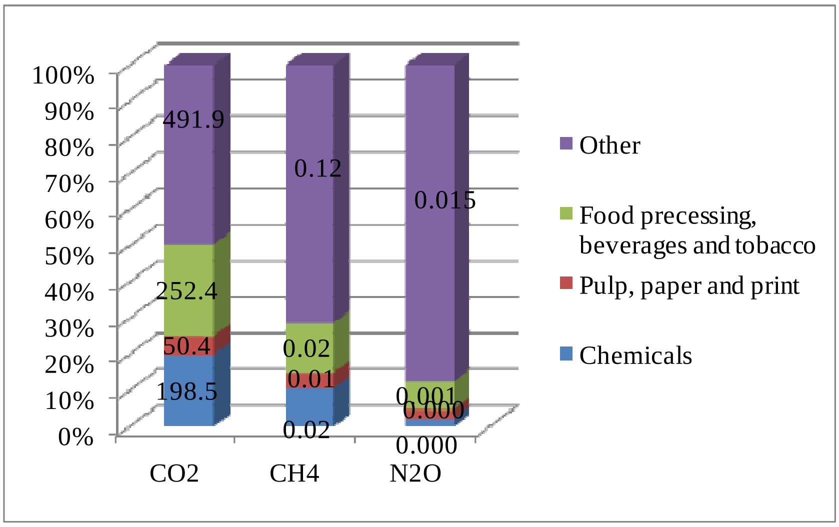


Fig. 3-17. Total GHG emissions from manufacture and construction sectors in 2009 were 993.2 Gg CO_2, 0.16 Gg CH_4 and 0.017 Gg N_2O.

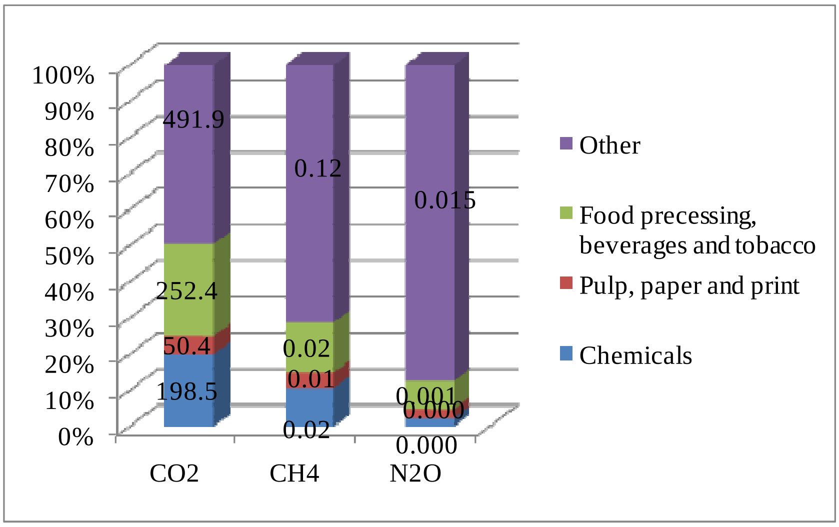


Fig. 3-17. CO_2 emissions (Gg) from fuel combustion different manufacture and construction sectors in 2009.

The structure of GHG emission in agriculture, forestry, fisheries, residential and commercial sectors is shown in Fig. 3-18. Total GHG emissions from commercial institutional, residential, agriculture, forestry and fisheries sectors in 2009 were 1060.1 Gg CO_2, 6.13 Gg CH_4 and 0.084 Gg N_2O.

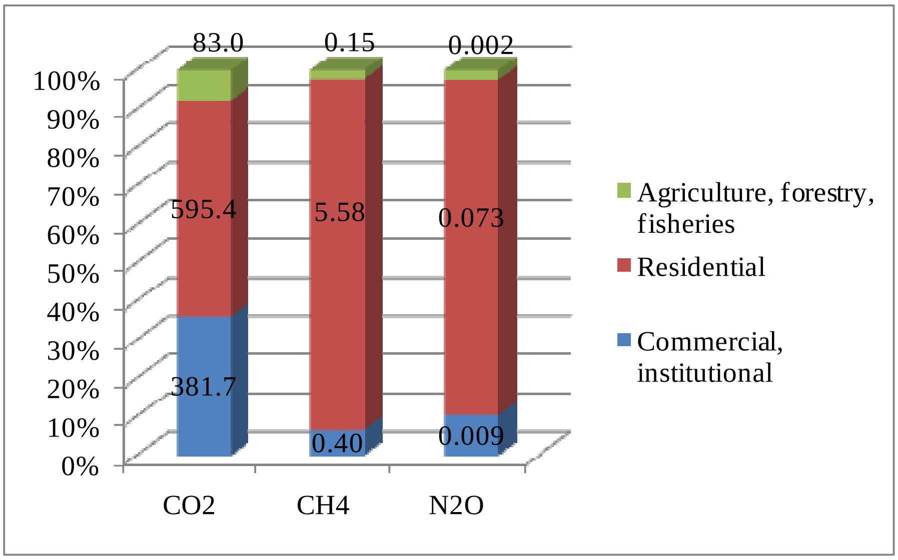


Fig. 3-18. CO_2, CH_4 and N_2O emissions (Gg) from fuel combustion in other sectors in 2009.

3.3.2 Methodological issues

3.3.2.1 Activity data

For calculation of GHG emissions in the energy sector all activity data had been obtained from the Lithuanian Statistics yearly publications "Energy balance" (Energy balance 2009: http://www.stat.gov.lt/en/catalog/list/?cat_y=2&cat_id=8), except for data on waste oil, which was taken from Environmental Protection Agency waste database.

The fuel and energy balance has been compiled based on the data provided by legal entities (enterprises) consuming, producing or supplying fuel and energy. The data presented in the Energy balances shows domestic fuel and energy resources of the Republic of Lithuania, including their extraction, production, exports and imports, fuel consumption for generating electricity and heat, as well as final fuel and energy consumption by main economic activity and in households.

All heat generated in public power plants, public heat plants, as well as energy (heat) from chemical processes, generated in chemical industry enterprises, is subsumed under the energy balance. Fuel is calculated in terms of tonnes of oil equivalent and terajoules using the net calorific value. The net calorific value (NCV) is the amount of heat which is actually available from the combustion process, i.e. excluding the latent heat of water formed during combustion.

Following the recommendation of ERT in 2010 in the individual review report, net calorific values (NCVs) used to convert fuel consumption in natural units into energy units are provided in the table below.

Table 3-2a. Specific net calorific values (conversion factors)

Type of fuel	Tonne	Tonne of oil equivalent (TOE)	TJ/tonne
Hard coal	1,0	0,600	0,02512
Coke	1,0	0,700	0,02930
Peat	1,0	0,280	0,01172
Peat briquettes	1,0	0,360	0,01500

Firewood (m3)	1,0	0,196	0,00820
Biogas (1000 m3)	1,0	0,480	0,02000
Natural gas (1000 m3)	1,0	0,800	0,03349
Liquefied petroleum gases	1,0	1,109	0,04642
Motor gasoline	1,0	1,070	0,04479
Gasoline type jet fuel	1,0	1,070	0,04479
Kerosene type jet fuel	1,0	1,031	0,04316
Transport diesel	1,0	1,029	0,04307
Heating and other gasoil	1,0	1,029	0,04307
Fuel oil	1,0	0,957	0,04006
Crude oil	1,0	1,022	0,04278
Bioethanol	1,0	0,645	0,02700
Biodiesel (methyl ester)	1,0	0,884	0,03700

	TOE	**GJ**	**Gcal**	**MWh**
TOE	1,000	41,86	10,00	11,63
GJ	0,024	1,00	0,24	0,28
Gcal	0,100	4,19	1,00	1,163
MWh	0,086	3,60	0,86	1,00

Source: Energy balance 2009, Statistics Lithuania

Brief overview of the Lithuania's Energy balance is presented below.

- *Consumption in the energy sector* refers to the quantities consumed by the energy industry to support extraction (mining, oil and gas production) or plant operations of transformation activities, as well as for pumped water storage in hydropower stations. The quantities of fuels transformed into another form of energy are excluded. Energy enterprises are those which under the international methodology of energy are subsumed under the following kinds of activity according to the national version (EVRK Rev. 2) of the Statistical Classification of Economic Activities in the European Community (NACE Rev. 2):
    - Extraction of crude petroleum;
    - Extraction of peat;
    - Support activities for petroleum and natural gas mining;
    - Manufacture of refined petroleum products;
    - Electricity, gas, steam and air conditioning supply.
- *Non-energy use* covers energy resources used as raw materials, i.e. energy resources which are neither used as fuel nor converted into other kind of fuel.
- *Consumption in industry* refers to fuel quantities consumed by an industrial undertaking in support of its primary activities. Industrial enterprises are those which under the international methodology of energy are subsumed under the following kinds of activity according to EVRK Rev. 2 (excluding enterprises which are subsumed under the energy sector):
        - Mining and quarrying;
        - Manufacturing.
- *Consumption in the transport sector* includes fuel and energy consumed by all means of transport: railways, inland waterways (excluding fishing), air (international, domestic and military aviation), road (fuel used in road vehicles including fuel used by agricultural vehicles on highways), pipeline system and other transport, irrespective of the kind of enterprise (industrial, construction, transport, agricultural, commercial or public) the transport facility belongs to. Moreover, fuel consumed by personal transport facilities is included. Fuel with which vehicles (cars, aircraft, ships, etc.) were fuelled abroad is not recorded.
- *Consumption in agriculture* encompasses fuel and energy consumption by enterprises whose economic activity is related to agriculture, hunting and forestry.
- *Consumption in fishing* encompasses fuels delivered to inland, coastal and deep-sea fishing vessels of all flags that are refueled in the country (including international fishing) and fuel and energy used in the fishing industry.

- *Consumption in the service sector* encompasses fuel and energy consumed in other economic activities not mentioned above, i.e. for heating and lighting premises meant for trade, education, health, commercial services, administration, etc.
- *Consumption in households* encompasses fuel and energy sold to the population for heating, lighting, cooking. Fuel consumed for individual transport is subsumed under the item “Consumption in transport”.
- *International marine bunkers* are defined as quantities of fuels delivered to ships of all flags that are engaged in international navigation. Consumption by ships engaged in fishing and domestic navigation vessels is excluded.

To improve transparency of the reporting in energy sector in the NIR, Lithuania provides the energy balance data for the entire time series (LT Energy balance 1990-2009.xls). The data was extracted from the publically available databases of the Statistics of Lithuania (http://www.stat.gov.lt/lt/). The energy balance is provided as Energy commodities balances (in Terajoule, thousand tonnes of oil equivalent and reporting units (e.g. Thousand tonnes, Mill. m^3). Conversion from reporting units to terajoules and thousand tonnes of oil equivalent was done by the Statistics Lithuania.
In addition to energy balance the following data was used:

- Data on trasportation of crude oil and oil products in pipelines (data source: Statistics Lithuania);
- Data on waste oil (data source: Environmental Protection Agency).

Road transportation emissions activity data

For calculation of GHG emissions in the road transport sector all activity data had been collected from the Lithuanian Statistics yearly publications “Energy balance”. According to the information provided by Lithuanian Statistics, fuel use in road transport data collection methodology is part of the annual energy and fuel statistics survey. Functional enterprises are surveyed irrespective to their kind and ownership form. Statistical survey covers enterprises producing, supplying and consuming fuel and (or) energy.
Statistical information about oil products (motor gasoline, diesel, LPG) consumption in road transport is reported by the following enterprises:

- Enterprises producing oil products;
- Enterprises importing and exporting oil products;
- Oil products wholesale trade enterprises;
- Enterprises, which according to Law on State’s oil and oil products reserve are obliged to store and manage State’s oil and oil products reserve;
- Enterprises consuming fuel and energy belonging to the following economical activities: agricultural (with 10 and more employees), forestry and fishing, mining and quarrying, manufacturing industry, construction, transport and storage (except for road transportation) (with 20 and more employees).

Energy balance statistical report EN-01 and Oil/ Oil products balance statistical report EN-06 are the sources for statistical data.
In the statistical reports respondents are providing statistical data about each fuel and energy type: changes in stocks at the beginning and end of the year, production, inter-product transfer processes, import and export, purchase and sale in the internal market, consumption allocated by consumption purposes.
Statistical indicator “Consumption in road transport” is based on the territorial principle, not on the resident, i.e. the fuel sold (purchased) in Lithuania’s territory is accounted, regardless of the country the vehicle originates.
In the balance row “Consumption in road transport” is included fuel used by all commercial and passenger vehicle’s engines, i.e. consumed in industry, construction, transportation, service and other sectors. Fuel used by personal vehicles and agricultural vehicles used on highways is accounted as well.

Annual energy balance methodology is prepared in line with EC Regulation No 1099/2008 of the European Parliament and of the Council of 22 October 2008 on energy statistics, which establishes a common framework for the production, transmission, evaluation and dissemination of comparable energy statistics in the Community.

3.3.2.2 Emission factors for stationary sources

For calculation of GHG emissions in the energy sector Tier 2 and Tier 1 Sectoral approach has been used. Emissions of direct greenhouse gases, i.e. CO_2, CH_4 and N_2O, were calculated on the basis of activity data – amount and sort of fuel used - and national/IPCC/Corinair emission factors. Activity data had been obtained from the Lithuanian Statistics publication "Energy balance".

National emission factors have been developed on the basis of international experience, to which local circumstances have been applied, by scientist Prof. B. Jaskelevicius and consultant P. Liuga who based themselves on emission factors developed by Danish, German and Slovak experts[8]. The emission factors calculated apply to CO_2 and SO_2, NOx, CO, CH_4, N_2O, NMVOC and particulate matter, for the different sectors for the following types of fuels: coal, fuel wood, natural gas, orimulsion, heating gas oil, petrol, kerosene, other processed fuel, flammable secondary energy sources.

Emission factors were assigned to a number of energy generating facilities categories that are in line with the categories used in national fuel and energy balance (Table 3-3).

Table 3-3. Categories of energy generating facilities in national fuel and energy balance and national emission factors sheets (Prof. B. Jaskelevicius,P. Liuga, 1997)

Fuel combustion sector	Categories of the national energy and fuel balance
1. Power plants	Production of electricity and thermal energy
2. Heat boiler houses	Energy companies
3. Industry	Industrial manufacturing
	Construction engineering and mounting works
4. Small companies	Municipal domestic needs
	Agricultural activities
	Other
5. Households	Households
6. Transport	Transport

CORINAIR 2007[9] emission factors have been used for petroleum coke (CO_2 – 101 t/TJ, CH_4 – 1.5 kg/TJ, N_2O – 1.4 kg.TJ) and biogas (CO_2 – 41.9 t/TJ, CH_4 – 1.5 kg/TJ, N_2O – 1.95 kg/TJ) fuels.

[8] (1) Jes Fenger, Jorgen Fenhann, Niels Kilde. Danish Budget for Greenhouse Gases Nord, 1990, Umweltpolitic. Klimaschutz in Deutschland. Zweiter Bericht der Regierung der Bundesrepublik Deutschland nach dem Rahmenũbereinkommen der Vereinten Nationen ũber Klimaänderungen. Bundesumweltminiisterium. Bundesumweltministerium fũr Umwelt, Naturschutz und Reaktorsicherheit. 1997; (2) Jiri Balajka. Estimating CO2 Emissions from Energy in Slovakia using the IPCC Reference Method. JDOJARAS, Vol. 99, No. 3-4, July-December, 1995).

[9] EMEP/CORINAIR Emission Inventory Guidebook - 2007. http://www.eea.europa.eu/publications/EMEPCORINAIR5/

CO_2 emission factors

Upon the request of ERT in 2010 country specific CO_2 EF were developed based on research data from the Lithuanian oil refinery (research protocols of UAB "ORLEN Lietuva" Quality Research Center). Comparison with previously reported emission factors for selected fuel types produced in the Lithuanian oil refinery are provided in Table 3-4. Motor gasoline, jet kerosene, gas/diesel oil, residual fuel oil, LPG and non liquefied petroleum gas used in the country are produced by the oil refinery UAB "ORLEN Lietuva". Imports of the fuels specified above comprise only a minor fraction of the fuels used in Lithuania.

Table 3-4. Revision of CO_2 emission factors for selected fuel types (kg/GJ).

Fuel	Revised Emission factor	Emission factor used in previous submissions	Difference , %
Motor gasoline	72.97	73	-0,04
Jet kerosene	72.24	71.5	1,03
Gas/Diesel Oil	72.89	74	-1,50
Residual Fuel Oil	81.29	78	4,22
Liquefied Petroleum Gases	65.42	65	0,65
Non liquefied petroleum gas	54.86	65	-15,60

CO_2 emission factors used in the Lithuanian national GHG inventory are provided in Table 3-5.

Table 3-5. CO_2 emission factors used in the Lithuanian national GHG inventory (kg/GJ)

Fuel	NIR Lithuania	Revised 1996 IPCC Guidelines	Revoldas, 2003	ETC/ACC, 2003, EU average	CORINAIR, 2007	JSC "Orlen Lietuva", 2009
Crude Oil	78	73,3	77,7	74,1		
Orimulsion	81	80,7	56,1			
Motor gasoline	72,97	68,9	74,85	70,5	72-74	72,97
Jet kerosene	72,24	71,5	72,32	71,8	72-74	72,24
Shale Oil	74	73,3		77,4		
Gas/Diesel Oil	72,89	74,1	72.3-77.3	73,9	72.7-75	72,89
Residual Fuel Oil	81,29	77,4	76.8-77.3	77,2	75.8-78	81,29
Liquefied Petroleum Gases	65,42	63,1	66,7	64		65,42
Bitumen	80,7	80,7		81,8		
Lubricants	73,3	73,3		73,3		
Petroleum Coke	101	100,8	79,1	98,3	100.8-121.2	
Refinery Feedstocks	73,3	73,3		73,9		
Paraffin Waxes	73,3					
Coking Coal	95	94,6	77.4-79.1	93,3	89.6-94	
Lignite	95	101,2	49,6	104,3		
Natural Gas	56,9	56,1	55,1	56,6	55.5-60.8	
Waste Oil	73,3		64,5			
Peat	102	106,0	56,2	106,6	98-115	
Wood/Wood Waste	102	109,6	102		92-124.9	
Charcoal	102					
Biogas	41,9	112,2			10.5-75	
Non liquefied petroleum gas	54,86					54,86

The table also provides comparison of the Lithuanian national EFs with the Revised 1996 IPCC Guidelines, CORINAIR 2007, average values for the EU countries provided in the European Topic Centre study (ETC/ACC[10]) andCO_2 emission factors for fuels used in Lithuania derived by

[10] Comparison of CO_2 emission factors for fuels used in Greenhouse Gas Inventories and consequences for monitoring and reporting under the EC emissions trading scheme. ETC/ACC Technical Paper 2003/10 July 2003. European Topic Centre on Air and Climate Change http://air-climate.eionet.europa.eu/docs/ETCACC_TechnPaper_2003_10_CO2_EF_fuels.pdf

measurements reported in a study by V. Revoldas performed in the Kaunas Technological University (V. Revoldas, 2003[11], UAB "ORLEN Lietuva", 2009[12]).

As can be seen from the Table 3-5 above, CO_2 emission factors used in the Lithuanian GHG inventory are within the range of data provided in the literature. Bearing in mind that EF values reported in the literature are scattered in quite wide range, currently used CO_2 emission factors for stationary emission sources could be considered as satisfactory.

CH_4 Emission Factors

Following the remarks of the ERT in 2009, a review of CH_4 emission factors was undertaken in 2010 (discussion and comparison with EF provided in the literature was presented in National Greenhouse Gas Emission Inventory Report 2010, covering the period 1990-2008). CH_4 emission factors used in the Lithuanian national GHG inventory are provided in Table 3-6.

Table 3-6. CH_4 emission factors used in the Lithuanian national GHG inventory (kg/TJ).

Fuel	Emission factor (kg/TJ)	Source / Comments
		Energy industries
Crude Oil	3	2006 IPCC Guidelines
Orimulsion	3	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Shale Oil	3	2006 IPCC Guidelines
Gas/Diesel Oil	3	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Residual Fuel Oil	3	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Liquefied Petroleum Gases	1	2006 IPCC Guidelines corresponding to CORINAIR range
Petroleum Coke	3	CORINAIR
Coking Coal	1	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Lignite		NO
Natural Gas	1	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Waste Oil	30	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Peat	1	2006 IPCC Guidelines
Wood/Wood Waste	30	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Charcoal		NO
Biogas	1	CORINAIR
		Manufacturing industries and construction
Crude Oil		NO
Orimulsion		NO
Shale Oil	3	2006 IPCC Guidelines corresponding to CORINAIR range
Gas/Diesel Oil	3	2006 IPCC Guidelines corresponding to CORINAIR range
Residual Fuel Oil	3	2006 IPCC Guidelines corresponding to CORINAIR range
Liquefied Petroleum Gases	1	2006 IPCC Guidelines corresponding to CORINAIR range
Petroleum Coke	3	CORINAIR
Coking Coal	10	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Lignite		NO
Natural Gas	5	Revised 1996 IPCC Guidelines
Waste Oil		NO
Peat	2	2006 IPCC Guidelines

[11] V. Revoldas. Degimo procesų sąlygojamos taršos vertinimas, Kaunas, KTU, 2003.
[12] JSC "ORLEN Lietuva", 2009. JSC "ORLEN Lietuva" Kokybės tyrimų centro tyrimų protokolai, 2009 m. ŠESD apskaitos ataskaita.

Wood/Wood Waste	30	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Charcoal		NO
Biogas	1	CORINAIR
Commercial/Institutional		
Crude Oil		NO
Orimulsion		NO
Shale Oil	10	2006 IPCC Guidelines
Gas/Diesel Oil	10	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Residual Fuel Oil	10	2006 IPCC Guidelines
Liquefied Petroleum Gases	5	2006 IPCC Guidelines corresponding to CORINAIR range
Petroleum Coke		NO
Coking Coal	10	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Lignite	10	2006 IPCC Guidelines
Natural Gas	5	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Waste Oil		NO
Peat	10	2006 IPCC Guidelines corresponding to CORINAIR range
Wood/Wood Waste	300	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Charcoal	200	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Biogas	5	CORINAIR
Residential/Agriculture		
Crude Oil		NO
Orimulsion		NO
Shale Oil	3	2006 IPCC Guidelines
Gas/Diesel Oil	3	2006 IPCC Guidelines corresponding to CORINAIR range
Residual Fuel Oil	3	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Liquefied Petroleum Gases	5	2006 IPCC Guidelines
Petroleum Coke		NO
Coking Coal	300	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Lignite	300	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Natural Gas	5	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Waste Oil		NO
Peat	300	2006 IPCC Guidelines
Wood/Wood Waste	300	Revised 1966 IPCC Guidelines and 2006 IPCC Guidelines
Charcoal		NO
Biogas	5	CORINAIR

N_2O Emission Factors

Following the remarks of the ERT, a review of N_2O emission factors was undertaken in 2010 (discussion and comparison with EF provided in the literature was presented in National Greenhouse Gas Emission Inventory Report 2010, covering the period 1990-2008). N_2O emission factors used in the Lithuanian national GHG inventory are provided in Table 3-7.

Table 3-7. N_2O emission factors used in the Lithuanian national GHG inventory (kg/TJ).

Fuel	Emission factor (kg/TJ)	Source / Comments
Energy industries		
Crude Oil	0.6	2006 IPCC Guidelines

Orimulsion	0.6	2006 IPCC Guidelines
Shale Oil	0.6	2006 IPCC Guidelines
Gas/Diesel Oil	0.6	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Residual Fuel Oil	0.6	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Liquefied Petroleum Gases	1.5	EF used in earlier submissions corresponding to CORINAIR range
Petroleum Coke	0.6	CORINAIR
Coking Coal	1.4	Revised 1996 IPCC Guidelines
Lignite		NO
Natural Gas	0.1	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Waste Oil	4	2006 IPCC Guidelines
Peat	4	EF used in earlier submissions corresponding to CORINAIR range
Wood/Wood Waste	4	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Charcoal		NO
Biogas	1.95	CORINAIR
Manufacturing industries and construction		
Crude Oil		NO
Orimulsion		NO
Shale Oil	0.6	2006 IPCC Guidelines
Gas/Diesel Oil	0.6	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Residual Fuel Oil	0.6	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Liquefied Petroleum Gases	1.5	EF used in earlier submissions corresponding to CORINAIR range
Petroleum Coke	0.6	CORINAIR
Coking Coal	1.4	Revised 1996 IPCC Guidelines
Lignite		NO
Natural Gas	0.1	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Waste Oil		NO
Peat	4	EF used in earlier submissions corresponding to CORNAIR range
Wood/Wood Waste	4	EF used in earlier submissions corresponding to Revised 1996 IPCC Guidelines
Charcoal		NO
Biogas	1.95	CORINAIR
Commercial/Institutional		
Crude Oil		NO
Orimulsion		NO
Shale Oil	0.6	2006 IPCC Guidelines
Gas/Diesel Oil	0.6	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Residual Fuel Oil	0.6	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Liquefied Petroleum Gases	1.5	EF used in earlier submissions corresponding to CORINAIR range
Petroleum Coke		NO
Coking Coal	1.4	Revised 1996 IPCC Guidelines
Lignite	1.5	2006 IPCC Guidelines
Natural Gas	0.1	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Waste Oil		NO
Peat	4	EF used in earlier submissions corresponding to CORINAIR range
Wood/Wood Waste	4	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Charcoal	1	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Biogas	1.95	CORINAIR
Residential/Agriculture		
Crude Oil		NO
Orimulsion		NO
Shale Oil	0.6	2006 IPCC Guidelines

Gas/Diesel Oil	0.6	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Residual Fuel Oil	0.6	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Liquefied Petroleum Gases	1	EF used in earlier submissions corresponding to CORINAIR range
Petroleum Coke		NO
Coking Coal	1.4	Revised 1996 IPCC Guidelines
Lignite	1.5	2006 IPCC Guidelines
Natural Gas	0.1	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Waste Oil		NO
Peat	4	EF used in earlier submissions corresponding to CORINAIR range
Wood/Wood Waste	4	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Charcoal		NO
Biogas		NO

3.3.2.3 Emission factors for mobile sources

Following the remarks of the ERT, a review of emission factors for mobile sources was undertaken in 2010 (discussion and comparison with EF provided in the literature was presented in National Greenhouse Gas Emission Inventory Report 2010, covering the period 1990-2008). Emission factors for mobile sources used in the Lithuanian national GHG inventory are provided in Table 3-8, Table 3-9 and Table 3-10.

Country specific CO_2 EF were developed in 2010 based on research data from the Lithuanian oil refinery (research protocols of UAB "ORLEN Lietuva" Quality Research Center). Motor gasoline, jet kerosene, gas/diesel oil, residual fuel oil, LPG and non liquefied petroleum gas used in the country are produced by the oil refinery UAB "ORLEN Lietuva". Imports of the fuels listed above comprise only a minor fraction of the fuels used in Lithuania.

Table 3-8. CO_2 emission factors for transport sector used in the Lithuanian national GHG inventory (kg/TJ).

Fuel	Emission factor (kg/GJ)	Source / Comments
Aviation		
Aviation gasoline	70	2006 IPCC Guidelines
Jet kerosene	72.24	Country specific EF based on producer data (research protocols of JSC "ORLEN Lietuva" Quality Research Center)
Road transportation		
Motor gasoline	72.97	Country specific EF based on producer data (research protocols of JSC "ORLEN Lietuva" Quality Research Center)
Gas/Diesel oil	72.89	Country specific EF based on producer data (research protocols of JSC "ORLEN Lietuva" Quality Research Center)
LPG	65.42	Country specific EF based on producer data (research protocols of JSC "ORLEN Lietuva" Quality Research Center)
Biodiesel	70.8	2006 IPCC Guidelines
Bioethanol	70.8	2006 IPCC Guidelines
Railways		
Diesel oil	72.89	Country specific EF based on producer data (research protocols of JSC "ORLEN Lietuva" Quality Research Center)
Navigation		
Residual Fuel Oil	81.29	Country specific EF based on producer data (research protocols of JSC "ORLEN Lietuva" Quality Research Center)
Diesel Oil	72.89	Country specific EF based on producer data (research protocols of JSC "ORLEN Lietuva" Quality Research Center)

Off-road vehicles		
Motor gasoline	72.97	Country specific EF based on producer data (research protocols of JSC "ORLEN Lietuva" Quality Research Center)
Diesel oil	72.89	Country specific EF based on producer data (research protocols of JSC "ORLEN Lietuva" Quality Research Center)

Table 3-9. CH_4 emission factors for transport sector used in the Lithuanian national GHG inventory (kg/TJ).

Fuel	Emission factor (kg/TJ)	Source / Comments
Aviation		
Aviation gasoline	20	Revised 1966 IPCC Guidelines
Jet kerosene	1.5	EF used in earlier submissions close to the EU average
Road transportation		
Motor gasoline	20	Revised 1966 IPCC Guidelines
Gas/Diesel oil	3.3	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
LPG	19.2	EF used in earlier submissions close to EU average
Biodiesel	10	2006 IPCC Guidelines
Bioethanol	10	2006 IPCC Guidelines
Railways		
Diesel oil	5	EF used in earlier submissions corresponding to Revised 1996 IPCC Guidelines
Navigation		
Residual Fuel Oil	3	EF used in earlier submissions
Diesel Oil	3	EF used in earlier submissions close to EU average
Off-road vehicles		
Motor gasoline	26	2006 IPCC Guidelines
Diesel oil	1.67	2006 IPCC Guidelines

Table 3-10. N_2O emission factors for transport sector used in the Lithuanian national GHG inventory (kg/TJ).

Fuel	Emission factor (kg/TJ)	Source / Comments
Aviation		
Aviation gasoline	2	EF used in earlier submissions close to EU average
Jet kerosene	2.2	EF used in earlier submissions close to Revised 1996IPCC Guidelines
Road transportation		
Motor gasoline	2	EF used in earlier submissions close to EU average
Gas/Diesel oil	4	EF used in earlier submissions close to 2006 IPCC Guidelines
LPG	0.2	2006 IPCC Guidelines
Biodiesel	0.6	2006 IPCC Guidelines
Bioethanol	0.6	2006 IPCC Guidelines
Railways		
Diesel oil	3	EF used in earlier submissions close to 2006 IPCC Guidelines
Navigation		
Residual Fuel Oil	0.6	2006 IPCC Guidelines
Diesel Oil	0.6	2006 IPCC Guidelines
Off-road vehicles		
Motor gasoline	2	2006 IPCC Guidelines
Diesel oil	28.6	2006 IPCC Guidelines

3.4 Uncertainties

There is a certain level of uncertainty for the fuel combustion sector. Data on fuel consumption are collected by the Lithuanian Statistics which prepares the annual report "Energy balance". Some categories defined in the CRF do not exactly match the categories of energy commodities and economic sectors identified in the national statistics. Therefore the final figures for fuel consumption and respective emissions have had to be calculated by grouping data selected from the Energy Balance, using one's best judgment. Based on recommendations provided by 2006 IPCC Guidelines for GHG inventories (IPCC, 2006) the default uncertainty range for fossil fuel combustion data should be assumed to be ±5%. Since data on biomass as fuel are not well developed as for fossil fuel, the uncertainty range for biomass is ±50% as recommended by (IPCC, 2006).

3.5 Source specific recalculations

Following the remarks of the ERT in 2010, CO_2 emissions from combustion of motor gasoline, jet kerosene, gas/diesel oil, residual fuel oil, LPG and non liquefied petroleum gas were recalculated using revised country specific emission factors (based on research protocols of UAB "ORLEN Lietuva" Quality Research Center). It is considered, that these emission factors are more accurate than emission factors used in previous submissions, as fuels used in Lithuania are mainly produced by oil refinery UAB "ORLEN Lietuva" and imports of the fuels specified above comprise only a minor fraction of the fuels used in Lithuania.

Additional recalculations were made due to change of statistical data on use of specific fuels (annual revision of energy balance by Statistics Lithuania).

Emission factors for CO_2, CH_4 and N_2O emissions from international bunkers were reviewed and corrected. The effect of recalculations performed in energy sector is presented in the table 3-11.

Table 3-11. Impact of recalculations on CO_2, CH_4, N_2O emissions (Gg) in energy sector.

Year	CO_2			CH_4			N_2O		
	Previous submission	Latest submission	Difference	Previous submission	Latest submission	Difference	Previous submission	Latest submission	Difference
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
1990	34.078,73	32.987,81	-3,20	372,43	370,50	-0,52	352,87	341,35	-3,27
1991	35.824,41	35.143,77	-1,90	388,63	386,78	-0,48	309,44	300,94	-2,75
1992	20.309,18	19.685,87	-3,07	283,87	282,58	-0,45	217,04	210,41	-3,06
1993	16.291,44	15.727,12	-3,46	315,51	314,38	-0,36	194,39	188,62	-2,97
1994	15.278,17	14.848,08	-2,82	317,02	316,02	-0,32	178,33	173,36	-2,79
1995	14.248,87	13.769,97	-3,36	329,55	328,53	-0,31	173,17	168,14	-2,91
1996	14.545,23	14.236,15	-2,12	351,47	350,55	-0,26	144,64	141,04	-2,49
1997	14.015,75	13.757,39	-1,84	364,18	363,30	-0,24	144,31	141,37	-2,04

1998	14.686,98	14.495,22	-1,31	387,03	386,08	-0,25	146,33	143,78	-1,75
1999	12.215,96	12.083,71	-1,08	389,52	388,70	-0,21	123,52	121,66	-1,51
2000	10.664,17	10.485,58	-1,67	393,85	393,31	-0,14	109,19	107,78	-1,29
2001	11.334,22	11.153,05	-1,60	409,53	409,15	-0,09	113,95	112,71	-1,09
2002	11.435,54	11.220,05	-1,88	403,72	403,37	-0,09	117,67	116,38	-1,09
2003	11.436,39	11.188,77	-2,17	401,71	401,35	-0,09	117,65	116,35	-1,10
2004	12.082,63	11.805,65	-2,29	395,01	394,66	-0,09	124,50	123,20	-1,04
2005	12.755,61	12.468,32	-2,25	406,36	406,07	-0,07	130,41	129,03	-1,05
2006	12.852,30	12.611,35	-1,87	411,46	412,07	0,15	133,01	131,85	-0,87
2007	13.042,32	12.795,19	-1,89	403,43	405,00	0,39	140,67	139,39	-0,91
2008	12.813,43	12.499,07	-2,45	409,60	411,07	0,36	143,96	142,86	-0,76

3.6 Source specific QA/QC

Calculated CO_2 emissions for quality assurance were compared with verified CO_2 emissions in GHG Registry.

The Lithuanian Greenhouse Gas Emission Allowance Registry was established in 2005 and re-established as the State Greenhouse Gas Registry by the Government Resolution No 1072 On the establishing Greenhouse Gas Registry and approval of the regulation of the Greenhouse Gas Registry, adopted on 14 July 2010. The managing institution (competent authority) of the Registry is the Ministry of Environment and administrating institution - the Lithuanian Environment Investment Fund. In 2009 the Fund provided information on verified CO_2 emissions for 100 fuel combustion installations[13] (Annex 3). CO_2 emissions from production process are included in the registry for the installations, covered by activities, listed in Annex 1 of the EU Directive 2003/87/EC (mineral oil refinery, production of cement clinker, manufacture of glass, ceramic and paper, rockwool).

For the purpose of comparison of verified emissions of the Greenhouse Gas Registry with the CO_2 emissions in the NIR, installations were allocated to a certain CRF sector (fuel combustion, sectoral approach). Comparison of the verified CO_2 emissions and NIR are provided in Table 3-15.

Table 3-12. Comparison of the verified CO_2 emissions in the Greenhouse Gas Registry and NIR (Fuel combustion sectoral approach), 2009.

Sector in NIR	Verified CO_2 emissions in the Greenhouse Gas Emission Allowance Registry, Gg	Calculated CO_2 emissions in NIR fuel combustion, sectoral approach, Gg	Difference (NIR minus GHGEAR), Gg	Difference (NIR minus GHGEAR), %
1.AA 2.D Pulp, Paper and Print	56,5	50,4	-6,1	-12%
1.AA.1.A Public Electricity and Heat Production	2714,7	3170,5	455,8	14%
1.AA.1.B Petroleum Refining	2102,8	1707,2	-395,6	-23%
1.AA.2.C Chemicals	181,5	198,5	17,0	9%
1.AA.2.E Food processing, Beverages and Tobacco	44,6	252,4	207,8	82%
1.AA.4.C Agriculture/ Forestry/	47,4	83,0	35,5	43%

[13] http://www.laaif.lt/index.php?-130096284

Fisheries				
1.AA.2.F Other	639,3	491,9	-147,4	-30%
Total	5786,7	5953,9	167,1	3%

Total CO_2 emissions calculated in NIR sectoral approach are 3% higher (167,1 Gg) as compared to verified emissions in the Greenhouse Gas Registry. The difference may be due to accuracy of emission factors and due to CO_2 emissions from some production process (not related with fuel combustion) are included in the Registry data.

Large fuel combustion installations are used for several purposes (e.g. oil refining and electricity/ heat production) therefore allocation of installations to certain NIR sectors is not accurate and comparison of emissions on the level of NIR sectors is not enough informative.

3.7 Planned improvements

The following improvements were added to the inventory improvement plan in the energy sector and will be implemented in the NIR 2012:

- Further improve transparency providing more detailed description of methods and EF used;
- To reassess uncertainty of activity data and emission factors used for uncertainty calculation;
- Calculation of emissions from road transport using Copert 4 programme;
- To address time-series inconsistency in the AD on international bunker fuels used for aviation;
- To provide more explanations for the difference between the emission estimates in sectoral and reference approach;
- To investigate the possibility of using data provided in the EU ETS, reported by the operators for the energy sector emission estimates.

Major part of liquid fuels to the Lithuanian market is supplied by the UAB Orlen Lietuva refinery. CO_2 emission factors for liquid fuels (gasoline, diesel oil, LPG, jet kerosens, residual fuel oil) used in 2011 submission were reviewed and corrected based on analysis of liquid fuels supplied by the refinery. However, certain part of fuels is placed on the Lithuanian market by other suppliers. Further analysis of market conditions is planned in order to evaluate suitability of emission factors established for fuels supplied by UAB Orlen Lietuva refinery for estimating overall GHG emissions from fuel combustion.

In 2012 will start a Norway Grants capacity building project between Lithuania and Norway “Cooperation on GHG inventory”. The partner of this programme will be Norwegian Climate and Pollution Agency, which is national entity responsible for GHG inventory preparation in Norway. One of the outcomes of this project will be a study on EFs used for energy sector in Lithuania. It is expected that results of this study will be presented in 2013 submission.

3.8 Fugitive emissions from oil and gas operations (CRF 1.B)

Fugitive emissions from oil and natural gas activities include all emissions from the exploration, production, processing, transport, and use of oil and natural gas and from non-productive combustion. Fugitive emissions consist mainly of emissions of methane, carbon dioxide and nitrous oxide.

Emissions were calculated using emission factors (Table 3-11). As country-specific emission factors are not available, emissions of CH_4 and CO_2 from natural gas distribution and transmission were calculated using default emission factors (averages) for countries with economies in transition provided in IPCC GPG 2000 and based on activity data obtained from various sources: Geological Survey of Lithuania (number of drilling, testing, servicing wells), Statistics Lithuania publication

"Energy balance" (oil production and refining), JSC "Lietuvos dujos" (length of pipelines). There are no mining activities in Lithuania, thus no fugitive emissions from solid fuels exists.

Table 3-11. Emission factors used for estimation of emissions from oil operations.

Category	Subcategory	Emission Type	Emission factor			Units of measure
			CH_4	CO_2	N_2O	
Wells	Drilling	All	4.3E-07	2.8E-08	0	Gg per number of wells drilled
	Testing	All	2.7E-04	5.7E-03	6.8E-08	Gg per number of wells drilled
	Servicing	All	6.4E-05	4.8E-07	0	Gg/yr per number of producing and capable wells
Gas transmission	All	Fugitives	2.5E-03	1.6E-05	0	Gg per year per km of transmission pipeline
		Venting	1.0E-03	8.5E-06	0	Gg per year per km of transmission pipeline
Gas distribution	All	All	6.15E-04	9.55E-05	0	Gg per year per km of transmission pipeline
Oil production	Conventional oil	Fugitives	1.45E-05	2.7E-04	0	Gg per 10^3 m^3 conventional oil production
		Venting	138.1E-05	1.2E-05	0	Gg per 10^3 m^3 conventional oil production
		Flaring	13.75E-05	6.7E-02	6.4E-07	Gg per 10^3 m^3 conventional oil production
Oil transport	Pipelines	All	5.4E-06	4.9E-07	0	Gg per 10^3 m^3 oil transported by pipeline
Crude oil refining	All	All	745	0	0	Kg per PJ oil refined

Emissions from natural gas distribution were calculated by using emission factors provided in the IPCC Good Practice Guidelines (2000) and based on pipeline length. As noted in the IPCC Good Practice Guidelines (p. 2.84), "fugitive emissions from gas transmission and distribution systems do not correlate well with throughput, and are better related to lengths of pipeline". It should be assumed that emissions from natural gas distribution cover emissions at residential and commercial sectors and in industrial plants and power stations. Therefore these emissions were not calculated separately and marked with notation key "IE".

Emission from natural gas storage was not estimated due to there are no natural gas storage facilities in Lithuania. Lithuania uses storage facilities located in Latvia.

Upon the request of ERT in 2010 individual review report, Lithuania was asked to provide an explanation on the differences between International Energy Agency (IEA) and CRF data on coal mines. There are no coal mining activity in Lithuania as confirmed by the specialists of Lithuanian Geological Survey, thus "NO" is reported under fugitive emissions from mining processes.

3.9 Emissions of Precursor Gases

The inventory of ozone precursors (CO, NO_X and NMVOCs) and aerosol precursor (SO_2) gases are reported in the CRF from 2002 onwards. Emission estimates for precursors in the relevant subcategories: nitrogen oxides (NO_x), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOC) are mainly emitted from the energy sector as a result of organic fuel combustion and oil processing. Data on precursors emissions are reported annually under the

Convention of Long-Range Transboundary Air Pollution (CLRTAP) and used as a data source for GHG inventories.

4 INDUSTRIAL PROCESSES (Sector 2)

4.1 Industry Sector Overview

After the economic recession in early 1990's, Lithuania's industrial production and economy started to grow, as reflected by the growth of the GDP. In 2008 Lithuania was struck by the global economic crisis causing significant reduction in industrial production. Trends of development of some key industrial activities are shown in Fig. 4-1.

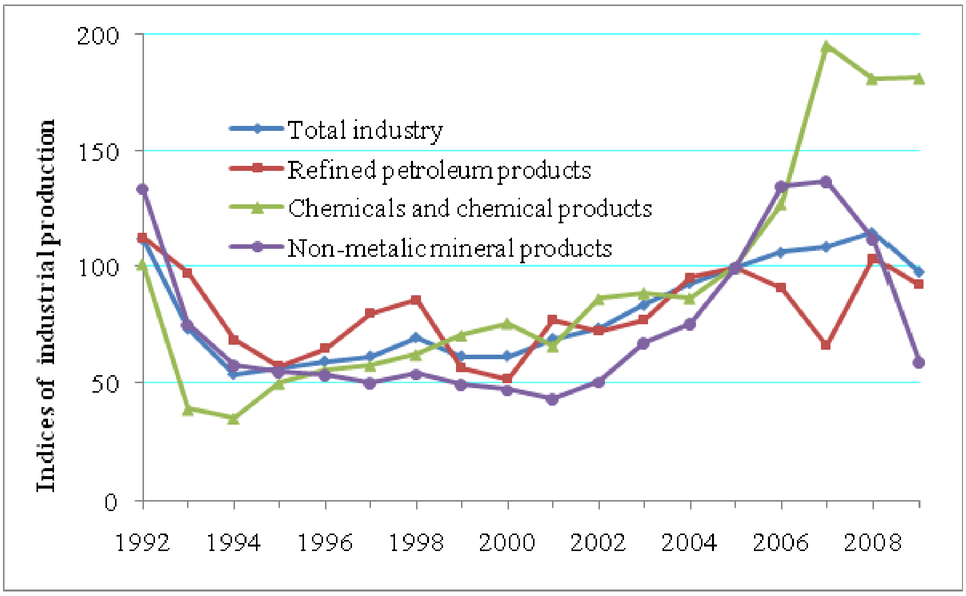


Fig. 4-1. Trends in development of some key industrial activities in 1992-2009 (2005 = 100)

4.2 Greenhouse Gas Sources and Emissions

Emission from industrial processes occur when chemical reactions result in the production of CO_2 (as in cement production) and a portion of it is released to the atmosphere or when GHG themselves are used in the industrial processes.

Only three GHG sources in industry fall within the key source categories (Table 4-1).

Table 4-1. Key categories in industrial processes sector (Gg CO_2 equivalent, incl. LULUCF) in 2009

Key Category	GHG emissions, Gg CO2 eq.	Level assessment
2.B.1. Ammonia Production, CO2	1,173.01	4.6%
2.B.2. Nitric Acid Production, N2O	731.28	2.9%
2.A.1. Cement Production, CO2	284.02	1.1%

4.3 Mineral Industry

4.3.1 Cement Production

4.3.1.1 Activity data

Emissions of CO_2 occur during the production of clinker that is an intermediate component in the cement manufacturing process. High temperatures in cement kilns chemically change calcium carbonate into lime and CO_2. The conversion of the lime into cement clinker then results in the release of further CO_2.

Cement is produced in a single company UAB “Akmenes Cementas” situated in the North Western part of Lithuania. The total nominal capacity of the plant is about 5 million tonnes cement per year. The data on clinker production and composition were provided by the UAB “Akmenes Cementas” .

Clinker production has fallen sharply after the declaration of independence from more than 3 million tonnes annually in 1990 to about 500 to 600 thousand tonnes in 2000 (Fig. 4-2). During the last several years production has slightly increased and reached more than 900 thou. tonnes in 2006 and 2007, but decreased again to 522 thou. tonnes in 2009.

CaO content in clinker fluctuated from 62.3% to 65.3% (1990 to 2009), the average value being 64.3%, standard deviation 0.8%.

The data on MgO content in clinker were available only for the period 2000 to 2009. MgO content fluctuated in the range from 3.33% to 4.13%, average value was 3.84%, standard deviation 0.27%. For GHG calculation for the period 1990 to 1999 average MgO content value was used.

The data on generation of cement kiln dust (CKD) (fraction not recycled to the kiln) were provided only for 2005-2009 (fluctuation from 0.5% to 2.3% of clinker production, average value 1.3%). Average value was used for the period when specific data were not available. According to the UAB “Akmenes Cementas”, only about 5% of the CKD is calcinated.

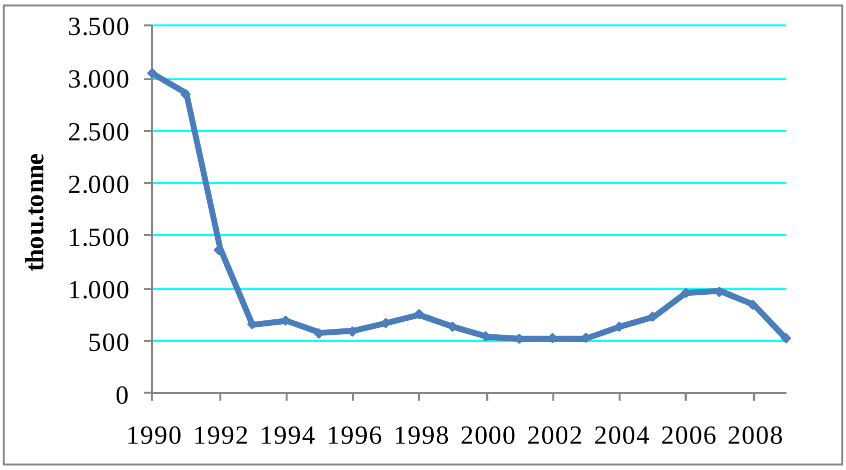


Fig. 4-2. Clinker production in UAB “Akmenes Cementas”

4.3.1.2 Methodological issues

For the years 2005-2009 CO_2 emission data have been accessed via the verified EU ETS reports of the plant. For the years 1990-2004 CO_2 emission was calculated by Tier 2 method using specific production data provided by the production company. CO_2 emissions were calculated from material mass balance assuming that all carbon contained in raw materials (limestone) was released to the atmosphere as CO_2. Actual CO_2 emission was calculated from the data on clinker production and composition In addition it was assumed that CO_2 was released from calcinated fraction of kiln dust.

CO_2 emission was calculated using the following equation:

$$Emission = CP \times (C_{CaO} \times (M_{CO2}/M_{CaO}) + C_{MgO} \times (M_{CO2}/M_{MgO})) + $$
$$+ CKD \times CF \times (C_{CaO} \times (M_{CO2}/M_{CaO}) + C_{MgO} \times (M_{CO2}/M_{MgO})),$$

where

CP is clinker production, Gg,
CKD is cement kiln dust generation, Gg,
CF is calcinated fraction of the CKD,
C_{CaO} and C_{MgO} are CaO and MgO fractions in clinker,
M_{CO2}, M_{CaO}, M_{MgO} are molecular weights of CO_2, CaO and MgO.

Estimated CO_2 emissions in cement production are shown in Table 4-2.

Table 4-2. Estimated CO_2 emissions (Gg/year) in cement production

Year	Emission	Year	Emission
1990	1,668.1	2000	292.5
1991	1,550.0	2001	283.4
1992	755.0	2002	290.5
1993	363.9	2003	292.5
1994	381.6	2004	351.0
1995	308.0	2005	383.3
1996	317.5	2006	515.3
1997	366.1	2007	524.1
1998	411.7	2008	453.8
1999	345.8	2009	284.0

4.3.2 Lime Production

4.3.2.1 Activity data

The data on lime production were provided by the Statistics Lithuania[14]. After declaration of independence lime production decreased from approximately 300 thou. tonnes annually to 50 thou. tonnes in 1993 and was fluctuating about this value until 2008 but have contracted again very significantly in 2009 (Fig. 4-3).

The data on hydrated lime production are provided by the Statistics Lithuania from 2002. The fraction of hydrated lime was very small, about 0.001% in 2002 to 2006. In 2007 its production reached maximum at about 900 tonnes declining again to 550 tonnes in 2008 and 209 tonnes in 2009.

Actual hydrated lime production data were used for emission calculation in 2002-2009 and it was assumed that hydrated lime production was zero in 1990 to 2001.

Hydrated lime data were converted to quicklime using default water content correction factor 0.28[15].

[14] http://db1.stat.gov.lt/statbank/default.asp?w=1440

[15] IPCC GPG 2000, p. 3.22-23

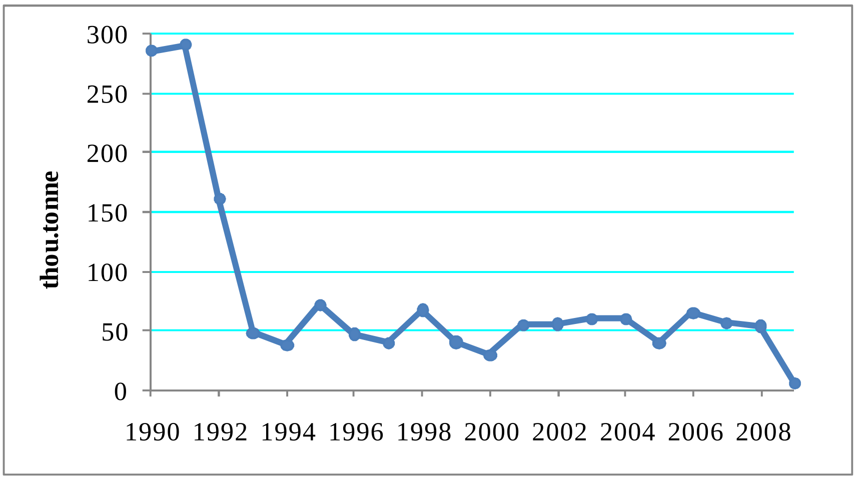


Fig. 4-3.Lime production

According to the data provided by the AB "Naujasis Kalcitas" company which is the main lime producer in Lithuania, limestone used for lime production contains 90% to 92% $CaCO_3$ and 4% to 5% $MgCO_3$. Based on these data it was assumed that the product contains on average 91.1% CaO, 3.9% MgO and 5% impurities.

4.3.2.2 Methodological issues

CO_2 emission was calculated by Tier 2 method using production data provided by the Statistics Lithuania and limestone composition data provided by the AB "Naujasis Kalcitas". CO_2 emissions were calculated from material mass balance assuming that all carbon contained in raw materials (limestone) was released to the atmosphere as CO_2.

As it was mentioned above, hydrated lime data were converted to quicklime using default water content correction factor 0.28. CO_2 emission was calculated using the following equation:

$$Emission = LP \times (C_{CaO} \times (M_{CO2}/M_{CaO}) + C_{MgO} \times (M_{CO2}/M_{MgO}))$$

where

LP is lime production, Gg,
C_{CaO} and C_{MgO} are CaO and MgO fractions in lime,
M_{CO2}, M_{CaO}, M_{MgO} are molecular weights of CO_2, CaO and MgO.

Estimated CO_2 emissions in lime production are provided in Table 4-3.

Table 4-3. Estimated CO_2 emissions (Gg/year) in lime production

Year	Emission	Year	Emission
1990	216.4	2000	22.2
1991	220.4	2001	41.4
1992	121.9	2002	41.7
1993	36.4	2003	45.3
1994	28.5	2004	45.3
1995	54.3	2005	29.7
1996	35.6	2006	49.2
1997	29.6	2007	42.3
1998	51.0	2008	40.3

1999	30.5	2009	4.2

4.3.3 Limestone and Dolomite Use

4.3.3.1 Activity data

Specific CO_2 emissions caused by thermal degradation of limestone and dolomite are covered in sections dealing with cement, lime, glass, mineral wool, brick and tile production. This section covers limestone flux use in iron foundries. Consumption of limestone flux in iron foundries was calculated as one tent of iron production in accordance with the information provided by the foundries.

4.3.3.2 Methodological issues

CO_2 emission was calculated by Tier 2 method iron production data provided by the Statistics Lithuania. Consumption of limestone flux in iron foundries was calculated as one tent of iron production in accordance with the information provided by the foundries. CO_2 emissions were calculated from material mass balance assuming that all carbon contained in raw materials (limestone) used as flux was released to the atmosphere as CO_2.

CO_2 emission was calculated using the following equation:

$$Emission = LP \times (C_{CaO} \times (M_{CO2}/M_{CaO}) + C_{MgO} \times (M_{CO2}/M_{MgO}))$$

where

LP is lime production, Gg,
C_{CaO} and C_{MgO} are CaO and MgO fractions in lime,
M_{CO2}, M_{CaO}, M_{MgO} are molecular weights of CO_2, CaO and MgO.

Estimated CO_2 emissions from lime and dolomite use are provided in Table 4-4.

Table 4-4. Estimated CO_2 emissions (Gg/year) from lime and dolomite use

Year	Emission	Year	Emission
1990	4.5	2000	0.98
1991	3.6	2001	1.04
1992	1.6	2002	0.74
1993	1.0	2003	0.67
1994	0.7	2004	0.62
1995	0.7	2005	0.48
1996	0.7	2006	0.42
1997	0.9	2007	0.48
1998	1.1	2008	0.46
1999	1.0	2009	0.19

4.3.4 Glass Production

4.3.4.1 Activity data

There were three glass production plants in Lithuania. One of them (AB Ekranas producing cathode ray tubes) got bankrupt in 2006 and only two plants are in operation currently.

Variations in glass production in 1990-2009 are shown in Fig. 4-4.

UAB Kauno stiklas is the oldest glass production plants in Lithuania and produces container glass. In the whole period 1990 to 2009, its production was comparatively stable averaging about 20 thousand tonnes annually.

AB Panevėžio stiklas is the largest overall glass producer manufacturing both sheet glass and container glass. Its production has fallen down substantially in early nineties following the declaration of independence but increased again later even exceeding pre-independence level. However, sheet glass production was stopped in 2002 causing again substantial reduction in production to approximately 40 thousand tonnes per year.

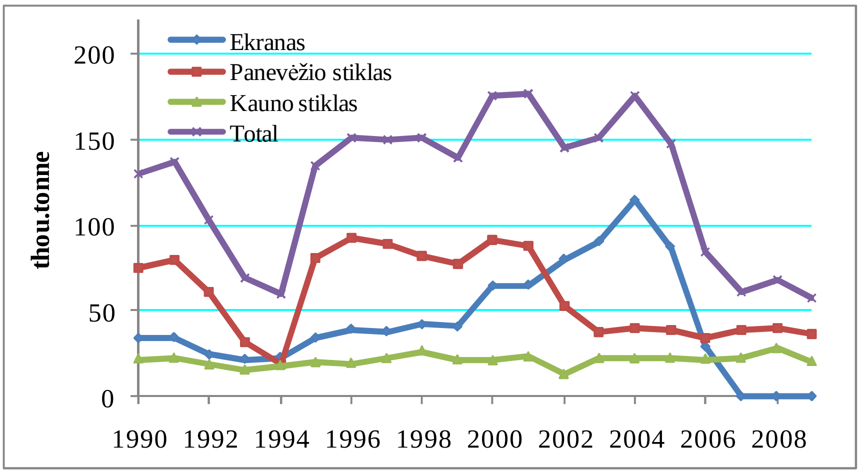


Fig. 4-4. Variations in glass production in 1990-2009

Glass production in CRT manufacturer AB “Ekranas” decreased slightly in the very beginning of the period but then was increasing continuously from 1993 to 2004. However, changing market conditions and sharp reduction of demand for CRTs caused sudden bankruptcy of the company and production was stopped completely in 2006.

4.3.4.2 Methodological issues

UAB “Kauno Stiklas” provided data on dolomite and soda ash consumption and dolomite composition for 2004-2009. The data on dolomite, soda ash, potash and chalk consumption by AB “Panevėžio Stiklas” were provided starting from 1999, however, the data on composition of these batch components were available only from 2005. Average composition of the components was used for calculation of CO_2 emissions in 1999-2004.

CO_2 emissions were calculated using the following equation:

$$Emission = \sum\left(CC_i \times \sum(C_{i,j} \times (M_{CO2}/M_j))\right),$$

where

CC_i is consumption of component *i*, Gg,
$C_{i,j}$ are the fractions of accordingly $CaCO_3$, $MgCO_3$, Na_2CO_3 and K_2CO_3 in component *i*,
M_{CO2} is molecular weights of CO_2,
M_l are the molecular weights of$CaCO_3$, $MgCO_3$, Na_2CO_3 and K_2CO_3 accordingly.

CO_2 emissions for the periods for which data on batch composition were not available were established using emission factors calculated by dividing the total annual CO_2 emission by the total glass production. Calculated emission factors were 0.102 for AB “Panevėžio Stiklas” and 0.114 for UAB “Kauno Stiklas”.

Estimated CO_2 emissions in glass production are provided in Table 4-5.
CH_4 and N_2O emissions from glass production were not estimated due to lack of IPCC methodology.

Table 4-5. Estimated CO_2 emissions (Gg/year) in glass production

Year	Emission	Year	Emission
1990	13.2	2000	18.5
1991	13.9	2001	18.3
1992	10.6	2002	13.4
1993	7.0	2003	14.9
1994	6.1	2004	16.7
1995	13.7	2005	14.6
1996	15.3	2006	8.3
1997	15.2	2007	6.7
1998	15.3	2008	6.9
1999	15.2	2009	5.0

4.3.5 Other Use of Soda Ash

4.3.5.1 Activity data

The data on soda CO_2 emissions from soda ash use was calculated taking into account separately soda ash consumption in glass production and other use of soda ash.

Data on overall use of soda ash were taken from the publications of the Statistics Lithuania[16]. The data provided by glass manufacturing companies included soda ash consumption by AB “Panevėžio Stiklas” from 1999 and by UAB “Kauno Stiklas” from 2004. Relative soda ash consumption was calculated from available data as factor expressing soda ash consumption per production of on tonne glass and used for evaluation of soda ash consumption for glass production during the remaining period. Keeping in mind that speciality CRT glass contains substantially less sodium, soda ash consumption factor for CRT producer AB “Ekranas” was divided by half.

Variations of soda ash use are shown in Fig. 4-5.

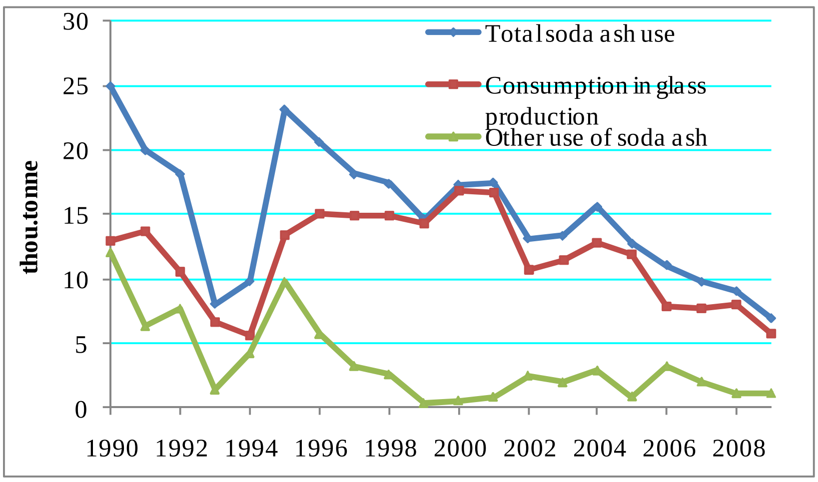


Fig. 4-5. Evaluated use of soda ash in 1990-2009

[16] Statistic Lithuania publication “Raw Materials”

4.3.5.2 Methodological issues

CO_2 emissions were calculated from mass balance assuming that all carbon contained in soda ash was released to the atmosphere after use as CO_2. The following equation was used:

$$Emission = SA \times M_{CO2}/M_{Na2CO3},$$

where

SA is other use of soda ash, Gg,

M_{CO2} and M_{Na2CO3} are molecular weights of CO_2 and Na_2CO_3.

Estimated CO_2 emissions from other use of soda ash are provided in Table 4-6.

Table 4-6. Estimated CO_2 emissions (Gg/year) from other use of soda ash

Year	Emission	Year	Emission
1990	5.0	2000	0.2
1991	2.6	2001	0.3
1992	3.2	2002	1.0
1993	0.6	2003	0.8
1994	1.7	2004	1.2
1995	4.0	2005	0.3
1996	2.4	2006	1.3
1997	1.3	2007	0.8
1998	1.1	2008	0.4
1999	0.1	2009	0.4

4.3.6 Rock Wool Production

4.3.6.1 Activity data

Two rock wool plants were in operation in Lithuania in 1990. The Alytus plant was closed soon after independence. Another plant (AB “Silikatas” in Vilnius) continued operation but production was constantly decreasing. Finally it was bought by the Finnish company “Paroc” which performed major upgrading of the plant in 1996 when production fell down actually to zero.

It was not possible to find actual data on rock wool production from 1990 to 1996. Evaluation of production figures for that period based on remaining data was performed by prof. A. Kaminskas who was the director of the Institute of Thermal Insulation in Vilnius in eighties and nineties. Production data for the period from 1997 were provided by the “Paroc” company.

Production data for the last several years were reviewed and corrected. Specifically production data of the new rock wool production line which was put into operation in 2005 were added.

The fluctuation of rock wool production from 1990 to 2008 is shown in Fig. 4-6.

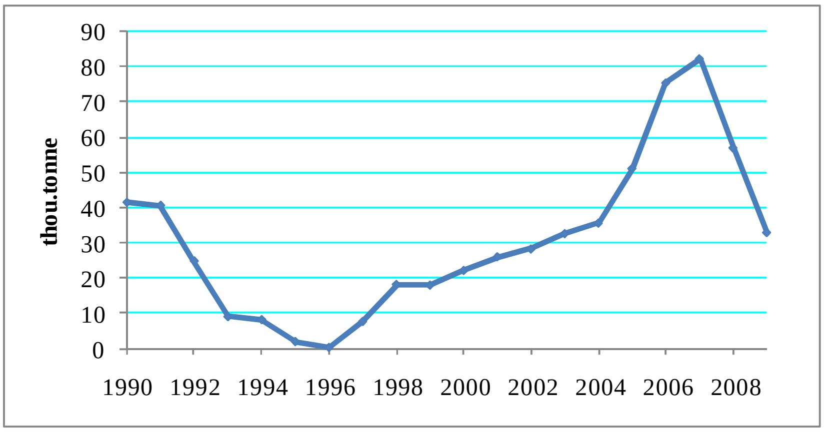


Fig. 4-6. Rock wool production

In rock wool production CO_2 is formed by decomposition of dolomite. The data on consumption of dolomite for rock wool production for 2002-2009 were also provided by the "Paroc".

4.3.6.2 Methodological issues

CO_2 emissions from rock wool production were recalculated using new more accurate and reliable data provided by the production company.

Specific batch composition for rock wool production is considered confidential by the "Paroc" and was not disclosed. However, the company provided data on dolomite consumption for the years 2002 to 2009 and CO_2 emission factor which is 0.44 t CO_2 per tonne dolomite.

CO_2 emissions in 2002-2009 were calculated using dolomite consumption data and emission factor provided by the production company. Based on the results, average emission factor for CO_2 emission from rock wool production was calculated as 0.147 tonnes CO_2 per tonne rock wool produced. This emission factor was used for calculation on CO_2 production in 1990-2001.

Estimated CO_2 emissions in rock wool production are provided in Table 4-7.

Table 4-7. Estimated CO_2 emissions (Gg/year) in rock wool production

Year	Emission	Year	Emission
1990	6.1	2000	3.26
1991	6.0	2001	3.84
1992	3.7	2002	3.56
1993	1.3	2003	4.68
1994	1.2	2004	5.11
1995	0.3	2005	8.05
1996	0.1	2006	12.10
1997	1.1	2007	12.43
1998	2.7	2008	9.05
1999	2.7	2009	4.9

4.3.7 Brick and Tile Production

4.3.7.1 Activity data

The data on ceramic brick, tile and vitrified clay pipes production were taken from Statistics Lithuania publications[17]. It should be noted that ceramic brick production in previous submissions was overestimated as subcategory 26.40.11.13 "Ceramic bricks and blocks for common masonry" was added to the category 26.40.11.10 "Non-refractory clay building bricks" which already contained the former subcategory.

Ceramic bricks production data in the Statistics Lithuania publications for various periods are provided in different units. The data for 1990-2001 are provided in millions of bricks, while the data for the following years are in thousands cubic metres. Recalculation of data to mass units was made by applying average conversion factors based on information provided by the largest ceramic brick and pipe producer in Lithuania AB "Palemono Keramika"[18]. It was assumed that average brick mass in 2.7 kg and average volume weight of bricks is 1.6 t/m^3.

Vitrified clay pipes production data in the Statistics Lithuania publications are provided in thousands of kilometres for the period 1990-2001 and in tonnes for the remaining period. Production of vitrified clay pipes were converted to mass units using conversion factor 3.0 tonnes per km.

Ceramic tile production data were provided in square metres from 1990 to 2001 and in tile units from 2002. These data were converted to weight units assuming that average tile area is 350×200 mm and average weight is 2.8 kg (information by AB "Palemono Keramika").

Variations of ceramics production in Lithuania are provided in Fig. 4-7.

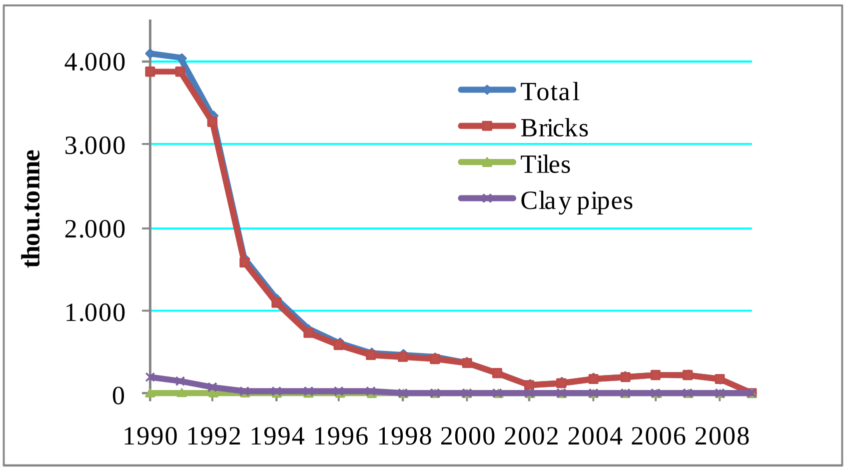


Fig. 4-7. Variations of ceramics production

It should be noted that production of bricks, tiles and clay pipes has fallen down dramatically from 1990, tiles were not produced in 2008 in general.

4.3.7.2 Methodological issues

CO_2 emissions from ceramics production were calculated from material balance based on CaO and MgO contents in the product provided by the AB "Palemono Keramika". According to the company, CaO content in bricks is fluctuating from 3.5% to 4.7% and MgO content is varying from 1.65% to 2.65%. Average values of 4.1% CaO and 2.15% MgO were taken as emission factors for calculation of emissions.

[17] http://db1.stat.gov.lt/statbank/default.asp?w=1440
[18] http://www.palemonokeramika.lt/

CO_2 emissions were calculated using the following equation:

$$Emission = CP \times (C_{CaO} \times (M_{CO2}/M_{CaO}) + C_{MgO} \times (M_{CO2}/M_{MgO}))$$

where

CP is ceramics production, Gg,
C_{CaO} and C_{MgO} are CaO and MgO fractions in ceramics products,
M_{CO2}, M_{CaO}, M_{MgO} are molecular weights of CO_2, CaO and MgO.

Estimated CO_2 emissions on ceramics production are provided in Table 4-8

Table 4-8. Estimated CO_2 emissions (Gg/year) in ceramics production

Year	Emission	Year	Emission
1990	228.1	2000	20.9
1991	224.8	2001	13.6
1992	186.3	2002	6.0
1993	90.0	2003	7.4
1994	63.3	2004	10.3
1995	42.8	2005	11.4
1996	33.9	2006	12.1
1997	27.1	2007	12.4
1998	26.2	2008	9.2
1999	23.9	2009	4.9

4.3.7.3 Uncertainties

The data on clinker production provided by the single production company should be considered reliable and it was assumed that uncertainty in this case is 2%. The data on lime production was taken from the Statistics Lithuania publications and it was assumed that uncertainty of these data is about 5%.

Limestone and dolomite use was evaluated only for iron production. Bearing in mind that some other uses may not been taken into account, it was assumed that uncertainty limestone and dolomite use data may be about 10%.

Soda ash use was evaluated as difference of data provided by the Statistics Lithuania and evaluated other uses. As each of these components contains certain uncertainty, the total uncertainty in soda ash use was assumed to be 10%.

CO_2 emissions in glass production were calculated from the data on use of raw materials containing carbonates. The data were obtained from the production companies but only for the second half of the period under consideration (1999-2009). Detailed data on composition of raw materials were available only for the last 5 years. In addition, only very limited data were obtained from cathode ray tubes producer Ekranas which got bankrupt in 2006. In view of these considerations it was assumed that activity data uncertainty for glass production was about 7%.

The data on rock wool production and raw materials consumption obtained from the production company are reliable and precise, however, they cover only the period after reconstruction of the plant (from 1997). Historic data for 1990-1996 are expert evaluation and may contain significant error. It was assumed that overall uncertainty of rock wool production activity data is about 7%.

Emission factor uncertainty for production of mineral products was assumed to be 5%.

4.3.8 Source specific recalculations

For the years 2005-2009 CO_2 emissions from cement production have been recalculated using data provided in the EU ETS reports of the plant.

4.4 Chemical Industry

4.4.1 Ammonia Production

4.4.1.1 Activity data

The AB "Achema" company is a single ammonia production company in Lithuania. According to information, provided by AB "Achema", ammonia is produced at 22,0-24,0 MPa pressure from hydrogen and nitrogen, which are generated at 800-1000 °C temperatures by conversion of natural gas. The converted gas is cleaned from impurities (CO, CO_2, H_2O vapour, etc.).
Capacities:
AM-70 unit – project (design or primary) capacity was 1360 t/day; after reconstruction (in 1995) it reached 1560 t/day or 569400 t/year.
AM-80 unit – project capacity is 1560 t/day or 569400 t/year.
Total ammonia capacity is 1138800 t/year.

Ammonia production and natural gas consumption data (Fig. 4-8) were provided by AB Achema company.

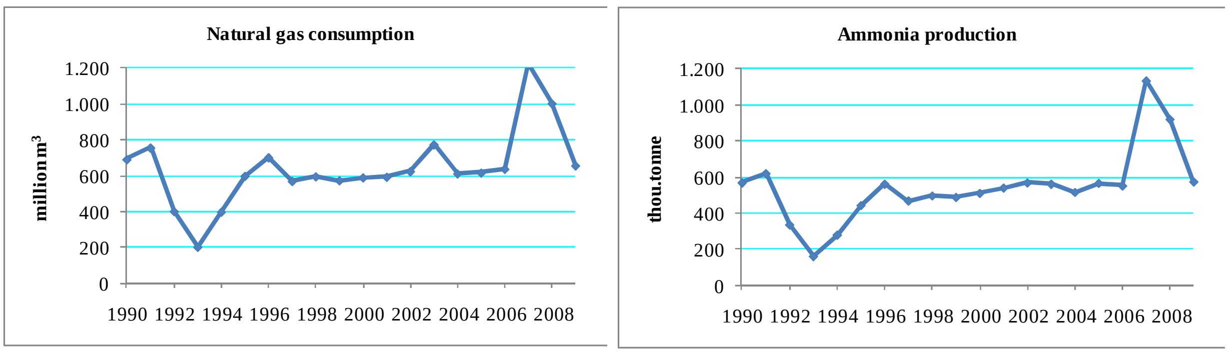


Fig. 4-8. Variations of natural gas consumption and ammonia production

4.4.1.2 Methodological issues

CO2 emissions were calculated from natural gas consumption using carbon content in natural gas data (Tier 1a, IPCC 1996):

Emission = Consumption of natural gas x carbon content of NG x 44/12

Natural gas consumption and carbon content in natural gas data was provided by the production company. For this NIR submission, company provided renewed data sets for all time series, thus emissions were recalculated using this updated data.

Upon the ERT request in 2010, carbon content values of the natural gas used as feedstock are provided in Table 4-9. The reason of carbon content fluctuations is that natural gas is imported from Russia and variations of carbon content in natural gas mostly depends on supply source.

Table 4-9. Estimated CO_2 emissions (Gg/year) in ammonia production and carbon content of natural gas

Year	Carbon content of natural gas, kg/m3	Emission	Year	Carbon content of natural gas, kg/m3	Emission
1990	0.469	1,190.53	2000	0.492	1,066.34
1991	0.467	1,296.58	2001	0.519	1,130.57
1992	0.474	699.37	2002	0.519	1,190.14
1993	0.444	330.48	2003	0.405	929.02
1994	0.396	579.64	2004	0.51	1,073.75
1995	0.421	925.12	2005	0.51	1,153.98
1996	0.455	1,173.17	2006	0.518	1,234.19
1997	0.467	977.91	2007	0.517	2,328.45
1998	0.474	1,037.24	2008	0.519	1,915.9
1999	0.484	1,020.08	2009	0.519	1,173.0

4.4.2 Nitric Acid Production

4.4.2.1 Activity data

Nitric acid is produced by AB “Achema” company which is a single nitric acid production company in Lithuania.

According to information, provided by AB “Achema”, in the UKL-7 units and GP unit nitric acid is produced by absorbing NO_2 with water. NO_2 produced by air oxidation of NO with oxygen. Nitric oxide (NO) produced by air oxidation of ammonia with oxygen on Pt mesh catalyst. UKL-7 units are working by single pressure (high pressure) scheme. Gaseous emissions after absorption are cleaned from NOx in a reactor. Grande Paroisse (GP) unit uses a dual-pressure scheme (medium/high). Gaseous emissions from GP are cleaned from NOx in the reactor using a DeNOx technology.

Capacities:

There are 9 UKL-7 units in AB “Achema”. The biggest capacity of one UKL-7 unit is 120000 t/year (calculated to 100% HNO_3). Capacity of all UKL-7 units is 1080000 t/year. Capacity of GP unit is 360000 t/year.

Total nitric acid capacity is 1440000 t/year.
The Joint Implementation project “Nitrous Oxide Emission Reduction Project at GP Nitric Acid Plant in AB Achema Fertiliser Factory“ was carried out by installing secondary catalyst in August 2008. The baseline campaign was launched from September 2007 to July 2008 during which emissions were monitored to determine the baseline emissions of the plant. After installing of the secondary catalyst, the first project campaign was launched and the Project emissions monitored until the end of the campaign – 26 September 2009.
BASF technology was applied by introducing a new catalyst bed which was installed in a new basket, directly under the Platinum gauze in the nitric acid reactors. The secondary catalyst (on Al2O3 basis with active metal oxides CuO and ZnO) was installed underneath the platinum gauze. In order to be able to install a secondary catalyst the reconstruction of a burner basket was performed.

Nitric acid production data (Fig. 4-9) were provided by AB “Achema” .

4.4.2.2 Methodological issues

Following the recommendation of ERT in 2010 to use EFs for the calculation of emissions from nitric acid production derived by the measured data, plant specific N_2O emission factors measured and registered in automated monitoring system (AMS) data for years 2007-2008 were obtained from AB "Achema" and presented in tables 4-9a and 4-9b (Data source: Report of the AB "Achema" for the calculation of EU allowances for the third EU ETS period 2013-2020).

Table 4-9a. N_2O emission factors calculated using measured and registered in automated monitoring system data

Line No	Date	Emission factor kg/t HNO3
UKL-1	From 2008-03-14 to 2008-10-21	9,63
UKL-2	From 2007-11-09 to 2008-05-20	9,51
UKL-3	From 2007-09-01 to2008-07-04	5,45
UKL-4	From 2007-12-28 to 2008-07-31	7,73
UKL-5	From 2007-11-29 to 2008-06-17	6,61
UKL-6	From 2008-01-11 to 2008-07-21	10,34
UKL-7	From 2007-09-12 to 2008-03-27	9,09
UKL-8	From 2007-09-01 to 2008-04-15	6,96
UKL-9	Will be set in 2012 year	
GP	From 2007-09-05 to 2008-07-28	8,833

In line No.9 is measured only N_2O concentration. Full AMS is scheduled to be installed at this line in 2012 year.

Table 4-9b. N_2O emission factors calculated using measured and registered in automated monitoring system data after installation of the catalyst.

Line No	Date	Emission factor kg/t HNO3
UKL-1	From 2008-11-04	2,1
UKL-2	From 2008-11-07	1,8
UKL-3	From 2008-07-04	1,92
UKL-4	From 2008-10-06	2,77
UKL-5	From 2008-07-02	1,68
UKL-6	From 2008-07-25	4,94
UKL-7	From 2008-07-03	2,18
UKL-8	From 2008-06-11	4,35
GP	From 2008-08-17	1,066

As already mentioned, in 2008 JI project for N_2O emission reduction from the nitric acid plant in AB Achema has started. During the implementation of the project, substantial emission reduction was achieved as monitored in a automated monitoring system (table 4-9b).
N_2O emissions from the nitric acid production were recalculated for all time series using plant specific emission factors. For 1990-2008 emission calculation, the average of emission factors for separate units was used (8,24 kg/tone nitric acid). Emission for 2009 was estimated using average of emission factors, monitored after the catalyst installation (2,53 kg/tone nitric acid).

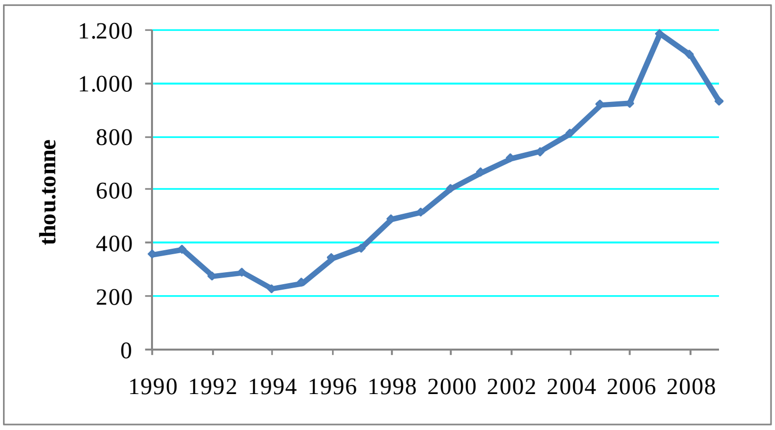


Fig. 4-9. Variations of nitric acid production

Estimated emissions of N_2O in nitric acid production and the effect of the recalculation are provided in Table 4-10.

Table 4-10. Estimated emissions of N_2O (Gg/year)in nitric acid production

Year	Emission	Year	Emission
1990	2.93	2000	4.97
1991	3.07	2001	5.48
1992	2.24	2002	5.93
1993	2.36	2003	6.11
1994	1.84	2004	6.69
1995	2.05	2005	7.59
1996	2.82	2006	7.62
1997	3.11	2007	9.79
1998	4.02	2008	9.14
1999	4.23	2009	2.36

4.4.3 Methanol Production

4.4.3.1 Activity data

AB "Achema" company is a single nitric acid production company in Lithuania. According to information, provided by the company, methanol is produced from the CO, CO_2 and H_2. The medium temperature technological scheme was used in which methanol synthesis reactions are carried out in 8.0 MPa and 180-280°C. Gases required for methanol synthesis are generated by converting natural gas.

Capacities:

Project capacity of methanol unit is 74000 t/year.

Methanol production data (Fig. 4-10) were taken from the Statistics Lithuania publications[19]. In 2009 methanol was not produced.

[19] http://db1.stat.gov.lt/statbank/default.asp?w=1440

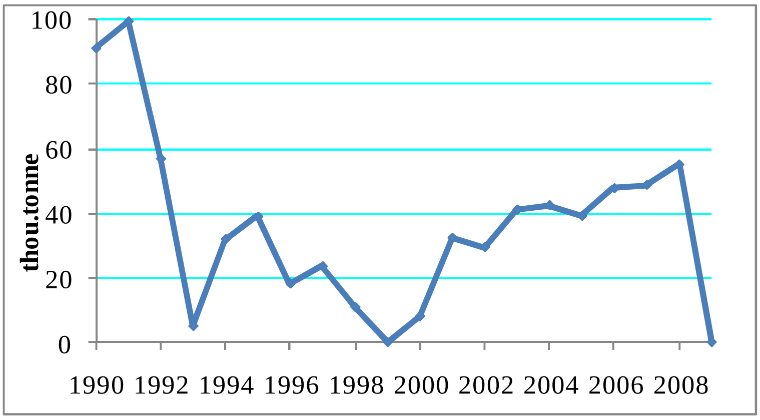


Fig. 4-10. Variations of methanol production

4.4.3.2 Methodological issues

CH_4 emissions were calculated from methanol production data using emission factor 2 kg CH_4 per tonne of produced methanol taken from Table 2-9 of the Revised 1996 IPCC Guidelines (p. 2.22).

Estimated emissions of CH_4 (Gg/year)in methanol production are provided in Table 4-11.

Table 4-11. Estimated emissions of CH_4 (Gg/year)in methanol production

Year	Emission	Year	Emission
1990	0.182	2000	0.016
1991	0.199	2001	0.065
1992	0.114	2002	0.059
1993	0.010	2003	0.082
1994	0.064	2004	0.085
1995	0.078	2005	0.078
1996	0.036	2006	0.096
1997	0.047	2007	0.098
1998	0.022	2008	0.110
1999	0.000	2009	0

4.4.4 Uncertainties

Uncertainty of activity data for chemical industry was assumed to be 2%. Emission factor uncertainty for CO_2 emissions from ammonia production and CH_4 emissions from methanol production was assumed to be 10%, and 30% for N_2O emissions from nitric acid production.

4.4.5 Source specific recalculations

Following the recommendation of ERT in 2010, N_2O emission from nitric acid production was recalculated for years 2007-2008 using plant specific EF calculated by using measured and registered in automated monitoring system data. More detailed description of the recalculation is presented in the chapter 4.4.2 (pages 68-70).

CO_2 emission from ammonia production was recalculated for all time series using updated data on natural gas consumption and carbon content of natural gas as provided by the company.

4.5 Cast iron production

4.5.1 Activity data

There are two facilities producing cast iron in blast furnaces and one facility using electric arc furnace in Lithuania. Only scrap metal is used as raw material.

Data on the total cast iron production are provided by the Statistics Lithuania[20]. The data on cast iron production in blast furnaces and on coke consumption were obtained from the plants. Variations of cast iron production in separate types of facilities are shown in Fig. 4-11.

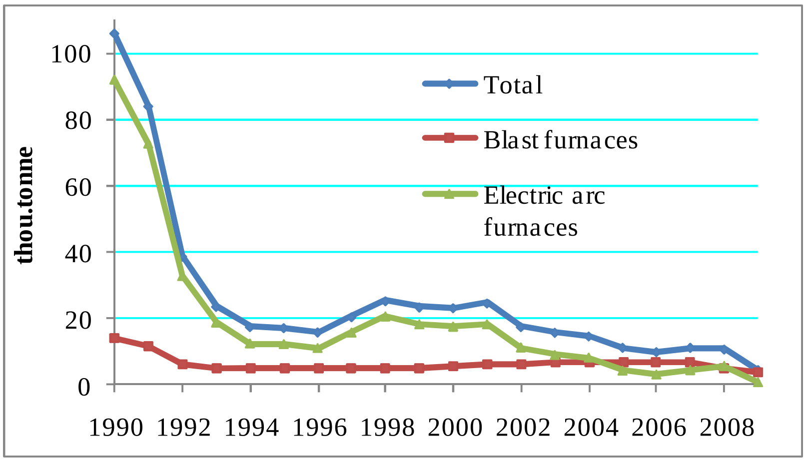


Fig. 4-11. Variations of cast iron production in separate types of facilities

4.5.2 Methodological issues

CO_2 emissions from blast furnaces were calculated from coke consumption using default emission factor 3.1 tonnes CO_2 per tonne coke (Revised 1996 IPCC Guidelines, Table 2-12, p. 2.26).

Revised 1996 IPCC Guidelines do not provide emission factor for electric arc furnaces. Therefore emission factor 0.08 tonne CO2 per tonne of steel produced is provided in 2006 IPCC Guidelines was used for evaluation of CO_2 emissions from electric arc furnace.

Estimated CO_2 emissions from cast iron production are shown in Table 4-12.

Table 4-12. Estimated CO_2 emissions (Gg/year)from cast iron production

Year	Emission	Year	Emission
1990	21.4	2000	7.5
1991	17.2	2001	7.8
1992	8.5	2002	7.2
1993	6.2	2003	7.3
1994	5.8	2004	7.0
1995	5.6	2005	7.2
1996	5.5	2006	6.9
1997	6.0	2007	6.5

[20] http://db1.stat.gov.lt/statbank/default.asp?w=1440

1998	6.6	2008	5.0
1999	7.0	2009	4.0

4.5.3 Uncertainties

The data on the total cast iron production were taken from the Statistics Lithuania and the data on cast iron production in blast furnaces were provided by the production companies. It was assumed that the overall uncertainty of activity data is about 4%. Default emission factors were used. Bearing in mind that cast iron is produced only from iron scrap while emission factors are established for production from iron ores, it should be expected that uncertainties in emission factors are comparatively large. It was assumed that uncertainty for emission factors are 10%.

4.5.4 Source specific recalculation

There were no recalculations of emissions.

4.6 Emissions of F-gases

4.6.1 Source category description

In accordance with Article 3.8 of the Kyoto Protocol Lithuania has chosen 1995 as its base year for F-gases.

Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) are used as alternatives to chlorofluorocarbons (CFCs), ozone depleting substances being phased out under the Montreal Protocol. Emissions of HFCs and SF_6 occur as leakage from use of equipment and form the destruction of such equipment after use.

Fluorinated gases, monitored under the UNFCCC, are not produced in Lithuania and national consumption is covered only by import.

Refrigeration equipment (CRF 2.F.1)

A survey of fluorinated gases in Lithuania was conducted in 2008 and the results of the survey were used as a basis for calculation of emissions. The data on use of F-gases were collected by interviewing representatives of most important trade and industry sectors. The representatives were asked also to evaluate the market situation and market share of the company. Evaluated use of fluorinated gases is shown in Table 4-13.

Table 4-13. Evaluated use of fluorinated gases in Lithuania

	F-gases in surveyed enterprises, t			Market share %	Total F-gases in use, t		
	R404a	R134a	R407c		R404a	R134a	R407c
Skating rinks	0.15			90%	0.17		
Supermarkets	72.86	1.48		65%	112.10	2.27	
Other retail enterprises*					5.61	0.11	
Meat processing	2.15			30%	7.17		
Milk processing	0.59			20%	2.95		
Fish processing	1.01			20%	5.03		

Fruit and vegetable processing	1.28			30%	4.27		
Beverage production	0.28			20%	1.41		
Processing of berries and mushrooms	1.07			45%	2.38		
Prefabricated food products	0.66			30%	2.20		
Warehouses	1.15			30%	3.83		
Poultry processing	1.20			25%	4.80		
PET production	0.13	0.12	0.39	30%	0.43	0.40	1.28
Other industries**					1.72	0.02	0.06
Total					**154.06**	**2.81**	**1.35**

**Assumed as 5% of supermarkets*
***Assumed 5% of the total*

Historically, most widely used refrigerant in meat, milk and other food product production and storage systems in eighties was ammonia. However, these huge systems were not able to survive in early nineties after introduction of market economy and were closed or split to smaller production units. The old refrigeration systems were substituted by the new smaller systems mainly using chlorinated refrigerants such as R-12 and R-22 which also were used in refrigeration systems in supermarkets.

Fluorinated refrigerants were started to be used in Lithuania in newly installed systems approximately from 2003. Based on expert judgement it was assumed that the amount of F-gases in refrigeration systems was increasing on average approximately 30% annually and in 2003-2004, immediately before accession to the EU, it reached 45% annually.

Refrigerant R-410A for air conditioning systems is used in Lithuania from only approximately 2001. It was evaluated that its amount was increasing by 70%-85% annually.

Evaluated use of F-gases is shown in Fig. 4-12.

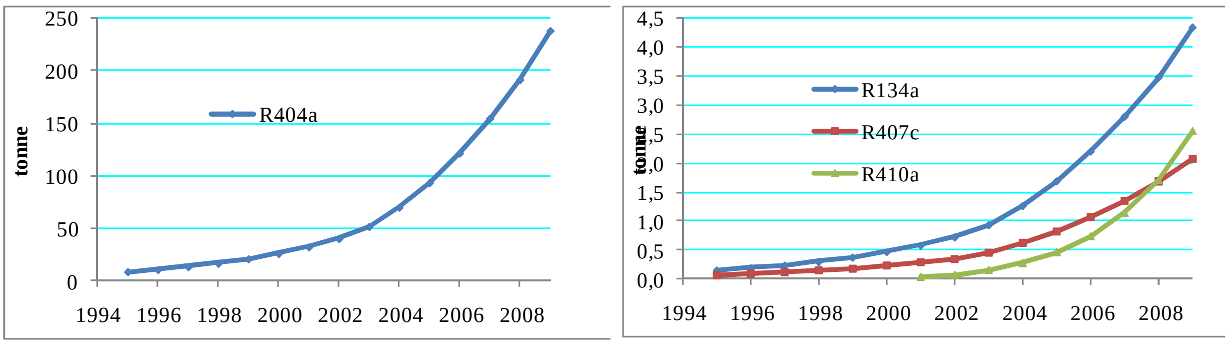


Fig. 4-12. Evaluated use of F-gases in 1995-2009

F-gases use separately in commercial and industrial sectors were evaluated by separating reviewed uses into two corresponding groups.

Commercial uses

- Skating rinks
- Supermarkets
- Other retail enterprises
- Storage facilities

Industrial users:

- Meat processing
- Milk processing
- Fish processing
- Fruit and vegetable processing
- Beverage production
- Processing of berries and mushrooms
- Prefabricated food products
- Poultry processing
- PET production
- Other industries

Representatives of eight companies involved in installation and operation of equipment containing F-gases were interviewed concerning leakages of F-gases during installation and operation. Leaking during operation was evaluated at approximately 3% of the amount of F-gases in circulation, and leaking during installation and refilling was evaluated at approximately 4%.

Evaluated emissions of fluorinated gases are provided in Table 4-14.

Table 4-14. Evaluated emissions of fluorinated gases

	1995	1996	1997	1998	1999	2000	2001	2002
Commercial								
HFC-32, t	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003
HFC-125, t	0.121	0.151	0.187	0.233	0.289	0.359	0.448	0.581
HFC-134a, t	0.016	0.020	0.025	0.031	0.039	0.049	0.060	0.078
HFC-143a, t	0.143	0.178	0.221	0.275	0.342	0.425	0.528	0.683
Total, Gg CO2 eqv.	**1.04**	**1.30**	**1.62**	**2.01**	**2.50**	**3.11**	**3.87**	**5.01**
Industrial								
HFC-32, t	0.001	0.001	0.001	0.001	0.002	0.002	0.003	0.003
HFC-125, t	0.033	0.041	0.051	0.063	0.079	0.098	0.122	0.157
HFC-134a, t	0.005	0.007	0.008	0.010	0.013	0.016	0.020	0.026
HFC-143a, t	0.038	0.047	0.059	0.073	0.091	0.113	0.140	0.182
Total, Gg CO2 eqv.	**0.28**	**0.35**	**0.44**	**0.54**	**0.68**	**0.84**	**1.04**	**1.35**

	2003	2004	2005	2006	2007	2008	2009
Commercial							
HFC-32, t	0.005	0.008	0.012	0.019	0.028	0.043	0.063
HFC-125, t	0.796	1.061	1.374	1.740	2.145	2.679	3.339
HFC-134a, t	0.107	0.142	0.184	0.233	0.287	0.358	0.445
HFC-143a, t	0.935	1.244	1.610	2.033	2.501	3.115	3.871
Total, Gg CO2 eqv.	**6.87**	**9.15**	**11.84**	**14.97**	**18.43**	**22.99**	**28.61**
Industrial							
HFC-32, t	0.005	0.006	0.008	0.010	0.012	0.015	0.019
HFC-125, t	0.215	0.286	0.371	0.468	0.576	0.717	0.891
HFC-134a, t	0.036	0.047	0.061	0.078	0.096	0.119	0.148
HFC-143a, t	0.249	0.331	0.428	0.541	0.665	0.828	1.029
Total, Gg CO2 eqv.	**1.85**	**2.46**	**3.18**	**4.02**	**4.95**	**6.16**	**7.66**

As F-gases from used fire extinguishing equipment currently are not collected or destructed, it was assumed that potential emissions of fluorinated gases are equal to the annual increases of F-gases in fire extinguishing equipment.

HFC-134a from stocks of domestic refrigerators

There is one company manufacturing domestic refrigerators in Lithuania (AB “Snaigė”). The company is producing domestic refrigerators charged with R600a gas and is not using HFCs as a refrigerants for their production.

HFC-134a emissions from domestic refrigerators were estimated using IPCC 1996 Guidelines methodology. The data used for HFC-134a emission estimation from domestic refrigerators were:
1. amount of inhabitants in Lithuania – obtained from Statistics Lithuania;
2. amount of households in Lithuania – was taken from Statistics Lithuania;
3. percentage of households using refrigerators – was taken from Statistics Lithuania.
In the absence of sufficient data for calculating the amount of HFC-134a charged in domestic refrigerators and the percentage of domestic refrigerators containing HFC-134a, few assumptions based on the expert judgment were made:
1. the amount of HFC-134a charged in domestic refrigerators was taken 100 g;
2. the percentage of domestic refrigerators containing HFC-134a has been chosen 30 % for period 1995-2009.
According to IPCC 1996 average percentage of losses during operation is 1% of the total quantity banked in the stock. Equation from IPCC 1996 for stock emissions estimation:

$$E_{operation} = E_{stock} \text{ x } x$$

where:
$E_{operation}$ – amount of emissions during equipment operation (t)
E_{stock} – amount of f-gases held in stocks in year t (t);
x – losses during operation period (%)

HFC-134a from stocks of mobile air conditioning

HFC-134a emissions from mobile air conditioning were estimated using IPCC 1996 Guidelines methodology. The basic data for HFC-134a emission estimation from mobile air conditioners was amount of passenger cars and trucks manufactured after 1995 which was obtained from Statistics Lithuania publications on transport registration, and percentage of cars filled with HFCs. As national data on percentage of cars filled with HFCs was not available, it was decided to use Latvia‘s data (Report “SF_6, HFC and PFC emission inventory in Latvia 1995-2003”, NIR Latvia 2011), assuming that Latvia’s vehicle fleet is very similar to Lithuania’s. The percentage of cars filled with HFCs according to Latvia‘s data is 20% for passenger cars and 50% for trucks for the period 1995-2000 and it was assumed that the percentage of passenger cars equipped with MACs filled with F-gases increases year by year and reaches 65% in year 2009. The same percentage increase was applied for trucks when percentage of trucks equipped with MACs increase from 50% in 2000 to 75% in 2008 (NIR Latvia 2011).
The typical refrigerant charges in mobile air conditioners were taken from IPCC 1996 Guidelines: 1.2 kg/unit for cars and 1.5 kg/unit for trucks.
According to IPCC 1996 Guidelines, average percentage of losses during operation lifetime is 15% of the total quantity banked in the stock. Equation from IPCC 1996 for stocks emissions:

$$E_{operation} = E_{stocks} \text{ x } x$$

where:
$E_{operation}$ – amount of emissions during equipment operation (t)
E_{stocks} – amount of f-gases held in stocks in year t (tonnes);
x – losses during operation period (%)

HFC-134a emission was calculated only for the period 2006-2009, due to data on registered vehicles age was not collected for earlier years. This reporting gap is planned to be filled in for the next year submission.

HFC's emission from foam blowing (*CRF 2.F.2*)

A number of companies producing foam plastics were interviewed. Producers of foam plastics for construction or packaging are using BASF technology in which foams are blown by steam. Lithuanian refrigerator producer "Snaigė" uses cyclopentane for production of insulation foams. So, conclusion was made that F-gases are not used for foam blowing in Lithuania.
As regards HFCs emissions from stock and disposal of foam, Lithuania accepted ERT recommended adjustment in this sector in 2010. ERT calculated HFCs emission in accordance with table 1 of the "Technical guidance on methodologies for adjustments under Article 5, paragraph 2, of the Kyoto protocol", using adjustment method 5 "Average emission rate from a cluster of countries based on driver". The ERT decided to use emissions per capita as the driver. The adjusted estimate for HFC emissions from foam blowing in 2008 amounts to 13.368 Gg CO_2 eq ("Report of the individual review of the annual submission of Lithuania submitted in 2010").
As activity data on HFCs in foams was not obtained so far, Lithuania calculated emission for 2009 from foam blowing using the same method, which applied ERT in 2010: emissions were calculated using average emission rate from a cluster of countries. The same parameters (countries for cluster, conservativeness factor etc.) were used for emission estimation. Emission amounts to 3,960 Gg CO_2 eq. in 2009.
It is planned to collect activity data on HFCs in foams and report emission in the NIR 2012.

Fire extinguishing equipment (CRF 2.F.3)

The first data on use of HFCs were collected by the Lithuanian Environmental Protection Agency in 2010 covering 2009. According to the data, there were 1605 kg of HFC134a and 344 kg of HFC125 in fire extinguishing equipment of which about 45% were added in 2009. According to the data providers, use of HFCs in fire extinguishing equipment in Lithuania started approximately in the year 2000.

Based on these data it was assumed that the amount of HFCs in fire extinguishing equipment since 2000 was increasing annually by 90% (i.e. 45% of the total amount of HFCs at the end of a current year were added during that year).

Evaluated amounts of F-gases in fire extinguishing equipment are shown in Table 4-15.

Table 4-15. Evaluated amounts of F-gases in fire extinguishing equipment (kg)

	2000	2001	2002	2003	2004	2005	2006	2007	2008
HFC125									
Amount in equipment	1.1	2.0	3.8	7.3	13.9	26.4	50.2	95.3	181.1
Amount added	1.1	1.0	1.8	3.5	6.6	12.5	23.8	45.1	85.8
HFC134a									
Amount in equipment	5.0	9.5	18.0	34.1	64.8	123.2	234.0	444.6	844.7
Amount added	5.0	4.5	8.5	16.2	30.7	58.3	110.8	210.6	400.1

Same as in case of refrigeration, leaking from equipment was evaluated at approximately 3% of the amount of F-gases, and leaking during installation and refilling was evaluated at approximately 4%.

Evaluated emissions of fluorinated gases are provided in Table 4-16.

Table 4-16. Evaluated emissions of fluorinated gases from fire extinguishing equipment (kg)

	2000	2001	2002	2003	2004	2005	2006	2007	2008
HFC 125	0.1	0.1	0.2	0.4	0.7	1.3	2.5	4.7	8.9
HFC 134a	0.3	0.5	0.9	1.7	3.2	6.0	11.5	21.8	41.3

Aerosols/Metered dose inhalers (CRF 2.F.4)

Emissions from metered dose inhalers were estimated using IPCC Guidelines 1996 methodology. To estimate emissions it is necessary to know the total amount of aerosol initially charged in product containers prior to sale. Activity data – the total sales of metered dose inhalers containing HFCs in particular year and specific HFC-134a quantity initially charged in product was obtained from State Medicines Control Agency under the Ministry of Health of Republic of Lithuania. The data was available for 2004-2009 period. Emission estimates for the rest years were extrapolated, taking into account that metered dose inhalers containing F-gases started to be registered in Lithuania's Register of Medicinal Products from 1994 year and making assumption that emission in 1995 constituted 50% of emission in 2004.
The quantity of total amount of HFC-134a used in metered dose inhalers was calculated as follows:

$$HFC_{sold} = \sum MDI_{sold} \times HFC_{filled}$$

Where:
HFC_{sold} – total amount of HFC sold in country
MDI_{sold} – amount of sold particular type of metered dose inhalers containing F-gases
HFC_{filled} – amount of F-gases filled in particular type of inhaler

According to IPCC Guidelines 1996, aerosol emissions are estimated to be one half of the current year sales of the aerosol plus one half of the previous year sales:

$$E_{HFC's} = 50\%\ HFC_{sold} \times x_t + 50\%\ HFC_{sold} \times x_{t-1}$$

Where:
$E_{HFC's}$ – total emissions of HFC-134a from metered dose inhalers
HFC_{sold} – total amount of HFC sold in country
x_t – leakage from inhalers in year t
x_{t-1} - leakage from inhalers in year t-1

Variations of estimated HFC-134a emissions from metered dose inhalers are shown in Table 4-17.

Table 4-17. HFC-134a emission from metered dose inhalers, tonnes

1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0.59	0.64	0.69	0.75	0.81	0.87	0.94	1.02	1.10	1.19	1.98	2.75	3.15	3.54	3.40

Potential emissions from the use of metered dose inhalers were estimated assuming that 100% of HFC-134a filled in inhalers sold in country in particular year is emitted to the air.

Solvents and other applications using ODS substitutes (CRF 2.F.5 & 2.F.6)

During survey of fluorinated gases in 2008 no possible sources from "Solvents" were identified in Lithuania, therefore notation keys "NO" ("not occurring") are used.
SF_6 is used from 2008 in one plant in Lithuania as gaseous insulator for testing semiconductor equipment. All used SF_6 is emitted to the environment. This emission was reported under the „2.F.6 Other“ subcategory.

Semiconductor manufacture (CRF 2.F.7)

There is one company in Lithuania producing semiconductors. F-gases are not being directly used in semiconductors manufacture processes, therefore emission reported as „NO“.

Electrical equipment (CRF 2.F.8)

SF_6 emission is calculated from SF_6 use in electrical equipment. Activity data (SF_6 amount filled in electrical equipment and emissions from equipment breakdown) was obtained directly from energy supply companies. It was assumed that emissions due to leakage and maintenance losses are 1% of annual stocks.

4.6.2 Uncertainties

It was assumed that uncertainty in establishing activity data may reach about 20%. Uncertainty of emission factors was assumed to be 20%.

4.6.3 Source specific recalculations

In this NIR, emissions of F-gases from the following sources were calculated for the first time:

- Domestic refrigerators;
- Mobile air conditioners;
- metered dose inhalers (both actual and potential);
- other applications using ODS substitutes.

Emissions from stationary refrigeration were disaggregated into industrial and commercial. Notation keys “NE” were changed to “NO” for 2.F.5 and 2.F.7 subsectors.

4.7 Planned improvements

A number of improvements were added to the inventory improvement plan in the industrial processes sector. The following tasks will be implemented in the NIR 2012:

- to improve transparency and provide more detailed descriptions of the methods, EFs and AD used as the source, to include analysis and explanation of the trends in GHG emissions for the specific subsectors;
- to include results of category-specific QA/QC activities accomplished during the preparation of the inventory in the category descriptions;
- to verify production and EFs data provided by the industry using data from the EU ETS;
- to verify the reported 5 per cent calcinated fraction in cement production and provide an explanation for the difference between plant-specific CKD correction factor and the default value from the IPCC GPG;
- to estimate transport refrigeration emissions;
- to calculate emission from foam blowing for the whole time series using national data;
- to collect all necessary activity data needed to report emission from mobile air conditioners for the 1990-2005 period;
- to fill in the gaps of reporting on F-gases emissions for the years 1990–1994. If the analysis will show that emissions occurred during this period, emissions will be calculated using extrapolation, as actual data is not available for historical years;
- to fill in the gaps of reporting on F-gases potential emission (domestic refrigeration, mobile air conditioning, foam blowing, transport refrigeration);

- to review the rates of refrigerant consumption and leakage, including SF_6 from electrical equipment as recommended by the ERT in 2010.

As already mentioned, in 2012 will start a Norway Grants capacity building project between Lithuania and Norway “Cooperation on GHG inventory”. The partner of this programme will be Norwegian Climate and Pollution Agency, which is national entity responsible for GHG inventory preparation in Norway. One of the activity and outcome of this project will be a study on F-gases use in Lithuania. It is expected that this study will cover all remaining reporting gaps in this area, but results of this study will be presented only in 2013 submission, at the earliest.

In accordance with the Order of the Minister of Environment issued in 2008, users of F-gases provided initial data on imports and use of F-gases in 2009. However, collected data are not complete, data providers from industrial companies have misunderstood certain requirements included in the Order of the MoE. Review and analysis of set reporting requirements are planned with a view of compiling an additional explanatory note for data providers with detailed explanations on how the reports should be compiled and what information should be provided. In addition, a workshop for industries importing and using F-gases is planned. From 2012 the EPA will install electronical data base for the compilation of f-gases data forms by data providers via internet.

5 SOLVENT AND OTHER PRODUCTS USE (Sector 3)

Solvent and other products use contribute a small amount to GHG emissions in Lithuania. Share of total emissions was only 0.5% in 2009 (excluding LULUCF). Indirect CO_2 emission from NMVOC for the following CRF categories was estimated:

- 3.A Paint application
- 3.B Degreasing and dry cleaning
- 3.D.5 Other (includes emissions from the use of glues and adhesives, graphic arts, domestic solvent use)

This year, N_2O emission from the use of N_2O for anaesthesia was calculated for the first time.

The inventory of NMVOC emissions from the solvent and other product use sector is performed at the Lithuanian Environmental Protection Agency. The NMVOC inventory is carried out to meet the obligations of the UNECE Convention on Long-range Transboundary Air Pollution.

Methodological issues

NMVOC emissions were calculated according to EMEP/CORINAIR methodology simpler approach based on per capita data for several source categories. Default per capita emission factors proposed in EMEP/CORINAIR guidebook were used (Table 5-1), multiplying them by the number of inhabitants.

Table 5-1. NMVOC emission factors

Subsectors	NMVOC emission factors, kg/cap/year
Paint application	4.5
Industrial degreasing	0.85
Dry cleaning	0.313
Graphic arts	0.65
Glues and adhesives	0.6
Domestic solvent use	1.8

Emissions were calculated using annual average population data provided by the Statistics Lithuania.

It was assumed that the average carbon content is 85 percent by mass for all categories under sector of solvents and other products use. CO_2 emissions from solvent and other product use were calculated using the equation below.

$$\text{Emission}_{CO2} = \text{Emission}_{NMVOC} \times 0.85 \times 44/12$$

N_2O emissions from N_2O used in anaesthesia activities were estimated taking into account amount of N_2O sold in Lithuania. Following the 2006 IPCC Guidelines, it was assumed that 100% of N_2O sold for anaesthesia was emitted to the air, therefore activity data is equal to estimated emissions. The data on the N_2O sales was available since 2005. Acitivity data was provided by the State Medicines Control Agency. Emissions for 1990-2004 were estimated with the increasing trend accordingly. Other sources of N_2O emissions were not estimated due to lack of activity data.

Table 5-2. CO_2, N_2O and NMVOC emissions (Gg) from solvents and other products use for the period 1990-2009

Year	CO_2 emission	NMVOC emission	N_2O emission
1990	100,50	32,22	0,31
1991	100,59	32,27	0,31
1992	100,48	32,24	0,30
1993	100,0	32,09	0,30
1994	99,31	31,87	0,29
1995	98,55	31,62	0,28
1996	97,80	31,38	0,28
1997	97,09	31,15	0,27
1998	96,38	30,93	0,27
1999	95,70	30,71	0,26
2000	95,03	30,49	0,25
2001	94,54	30,33	0,25
2002	94,21	30,23	0,24
2003	93,80	30,10	0,24
2004	93,30	29,93	0,23
2005	92,72	29,75	0,22
2006	92,17	29,57	0,13
2007	91,67	29,41	0,10
2008	91,19	29,26	0,01
2009	90,68	29,09	0,03

Source specific recalculation

N_2O emission from the use of N_2O for anaesthesia was calculated for the first time.

Planned improvements

No planned improvements are under the consideration.

6 AGRICULTURE (Sector 4)

6.1 Overview

Agricultural greenhouse gas emissions in Lithuania include CH_4 emissions from enteric fermentation of domestic livestock and CH_4 and N_2O emissions from manure management as well as direct and indirect N_2O emissions from agricultural soils. Direct N_2O emissions from agricultural soils include emissions from synthetic fertilizers, manure applied to soils, biological nitrogen fixation of N-fixing crops, crop residues and cultivation of organic soils. Indirect N_2O emission sources include emissions from atmospheric deposition and from nitrogen leaching. Rice is not cultivated and savannas do not exist in Lithuania, therefore reported as "NO". Field burning of agricultural residues is prohibited by the legislation and reported as "NO".
Emissions were evaluated according to the Revised 1996 IPCC Guidelines, the IPCC Good Practice Guidance 2000 and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Agricultural GHG key sources categories are shown in Table 6-1.

Table 6-1. GHG emissions from key sources in agriculture in 2009 (incl. LULUCF)

Key Category	Gas	GHG emissions, Gg CO_2 eq.	Level assessment
Direct Soil Emissions, N2O	N2O	1,375.09	5.4%
Enteric Fermentation domestic livestock, CH4	CH4	1,283.31	5.0%
Indirect Emissions, N2O	N2O	925.14	3.6%
Manure Management, CH4	CH4	559.09	2.2%
Manure Management, N2O	N2O	319.60	1.3%
Pasture, Range and Paddock Manure, N2O	N2O	203.64	0.8%

The total greenhouse gas emissions in agriculture sector in 2009 were evaluated at 4665.9 Gg CO_2 equivalents. The major part of emissions is related to agricultural soils. N_2O emission contributed 60.5% of the total GHG emission from the agricultural sector. The major part of the agricultural CH_4 emission originates from digestive processes. Methane emissions from enteric fermentation constituted 27.5 %, methane emissions from manure management 12.0%, nitrous oxide emissions from manure management - 6.85% and nitrous oxide emissions from agricultural soils – 53.7% of the total agricultural emissions. From 1990 to 2009 emissions from agriculture have decreased by 47.8% (see Fig. 6-1).

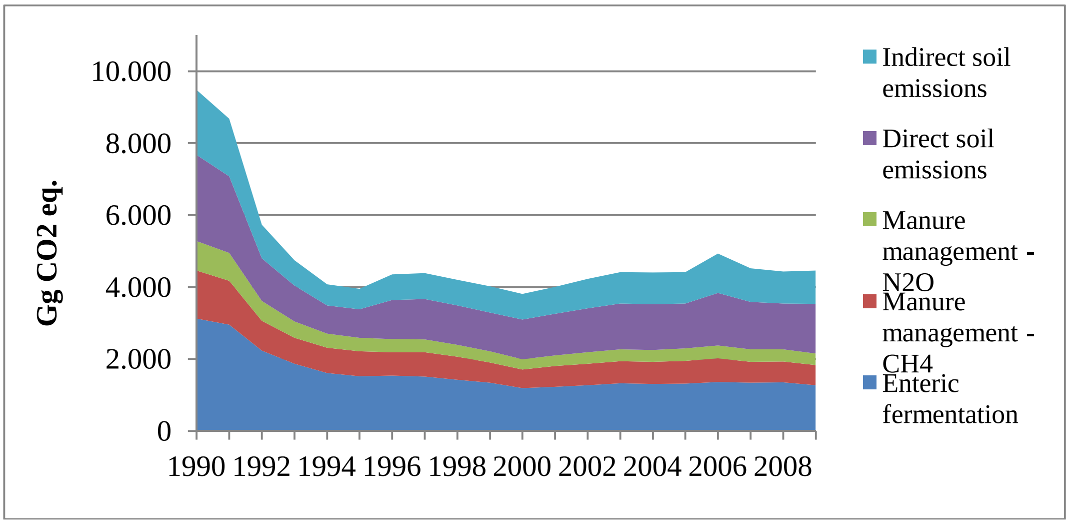


Fig. 6-1. Greenhouse gas emission variations in agriculture in 1990-2009

The quantitative overview of emissions from the agricultural sector are provided in Table 6-2.

Emissions from agriculture sector decreased substantially in the beginning of 90's. The agricultural sector contributed 24 percent of GDP in 1992 and employed 19 percent of the labor force. Lithuania's agriculture, efficient by soviet standards, produced a huge surplus that could not be consumed domestically. Traditionally, Lithuania grew grain (wheat, rye, barley, and feed grains), potatoes, flax, and sugar beets, and it developed dairy farming, meat production, and food processing. Crops accounted for one-third and livestock for two-thirds of the total value of agricultural output. Lithuanian agricultural production was high enough to allow the export of about 50 percent of total output.
Significant reforms were introduced in the early 1990s, particularly after the restoration of independence, to re-establish private ownership and management in the agricultural sector. The laws provided for the dismemberment of collective farms, but did not definitively ensure their replacement by at least equally productive private farms or corporations. Agricultural production decreased by more than 50 percent from 1989 to 1994. The farms were broken up into smallholdings, averaging 8.8 hectares in size, often not large enough to be economically viable.

Table 6-2. GHG emissions in agriculture by sources in 1990–2009 (Gg CO_2 equiv.)

Year	Enteric fermentation	Manure management		Agricultural soils	
				Direct	Indirect
	CH_4	CH_4	N_2O	N_2O	N_2O
1990	3,134.9	1,333.1	817.1	388.9	1,810.0
1991	2,960.4	1,223.6	770.7	377.5	1,601.2
1992	2,243.7	822.1	554.8	304.4	935.6
1993	1,878.4	716.3	459.6	267.0	705.9
1994	1,614.6	703.7	391.9	234.3	586.1
1995	1,529.6	696.7	368.0	222.1	561.3
1996	1,543.6	651.1	365.3	224.5	716.4
1997	1,521.9	675.5	358.0	219.7	721.5
1998	1,426.0	646.9	328.9	204.0	704.3
1999	1,351.4	558.8	314.7	195.4	727.2
2000	1,201.7	511.9	282.5	182.3	714.1
2001	1,237.9	571.4	298.9	192.1	754.4
2002	1,280.9	598.9	313.3	198.2	823.9
2003	1,333.4	611.4	331.5	206.1	871.2
2004	1,312.0	616.3	330.8	207.6	878.1
2005	1,322.6	636.2	342.0	209.8	874.4
2006	1,372.3	651.3	359.8	216.0	1,099.7
2007	1,350.0	582.9	339.9	216.5	935.0
2008	1,362.8	578.5	338.0	216.7	889.0
2009	1,283.3	559.1	319.6	203.6	925.1

Climatic conditions

Lithuanian climate is formed affected by global factors and local geographical circumstances. Key features of the climate depend on the country's geographical location. Lithuania is located in the middle latitudes climate zone and in accordance by B.Alisov climate classification belongs to the Atlantic forest area in the continental southwest region. Only the Baltic coastal region is closer to the climate of Western Europe and the climate can be attributed to individual Southern Baltic climate region.

Temperature

Over the past 16 years (1991-2006) the average annual air temperature throughout the territory of Lithuania broke through 6ºC threshold, and reached 6.5-7.9°C. The average annual air temperature in Lithuania in 1991-2006 compared to 1961-1990 rose 0.7-0.9°C, which shows climate warming. The hottest month in Lithuania is July, the coldest is January. In the period from 1995 to 2008, the average temperature in July was about 19.7°C and in January - about -2.9°C.
At the end of the twentieth century the number of extremely hot days increased with the daily maximum air temperature equal to or above 30°C. Their probability in 1991-2006 compared to 1961-1990 increased by 2-2.5 times and now amounts to 2-6 days a year. The highest probability is in southern and south-western Lithuania. Meanwhile, frosty days when the daily minimum air temperature drops to -20°C and below have decreased significantly: if in the period of 1961-1990 an average of 12-15 days during winter in the East of Lithuania occurred, in the recent years they occurred for only 8-9 days per season. It was found out, that the change in the probability of extremely hot and cold days originated mainly due to higher rates of recurrence of anticyclone processes during the summer and less frequent in winter.

Precipitation
Average annual rainfall in 1991-2006 compared to 1961-1990 in western and central part of Lithuania decreased by 12-56 mm, and in the South and the North-East of Lithuania increased by 20-66 mm. 2008 precipitated rainfall (697 mm) was close to the 1961-1990 climatic standards, which is 675 mm.
From April to October in Lithuania precipitates 60-65% of annual rainfall. In summer each year very strong falls occur with 30 mm of rainfall per day.
An average number of days with snow cover comparing the period of 1961-1990 with 1991-2006 decreased by 4-10 days. However, the maximum snow thickness increased by 0.8-2 cm. This relates to increasing precipitation in the cold period and more frequent snowfalls in the recent years. (Lithuania's Fifth National Communication under the United Nations Framework Convention on Climate Change. Vilnius, January 2010).

6.2 Enteric fermentation

This chapter describes estimation of the CH_4 emissions from 4.A Enteric Fermentation. In 2009 69.6% of agricultural CH_4 emissions arose from digestives processes.

6.2.1 Source-category description

Methane emissions from enteric fermentation of domestic livestock includes emissions from cattle (dairy cows, non-dairy cattle), sheep, goats, horses, swine, rabbits, nutria and fur-bearing (minks, foxes and polar foxes) animals. Methods for treating poultry in this context are not yet developed. In accordance with the IPCC (IPCC, 1996), the relevant quantities are considered as negligible and are not calculated. Activity data have been taken from the official Lithuanian agricultural statistics.

Animal population figures used in the inventory are shown in Table 6-3. The number of dairy cattle in 2009 decreased by 55.8% compared to 1990. In the same time non-dairy cattle population decreased by 75.9%, sheep population by 4.4%, horses population by 38.7%, swine population by 61.9%. The number of goats increased from 5.2 thousand in 1990 to 14.7 thousand in 2009.

Table 6-3. Animal population data used in GHG inventory (in thousands)

Animal category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Dairy cattle	842,0	831,9	737,8	678,1	614,9	586,0	589,9	582,8	537,7	494,3
Non-dairy cattle	1.479,5	1.364,7	963,2	706,2	537,5	479,1	464,2	433,5	385,1	403,5
Sheep	56,5	58,1	51,7	45,0	40,0	32,3	28,2	24,0	15,8	13,8
Goats	5,2	6,3	8,8	10,4	12,4	14,6	16,9	18,5	23,7	24,7
Horses	79,9	82,6	79,7	81,3	78,2	77,6	81,4	78,5	74,3	74,9
Swine	2.436	2.180	1.360	1.196	1.260	1.270	1.128	1.200	1.159	936

Rabbits	73.4	73.7	83.5	92.8	88.0	84.2	93.9	119.3	102.5	85.4
Nutria	17.3	17.1	13.3	10.3	9.6	8.9	7.1	4.8	3.5	2.2
Minks	117.3	120.8	119.0	76.5	73.9	72.4	75.3	75.3	39.0	37.5
Foxes	10.2	6.7	5.8	5.8	4.8	4.0	3.7	3.2	1.0	0.8
Polar foxes	30.7	28.4	21.3	17.2	15.9	13.6	14.4	12.0	5.7	3.6

Animal category	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Dairy cattle	438,4	441,8	443,3	448,1	433,9	416,5	399,0	395,9	394,3	371,8
Non-dairy cattle	309,9	309,9	335,8	364,0	358,1	383,8	439,8	375,3	380,3	357,1
Sheep	11,5	12,3	13,6	16,9	22,1	29,2	36,6	50,3	53,7	54,0
Goats	23,0	23,7	22,0	27,2	26,9	22,0	20,8	19,7	16,6	14,7
Horses	68,4	64,5	60,7	63,6	63,6	62,6	60,9	55,9	54,4	49,0
Swine	868	1.011	1.061	1.057	1.073	1.115	1.127	923	897	928
Rabbits	82.3	74.1	74.6	98.3	96.6	99.9	103.5	102.1	103.5	107.5
Nutria	2.2	2.0	1.6	1.5	1.4	1.7	2.9	1.7	1.3	1.3
Minks	39.7	45.6	53.0	76.6	118.9	158.	169.1	159.1	172.2	119.7
Foxes	0.7	0.8	0.8	1.6	3.0	3.3	1.9	1.0	1.7	0.5
Polar foxes	4.4	5.2	6.7	14.1	9.6	10.9	1.7	1.0	1.3	0.01

6.2.2 Methodological issues

The *IPCC Guidelines* describe two general methods for estimating emissions from enteric fermentation – Tier 1 method with constant emission factors based on internationally accepted estimates, and Tier 2 method that requires more disaggregated livestock population categories and uses calculated emission factors. Methods of estimation used in this report are given in Table 6-4.

Table 6-4. Methods and emissions factors used for estimations of emission from enteric fermentation

Animal category	**Sub-category**			**Method applied**	**Emission factor**
Cattle	Dairy cattle			Tier 2	CS
	Non-dairy cattle	cows used for producing meat		Tier 2	CS
		cattle to 2 year		Tier 2	CS
		cattle over 2 year	heifers	Tier 2	CS
			bulls	Tier 2	CS
Sheep				Tier 1	IPCC
Goats				Tier 1	IPCC
Horse				Tier 1	IPCC
Swine	Sows (including suckling pigs)			Tier 2	CS
	Growing pigs (10-110 kg)			Tier 2	CS
	Pigs over 8 - replacement month			Tier 2	CS
	Boars			Tier 2	CS
Rabbits				Tier 1	IPCC default*
Nutria				Tier 1	IPCC default*
Fur animals				Tier 1	IPCC default, Modified *

*see “calculation of CH_4 emissions from sheep, goats, horses, rabbits, nutria and fur-bearing animals

6.2.2.1 Characterisation of animal populations

CH_4 emission calculations are based on the data of domestic animal register of the Centre of Information and Rural Business of Ministry of Agriculture and the data from Statistics Lithuania.

Average annual number of cattle provided in the register of the Centre of Information and Rural Business of Ministry of Agriculture was used. In the Lithuanian inventory, the animal category "cattle" (CRF 4.A.) consists of dairy cattle and "non-dairy cattle". The data of CH_4 emission calculations of dairy cow group are taken in general. "Non-dairy cattle" include purebred and hybrid cows used for producing meat, cattle to 2 year and cattle over 2 year. Cattle over 2 year include heifers, fattening and stud bulls. The number of cattle used in 2009 report is given in Table 6-4a.

Table 6-4a. The number of cattle il Lithuania in 2009 (1000 heads)

Dairy cattle	Non-dairy cattle			
	beef cattle (mature cows)	cattle under 2 years	cattle over 2 years	
			heifers	bulls
371.8	17.0	291.0	39.3	9.8

Average annual number of sheep provided in the register of the Centre of Information and Rural Business of Ministry of Agriculture was used. The data on goats, horses, swine and poultry (data of poultry were used for calculation of emissions from manure management) populations were taken from Statistics Lithuania publications[21] (as of 1st of January 2010).

The category "swine" is divided into sows (including suckling pigs), growing pigs (10-110 kg), pigs over 8 month - replacement pigs, boars.

For the category "sheep, goats, ~~and~~ horses, rabbits, nutria and fur-bearing animals", the results are reported in aggregated form.

6.2.2.2 Calculation of CH4 emissions by cattle and swine

The CH_4 emissions from enteric fermentation were calculated using the following formula [22]:

$$CH_{4\ emissions} = EF \times Population / (10^6\ kg/Gg)$$

where:

EF – emission factor for each animal category, kg/head/year
Population – the number of head in the defined livestock population

Emission factors for dairy and non-dairy cattle were calculated in accordance with the methodology provided in GPG 2000[23]:

$$EF = (GE \times Y_m \times 365\ days/yr) / 55.65\ MJ/kg\ CH_4$$

where:

EF – emission factor, kg CH_4/head/yr
GE –gross energy intake of the sub-category, MJ/head/day
Y_m – methane conversion rate ((percentage of gross energy that is converted to methane) (assumed to be 0.06))

When determining the EF from dairy cattle, gross energy was calculated on the basis of the feed accumulation standards indicated in the reference book for animal production[24]. Most frequently used feedstuffs were included into the calculation, namely, hay, from cultivated meadows and pastures of different nutritive value, also clover and cereal grass hay, maize, cultivated meadow grass and silage from perennial wilted grass, grass from cultivated meadows and pastures of different nutritive values,

[21] Agriculture in Lithuania, 2010.
[22] IPCC 2000. Agriculture. Eq. 4.12. P. 4.25.
[23] IPCC 2000. Agriculture. Eq. 4.14. P. 4.26.
[24] Gyvulininkystės žinynas. Baisogala, Institute of Animal Science of LVA. 2007. - 616 p.

also leguminous green feeds and concentrates with respect to the composition of every different type of feed (Table 6-5).

Table 6-5. The amount of most important nutrients in the forage and the demand of the forage for dairy cows

Crude protein kg/ ration	Crude fat kg/ration	Crude fibre kg/ration	Nitrogen-free extracts kg/ration	The amount of dry matter kg/ration	Needed amount of forage kg DM/year
2,14	0.47	3.51	6.86	14.63	5338.85

Gross energy was calculated using the following formula:

$$\text{Gross energy (MJ/kg feed)} = 0{,}0239xCP+0{,}0398xCF_{at}+ 0{,}0201xCF_{ibre} + 0{,}0175xNFE$$ [25]

where:

CP – crude protein g/kg in dry matter
CF_{at} – crude fat g/kg in dry matter
CF_{ibre} – crude fibre g/kg in dry matter
NFE – nitrogen-free extracts g/kg in dry matter
GE ((MJ/head/day) was estimated by multiplying GE per kg of every feed from the amount of the necessary feed in dry matter, then making GE sums and calculating the amount per day.

$$GE_{(MJ/head/day)} = GE_{(MJ/kg\ feed)} \text{ x } (F_{quantity} \text{ x dry matter/kg feed}))/365$$

where:

$GE_{(MJ/kg\ feed)}$ – the amount of gross energy MJ/kg feed
$F_{quantity}$ x dry matter/kg feed – the amount of forage, necessary during a year, kg (counting as dry matter)

When determining the CH_4 emission from non-dairy cattle in the progeny under 2 years of age group, gross energy was also calculated on the basis of feed accumulation standards presented in the reference book for animal production. Most frequently used feedstuffs were used for the calculations: hay of different nutritive value from cultivated meadows and pastures, also clover and cereal grass hay, straw from different crops, maize, silages from cultivated meadow grasses and perennial wilted grass, sugar beet pulp silage, root-crops and their leaves, grasses of various nutritive value from cultivated pastures and meadows, leguminous green feeds, concentrates, also milk and milk replacers. The amount of the most important nutritive matter in the feeds and feed demands for cattle progeny under 2 years of age are presented in Table 6-6.

Table 6-6. The amount of most important nutrients in the forage and the demand of the forage for cattle progeny under 2 years of age

Crude protein kg/ ration	Crude fat kg/ration	Crude fibre kg/ration	Nitrogen-free extracts kg/ration	The amount of dry matter kg/ration	Needed amount of forage kg DM/year
1,04	0.25	1.7522	3.46	7.25	2645.61

To estimate the EF from cows used principally for producing meat and from cattle over 2 years

[25] Jeroch H. ir kt. Žemės ūkio gyvulių ir paukščių mitybos fiziologinės reikmės. P. 30.

gross energy was calculated using the following formulas[26]:

$$GE = (NE_m + NE_a + NE_l + NE_p)/(NE_{ma}/DE)/(DE/100)$$

$$GE = (((NE_m + NE_a)/(NE_{ma}/DE)) + (NE_g)/(NE_{ga}/DE)) / (DE/100)$$

where:

NE_m – Net energy required by the animal for maintenance, MJ/head/day
NE_a – Net energy for animal activity, MJ/head/day
NE_l –Net energy for lactation, MJ/head/day
NE_p – Net energy required for pregnancy, MJ/head/day
NE_{ma}/DE – ratio of net energy available in a diet for maintenance to digestible energy consumed
NE_g – Net energy needed for growth, MJ/head/day
NE_{ga}/DE – ratio of net energy available for growth in a diet to digestible energy consumed
DE – digestible energy expressed as a percentage of gross energy

Net energy for growth were estimated using equation4.3a [27]:

$$NEg = 4.18x(0.0635x(0.891x(BWx0.96)x(478/(CxMW)))^{0.75} x(WGx0.92)^{1.097})$$

where:

NEg – net energy needed for growth, MJ/day
BW –live body weight (BW) of the animal, kg
C – a coefficient with a value of 0.8 for females, 1.0 for castrates and 1.2 for bulls
MW – the mature body weight of an adult animal, kg
WG –daily weight gain, kg/day

The average weight of cows used principally for producing meat and cattle over 2 years of age was estimated based on the experts judgement. Pasture-cowshed time was calculated on average data on surveys in practice. The productivity of the cows used principally for producing meat and average weight gain of the cattle over 2 years of age was estimated based on the experts judgement.

Emission factors in the particular subgroups of cattle, estimated by calculations, are given in the Table 6-7.

Table 6-7. Calculated emission factors used for calculation of CH_4 emission from enteric fermentation

Animal category	Sub-category			EF (kg CH_4/head/year)
Cattle	Dairy cattle			102.5
	Non-dairy cattle			56.7
		cows used for producing meat		82.4
		cattle to 2 year		51.7
		cattle over 2 year		77.6
			heifers	84.7
			bulls	49.1

[26] IPCC 2000. Agriculture. Eq. 4.11. P. 4.20.
[27] IPCC 2000. Agriculture. Eq. 4.3a. P. 4.15.

When determining the CH_4 emission from swine, gross energy was also calculated on the basis of feed accumulation standards presented in the reference book for animal production. Most frequently used feedstuffs were used for the calculations: barley, wheat, triticale, dried pulses, rapeseed cake, soybean meal, milk replacers, fish meal, oil. The amount of the most important nutritive matter in the feeds and feed demands for swine are presented in Table 6-8.

Table 6-8. The amount of most important nutrients in the forage and the demand of the forage for pigs

Sub-category of swine	Crude protein kg/forage	Crude fat kg/forage	Crude fibre kg/forage	Nitrogen-free extracts kg/forage	The amount of dry matter kg/forage	Needed amount of forage kg DM /year /place
Sows	0.413	0.127	0.180	1.613	2.425	1056.7
Boars	0.366	0.083	0.173	1.367	2.057	900
Growing pigs 10-110 kg	0.280	0.075	0.090	1.194	1.722	724.5 (325x2.3)
Pigs over 8 month	0.429	0.104	0.132	1.726	2.457	1063.2

Gross energy for pigs was calculated as well as for cattle[28]. Calculated mission factors in the particular subgroups of swine are given in the Table 6-9.

Table 6-9. Calculated emission factors used for calculation of CH_4 emission from enteric fermentation of swine

Animal sub-category	EF (kg CH_4/head/year)
Sows	1.84
Boars	1.55
Growing pigs 10-110 kg	1.27
Pigs over 8 month	1.87
Average	1,37

6.2.2.3 Calculation of CH_4 emissions from sheep, goats, horses, rabbits, nutria and fur-bearing animals

Compared to cattle, the contribution of other farm animals to the whole CH_4 emissions from enteric fermentation is much smaller. Therefore, CH_4 emissions from enteric fermentation of sheep, goats and horses are estimated by the Tier 1 approach. Considering the rather small numbers of these animals the default values (emission factors) pursuant to IPCC were used (Table 6-10). As no IPCC and national default emissions factor for fur-bearing animals, rabbits and nutria is available, the Norwegian[29] emission factor for fur-bearing animals and Russian[30] emission factors for rabbits and nutria in our calculations were used.

Table 6-10. Default emission factors for each animal category used for calculation of CH_4 emission from enteric fermentation[31]

[28] Jeroch H. ir kt. 2004. Žemės ūkio gyvulių ir paukščių mitybos fiziologinės reikmės. P. 30.
[29] Greenhouse gas emissions in Finland. P. 214.
[30] National inventory Submissions, CRF Table 4A. Sectoras background data for agriculture. Enteric fermentation.
[31] IPCC 1996. Agriculture. Table 4-2. P. 4.3.

Animal category	EF (kg CH_4 / head /year)
Sheep	8.0
Goat	5.0
Horse	18.0
~~Swine~~	~~1.5~~
Fur-bearing animals	0,1
Rabbits	0.59
Nutria	0.35

6.2.3 Calculated emissions

Methane emissions are primarily related to cattle, which, in 2009, contributed 95.5 % of the emission from enteric fermentation. In 2009 dairy cows produced 62.4%, non-dairy cattle 33.1% of emissions. The shares of other animals were small. Emission from pigs made up 2.1 %, horses 1.4%, sheep and goats 0.1% of the total emissions from enteric fermentation.

Methane emissions from enteric fermentation comprised of 69.6% of total methane emissions from livestock and 26.2% of total agricultural emissions. In 2009, compared to 2008, methane emissions from enteric fermentation decreased by 5.8%. In the period from 1990 to 2009 methane emissions from enteric fermentation decreased by 59.1% (Table 6-11).

Table 6-11. The methane emissions (Gg) from enteric fermentation by livestock category 1990–2009

Year	Cattle		Sheep	Goats	Horse	Swine	Fur-bearing animals, rabbits and nutria
	dairy	non-dairy					
1990	76.35	67.30	0.45	0.03	1.44	3.65	0.07
1991	73.32	62.34	0.46	0.03	1.49	3.27	0.07
1992	62.06	40.79	0.41	0.04	1.43	2.04	0.07
1993	55.88	29.83	0.36	0.05	1.46	1.79	0.07
1994	50.76	22.38	0.32	0.06	1.41	1.89	0.06
1995	48.88	20.27	0.26	0.07	1.40	1.91	0.06
1996	49.69	20.28	0.23	0.08	1.47	1.69	0.07
1997	49.75	19.14	0.19	0.09	1.41	1.80	0.08
1998	46.87	17.65	0.13	0.12	1.34	1.74	0.07
1999	42.31	19.00	0.11	0.12	1.35	1.40	0.06
2000	39.48	14.94	0.09	0.12	1.23	1.30	0.05
2001	40.81	15.19	0.10	0.12	1.16	1.52	0.05
2002	41.39	16.65	0.11	0.11	1.09	1.59	0.05
2003	41.90	18.53	0.14	0.14	1.14	1.59	0.07
2004	41.27	18.07	0.18	0.13	1.14	1.61	0.07
2005	40.18	19.58	0.23	0.11	1.13	1.67	0.08
2006	39.21	22.88	0.29	0.10	1.10	1.69	0.08
2007	40.23	21.09	0.40	0.10	1.01	1.38	0.08
2008	40.43	21.55	0.43	0.08	0.98	1.35	0.08
2009	38.11	20.26	0.43	0.07	0.88	1.27	0.08
Trend 1990-2009	-50.1%	-69.9%	-4.4%	182.7%	-38.7%	-65.1%	16.4%

The overall reduction of methane emissions was caused by a decrease in total numbers of animals (excluding goats). In case of non-dairy cattle the attrition of animals was partly counterbalanced by an increase in weight of animals resulting in higher emission per animal. Estimation of 2009 comprised gross energy calculations in separate sub-categories and this resulted in a significantly lower methane emissions from swine (Table 6-12).

Table 6-12. The methane emissions (Gg) from enteric fermentation by non-dairy cattle sub-categories

Year	Beef cattle (mature cows)	Non-dairy cattle to 2 year	Non-dairy cattle at 2 year
2007	1.10	16.09	3.90
2008	1.23	15.99	4.33
2009	1.40	15.05	3.80

6.2.4 Uncertainties

6.2.4.1 Relevant animal head counts

The number of cattle is reliable and it is presented in the statistical data bases. In Lithuania cattle are marked individually. In the groups of cattle and sheep the average annual number of animals was used. However the precision of calculated data of emission is influenced by the fact that it is impossible to divide the cows into sub-groups. The weight of cattle for meat and their weight gain is established only in accordance with those conclusions of experts and the indices of registers, the data can have actual data error. The ratio of variation of animal number given by the Department of Statistics for animals is 2%.

Tier 1 methodology used for other animal categories is limited by factors such as weight, age, gender, and feeding system are assumed similar within a given animal category.

6.2.4.2 Emission factors

Emission factors estimated using the Tier 1 method may be uncertain to ±50%.[32] or ±20%[33]. Emission factor estimates using the Tier 2 method are likely to be in the order of ± 20%[34]. The overall uncertainty of 30% was assumed.

6.2.5 Source-specific QA/QC and verification

When comparing calculated emission factors in the group of cattle, it is seen, that the countries, indicating similar productivity of cows, such as Belarus, Latvia and Poland also indicates slightly less methane emission factors. However animal weight isn’t indicated (except Poland). Finland, Denmark and Czech Republic indicates similar animal weight as Lithuania, however they indicate higher productivity of cows and accordingly higher emission factors. Only Germany indicates higher productivity however lower emission factor (Table 6-13).

Table 6-13. Methane emissions from enteric fermentation in dairy cows, in various countries – a comparison of Emission Factors

[32] IPCC 2006. Emissions from livestock and manure management. P. 10.33
[33] IPCC 1996. Agriculture. P. 4.10
[34] IPCC 2000. Agriculture. P.4.28

Country	EF (kg/CH_4/head/year)	Milk yield (kg/head/day)	Weight (kg/animal)
Belarus	121.97	18.4	600
Czech Republic	115,88	18,59	585
Denmark	130.38	23.53	575
Estonia	132,51	18,58	586,85
Finland	125.24	21.92	628.21
Germany	127.99	18,69	638.29
Latvia	115.42	13.21	NE
Lithuania	102,5	13,18	575
Poland	96.57	12.29	500
Norway	110.97	25.81	NE

When comparing the calculated emission factors in the group of non-dairy cattle, it can be seen, that Denmark, Germany and Poland, indicating lower productivity of non-dairy cattle also indicate lower methane emission factors (Table 6-14). Besides they indicate lower gross energy intake and lower emission factors.

Table 6-14. Methane emissions from enteric fermentation in non-dairy cattle, in various countries – a comparison of Emission Factors

Country	EF (kg/CH_4/head/year)	Average gross energy intake (MJ/head/day)	Weight (kg/animal)
Czech Republic	51.87	131.81	NA
Denmark	40.42	130,47	325
Germany	44.50	105.51	288.64
Lithuania	56.73	144.16	351.4
Poland	47.92	121.78	313.11

When comparing the calculated emission factors in the group of swine showed that the Denmark, indicating major average gross energy intake also indicates less implied emission factors (Table 6-15).

Table 6-15. Methane emissions from enteric fermentation in swine, in various countries – a comparison of Emission Factors

Country	EF (kg/CH_4/head/year)	Average gross energy intake (MJ/head/day)
Austria	1.50	38.00
Denmark	1.13	39.87
Germany	0.99	25.07
Estonia	0.80	20.45
Sweden	1.50	38.00
Lithuania	1.37	34.86

According to the Statistics Lithuania dairy cow population by January 1, 2010 was 374.6 thousand. In this report the average dairy cow population 371.8 thousand in 2009 was used as provided by the register of animals. So the difference was 0.7%. According to the Statistics Lithuania the total population of cattle by January 1, 2010 was 759.4 thousand. In this report average population 728.8 thousand provided by the animal register was used, lower by 4%.

The data provided by the Statistics Lithuania are collected by applying continuous accountability for agriculture companies and applying sampling methods for farmers and households. The Information Centre of Agriculture and Country Business of the register of livestock in cooperation with The State Food and Veterinary Service uses animal registering and identification system, in which all the animal movements and changes of animal state are registered. Therefore we assume that the data of animal register are more precise and reliable.

6.2.6 Source-specific recalculations

CH_4 emission from enteric fermentation of fur-bearing animals, rabbits, nutria was added.
CH_4 emissions recalculated using new, more accurate data on swine fodder composition.
CH_4 emission from enteric fermentation from fur-bearing animals, rabbits and nutria was added.

Table 6-15a. Reported and recalculated emissions from enteric fermentation in 1990-2009, (Gg CO_2 equiv.)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Previous submission	3.133,6	2.932,6	2.213,3	1.848,7	1.586,0	1.499,4	1.509,8	1.485,6	1.390,5	1.311,0
This submission	3.134,9	2.960,4	2.243,7	1.878,4	1.614,6	1.529,6	1.543,6	1.521,9	1.426,0	1.351,4
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Previous submission	1.167,6	1.201,1	1.237,9	1.283,6	1.260,9	1.252,6	1.299,9	1.348,4	1.361,2	
This submission	1.201,7	1.237,9	1.280,9	1.333,4	1.312,0	1.322,6	1.372,3	1.350,0	1.362,8	

6.3 Manure Management

This chapter describes estimation of the CH_4 and N_2O emissions from 4B Manure management. In 2009 18.8% of agricultural GHG emissions arose from manure management.

6.3.1 Methane emissions from manure management

Methane is produced from the decomposition of the organic matter remaining in the manure under anaerobic decomposition. The amount of CH_4 produced from manure depends on the manure characteristics linked to animal types and diets, the amount of feed consumed, the digestibility of the feed, on the type of waste management system, on the environmental conditions. The annual mean air temperature in Lithuania is 6.2^0C. The difference between the warmest month June and the coldest month January makes up 21.8ºC.

6.3.1.1 Source-category description

Calculations of GHG emissions from manure management were performed using the same domestic animal data as described in previous section. The information on manure management systems has been provided by the Institute of Water Management of the University of Agriculture of the Republic of Lithuania.

6.3.1.2 Methodological issues

The IPCC Guidelines provide two methods for determining CH4 emissions from livestock manure. The Tier 1 approach is a simplified method that only requires livestock population data by animal category and climate region, in order to estimate emissions.

The Tier 2 method for estimating CH4 emissions from manure management systems requires detailed information on animal characteristics and the manner in which manure is managed.

The methods of calculation used in this report are given in Table 6-16.

Table 6-16. Methods and emissions factors used for estimations of CH_4 emission from manure management

Animal category	Method applied	Emission factor
Dairy Cattle	Tier 2	CS
Non-dairy cattle	Tier 2	CS
Sheep	Tier 1	IPCC
Goats	Tier 1	IPCC
Horses	Tier 1	IPCC
Swine	Tier 2	CS
Poultry	Tier 1	IPCC
Rabbits	Tier 1	IPCC
Minks	Tier 1	IPCC
Foxes	Tier 1	IPCC
Polar foxes	Tier 1	IPCC
Nutria	Tier 1	IPCC

6.3.1.3 Characterisation of manure management systems

Assumption on manure remaining on pasture was based on grazing time of dairy and non-dairy cattle. In the cattle category, the average duration of grazing on pasture periods and the average time spent in milking stalls are used to divide excrement into pasture and stable portions.

About 30% of cattle breeders use liquid manure reservoirs, the other use slurry storing systems. Therefore solid manure constitutes about 70% of the total generated through the stall period. As stall period takes about 60% of the year, the total fraction of manure managed by solid storage method is 42%. Fraction of manure stored in liquid/slurry systems is 18%.

Calves and cows for slaughter are normally kept in stalls all the time while calves and heifers for breeding and milk production, beef cattle are grazing in pastures for approximately 145 days per year, same as dairy cows. As the number of animals for slaughter is approximately 50%, average fraction of manure remaining on pastures and not managed is approximately 20%. Remaining manure is divided between solid storage and liquid/slurry systems in the same proportions as for dairy cows. So, 56% of manure is managed in solid storage systems and 24% in liquid/slurry systems.

Majority of swine farms use liquid manure storing systems. Such farms breed up to 68% of swine. In other farms swine are breeding on concrete floor using litter. The 12% of swine manure is managed in pits below confinements as deep bedding or is used for biogas. However, pits below animal confinements are not included in the CRF reporter. Therefore, this type of swine manure management is reported as “other manure management system”.
Since 1990 almost all fur-bearing animals, rabbits and nutria breeders use solid manure management systems. Liquid manure management systems have been started to be used only last few years in four fur–bearing animals farms.
Methane conversion factors (MCF) for manure management systems were taken as default values from the Revised 1996 IPCC Guidelines. Data on manure management used in calculations are provided in
Table 6-17.

Table 6-17. Data on manure management systems

	Solid storage	Liquid/slurry	Pit storage below confinements/deep bedding	Pasture/range and paddock	Anaerobic digestion
MCF	1%	39%	39%	1%	
Dairy cattle					

1990-1991	48%	12%		40%	
1992	47%	13%		40%	
1993	47%	13%		40%	
1994	47%	13%		40%	
1995	46%	14%		40%	
1996	46%	14%		40%	
1997	46%	14%		40%	
1998	45%	15%		40%	
1999	45%	15%		40%	
2000	45%	15%		40%	
2001	44%	16%		40%	
2002	44%	16%		40%	
2003	44%	16%		40%	
2004	43%	17%		40%	
2005	43%	17%		40%	
2006	43%	17%		40%	
2007-2009	42%	18%		40%	
Non-dairy cattle					
1990-1991	64%	16%		20%	
1992	63%	17%		20%	
1993	63%	17%		20%	
1994	62%	18%		20%	
1995	62%	18%		20%	
1996	61%	19%		20%	
1997	61%	19%		20%	
1998	60%	20%		20%	
1999	60%	20%		20%	
2000	60%	20%		20%	
2001	59%	21%		20%	
2002	59%	21%		20%	
2003	58%	22%		20%	
2004	58%	22%		20%	
2005	57%	23%		20%	
2006	57%	23%		20%	
2007-2009	56%	24%		20%	
Swine					
1990	20%	16%	64%		
1991	20%	16%	64%		
1992	20%	26%	54%		
1993	20%	26%	54%		
1994	20%	25%	55%		
1995	20%	24%	56%		
1996	20%	27%	53%		
1997	20%	26%	54%		
1998	20%	27%	53%		
1999	20%	27%	53%		
2000	20%	37%	43%		
2001	20%	31%	49%		
2002	20%	33%	47%		

2003	20%	38%	42%		
2004	20%	47%	33%		
2005	20%	48%	32%		
2006	20%	49%	31%		
2007	20%	58%	22%		
2008	20%	58%	22%		
2009	20%	68%	8.3%		3.70%

Calculation of CH4 emissions

CH_4 emissions from manure management were calculated using the following formula[35]

$$CH_{4\ EMISSIONS} = EF \times Population / (10^6\ kg/Gg)$$

where:

EF– emission factor for the defined livestock population, kg/head/year
Population–the number of head in the defined livestock population

Methane emissions from horses, goats, sheep and poultry were calculated according to the Tier 1 method. Default IPCC emission values for each relevant livestock category are used to calculate emissions from manure (Table 6-18).

Table 6-18. Emission factors used for calculation of CH_4 emission from manure management[36],[37]

Animal category	EF (kg CH_4/head/year)
Sheep	0.19
Goats	0.12
Horses	1.39
Poultry	0.078
Rabbits	0.08
Fur-bearing animals, nutria	0.68

Methane emissions from cattle and swine were calculated according to the Tier 2 method. The emission factor is determined via the following equation[38]:

$$EF = VS \times 365\ days/year \times Bo \times 0.67\ kg/m^3 \times \Sigma MCF \times MS$$

where:

EF–annual emission factor for defined livestock population, in kg
VS–daily VS excreted for an animal within defined population, in kg
Bo– maximum CH_4 producing capacity for manure produced by an animal within defined population, m^3/kg of VS
MCF– CH_4 conversion factors for each manure management system
MS–fraction of animal species/category manure handled using manure system
VS excretion rates were estimated from feed intake levels

$$VS = GE \times (1\ kg\text{-}dm/18.45\ MJ) \times (1 - DE/100) \times (1 - ASH/100)$$

[35] IPCC 2000. Agriculture. Eq. 4.15. P. 4.30
[36] IPCC 1996. Agriculture Table 4-4. P. 4.6
[37] 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table10.16. P. 10.41
[38] IPCC 2000. Agriculture. Eq. 4.17. P. 4.34

where:

GE–estimated daily average feed intake in MJ/day
DE–digestible energy of the feed in percent
ASH–ash content of the manure in percent

Gross energy consumption for dairy, and non-dairy cattle and swine was taken as calculated in section „enteric fermentation" (4.A). Volatile solid excretion rate for cattle was calculated using digestible energy of the feed (65% for cattle and 75% for swine) ash content of the manure (8% for cattle and 2% for swine) provided in the Good Practice Guidance[39]. Methane producing capacities B_0 (0.24 m^3 CH_4/kg VS for dairy cows and 0.17 m^3 CH_4/kg VS for non-dairy cattle, 0.45 for swine) were also taken from the Good Practice Guidance.

Animal manure treatment in a biogas device reduced emission of CH_4. In our estimations it was considered that all the biogases were collected and digested in the anaerobic digester, therefore, amount of CH_4 used as fuel was not included into the total emission.

6.3.1.4 Calculated emissions

Calculated emission factors for dairy cattle, non - dairy cattle and swine are presented in Table 6-19.

Table 6-19.Calculated emission factors

Category	EF (kg CH_4/head/year)
Dairy cattle	20,92
Non - dairy cattle	10,59
Swine	15,26

Total methane emissions from manure management of domestic livestock consisted approximately 12.6% of total agricultural emissions or 43.6% of total CH_4 emissions in 2009. In 2009, as compared to 2008, methane emissions from manure management decreased by 3.2% (Table 6-20). The highest methane emission among different categories of domestic animals in the year 2009 of manure management systems was established in swine breeding category. The use anaerobic digester for biogas-treatment in 2009 is responsible for the lower N_2O emissions compared to submission in 2008, however, the increased number of pigs partly counterbalances this effect.

Table 6-20. Methane emissions from manure in 1990–2009 (Gg CO_2 eq.)

Year	Dairy cattle	Non-dairy cattle	Swine	Sheep	Goats	Horses	Poultry	Fur-bearing animals	Rabbits	Nutria
1990	232.0	184.5	883.8	0.23	0.01	2.33	27.54	2.26	0.12	0.25
1991	222.8	170.9	790.9	0.23	0.02	2.41	27.84	2.23	0.12	0.24
1992	188.6	111.8	493.4	0.21	0.02	2.33	13.53	2.09	0.14	0.19
1993	169.8	81.8	434.0	0.18	0.03	2.37	14.30	1.42	0.16	0.15
1994	154.3	61.3	457.1	0.16	0.03	2.28	14.49	1.35	0.15	0.14
1995	148.5	55.6	460.8	0.13	0.04	2.27	13.83	1.29	0.14	0.13
1996	151.0	55.6	409.1	0.11	0.04	2.38	12.74	1.33	0.16	0.10
1997	151.2	52.5	435.4	0.10	0.05	2.29	12.16	1.29	0.20	0.07
1998	142.4	48.4	420.5	0.06	0.06	2.17	11.06	0.65	0.17	0.05
1999	128.6	52.1	339.6	0.06	0.06	2.19	10.44	0.60	0.14	0.03
2000	120.0	41.0	314.8	0.05	0.06	2.00	9.13	0.64	0.14	0.03

39 IPCC 2000. Agriculture. P. 4.31-4.32.

2001	124.0	41.6	366.7	0.05	0.06	1.88	10.77	0.74	0.12	0.03
2002	125.8	45.6	385.0	0.05	0.06	1.77	11.22	0.86	0.13	0.02
2003	127.3	50.8	383.7	0.07	0.07	1.86	13.21	1.32	0.17	0.02
2004	125.4	49.5	389.4	0.09	0.07	1.86	13.79	1.88	0.16	0.02
2005	122.1	53.7	404.4	0.12	0.06	1.83	15.39	2.46	0.17	0.02
2006	119.2	62.7	408.9	0.15	0.05	1.78	15.46	2.47	0.17	0.04
2007	172.4	82.6	335.0	0.20	0.05	1.63	16.17	2.30	0.17	0.02
2008	173.3	84.4	301.3	0.21	0.04	1.59	14.92	2.50	0.17	0.02
2009	163.3	79.4	297.5	0.22	0.04	1.43	15.25	1.72	0.18	0.02
Trend 1990-2009	-29.6%	-57.0%	-66.3%	-4.4%	282.7%	-38.7%	-44.6%	-23.9%	50.0%	-92%

In 2009, as compared to 1990, methane emissions from manure management decreased by 58.1% (Fig. 6-2).

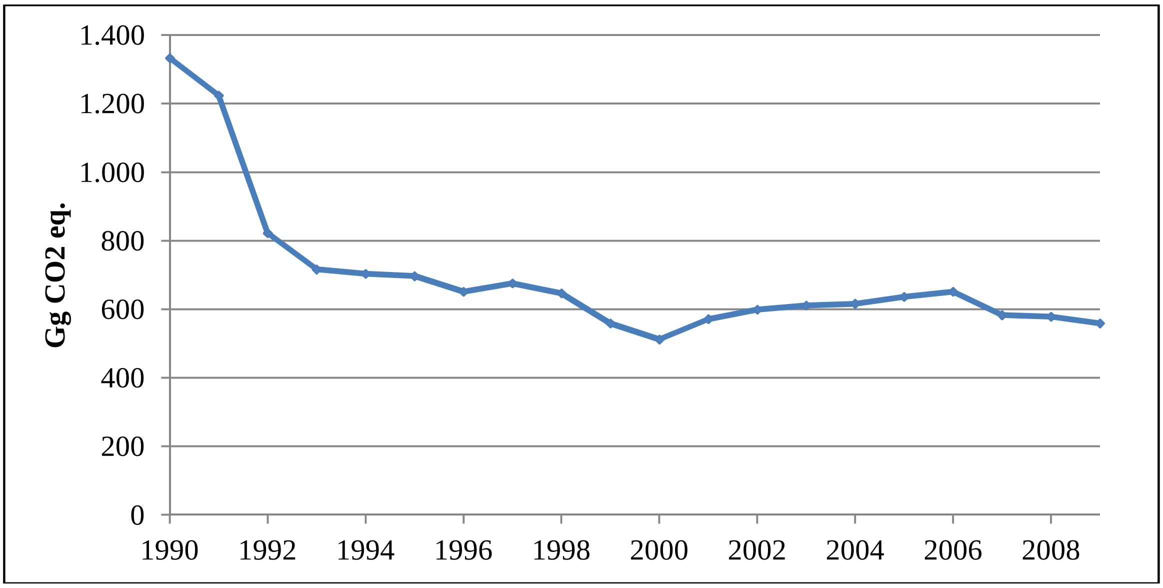


Fig. 6-2. **Methane emissions from manure management in 1990 – 2009 (Gg CO_2 eq.)**

The overall reduction of methane emissions from manure is caused by a decrease in total numbers of animals (excluding goats), but in the case of dairy and non-dairy cattle the attrition of animals is partly counterbalanced by an increase in emissions per animal (because of the increasing in volatile solid excretion and the connected gross energy intake).

6.3.1.5 Uncertainties

The ratio of animal number variation given by the Department of Statistics for animals is 2%, for poultry - 3%. However, the data on excretion and distribution of manure between the management systems is less reliable. It was assumed that overall uncertainty of activity data is about 20%.

2006 IPCC Guidelines for National Greenhouse Gas Inventories refers that for the Tier 1 method was larger uncertainty range for the default factors. For Tier 1 method uncertainty for CH_4 is estimated to be ±30%. Improvements achieved by Tier 2 methodologies are estimated to reduce uncertainty ranges in the emission factors to ±20%[40]

6.3.1.6 Source-specific recalculations

CH_4 emission from manure management of fur-bearing animals, rabbits, nutria was added.
Average weight of non-dairy cattle was corrected in accordance with the latest available data resulting in slight changes of methane emissions.
As data of cattle manure management systems for the period 1991-2007 were interpolated, there were two recalculations made in the 2011 submission – emissions of dairy cattle and emissions of non-dairy cattle

Table 6-20a . Reported and recalculated CH_4 emissions from manure management of dairy cattle and non-dairy cattle in 1990-2009, (Gg CO_2 equiv.)

	Dairy cattle		Non-dairy cattle	
	Previous submission	This submission	Previous submission	This submission
1990	232.0	232.0	184.5	184.5
1991	222.8	227.9	170.9	175.0
1992	188.6	197.2	111.8	117.1
1993	169.8	181.4	81.8	87.6
1994	154.3	168.3	61.3	67.2
1995	148.5	165.5	55.6	62.2
1996	151.0	171.7	55.6	63.5
1997	151.2	175.3	52.5	61.2
1998	142.4	168.4	48.4	57.6
1999	128.6	155.0	52.1	63.3
2000	120.0	147.3	41.0	50.7
2001	124.0	155.1	41.6	52.6
2002	125.8	160.2	45.6	58.7
2003	127.3	165.0	50.8	66.6
2004	125.4	165.4	49.5	66.1
2005	122.1	163.9	53.7	72.9
2006	119.2	162.6	62.7	86.6
2007	172.4	169.6	82.6	81.2
2008	173.3	173.3	84.4	84.4
2009		163.3		79.4

6.3.2 N_2O emissions from manure management

During manure storage and handling manure emits nitrous oxide through nitrification or denitrification. The amount of nitrogen oxide emitted depends on the nitrogen and carbon content of manure, on the type of manure storage system, the duration of time manure is stored, climatic condition during storage. Nitrous oxide is the most potent agricultural greenhouse gas. Its warming potential is 310 times greater than that of carbon dioxide.

6.3.2.1 Source-category description

The source of the N_2O calculation is the number of animals, amount of the produced manure, manure management systems.

[40] IPCC 2006. Emissions from Livestock and Manure management. P. 10.48

6.3.2.2 Methodological issues

The *IPCC Guidelines* method for estimating N_2O emissions from manure management entails multiplying the total amount of N excretion (from all animal species/categories) in each type of manure management system by an emission factor for that type of manure management system. Emissions are then summed over all manure management systems.

Methods and emissions factors used for estimations of N_2O emission from manure management were indicated in section 2.2.2. on methane emissions.

Characterisation of manure management systems

Characteristics of manure management systems are provided in Section 6.3.1.

Calculation of N_2O emissions

Nitrous oxide emissions from manure management are calculated by multiplying the total amount of N excretion (from all animal categories) in each type of manure management system by an emission factor for that type of manure management system[41]:

$$(N_2O\text{-}N)_{(mm)} = \Sigma_{(S)} ((\Sigma_{(T)} (N_{(T)} \times Nex_{(T)} \times MS_{(T,S)})) \times EF_{3(S)})$$

where:

$(N_2O\text{-}N)_{(mm)}$ –N_2O-N emissions from manure management in the country (kg N_2O-N/yr)
$N_{(T)}$ –Number of head of livestock species/category T in the country
$Nex_{(T)}$ –Annual average N excretion per head of species/category T in the country (kg N/animal/yr)
$MS_{(T,S)}$ –Fraction of total annual excretion for each livestock species/category T that is managed in
manure management system *S* in the country
$EF_{3(S)}$ –N_2O emission factor for manure management system S in the country (kg N_2O-N/kg N in manure management system S)
S– Manure management system
T–Species/category of livestock

Conversion of $(N_2O\text{-}N)_{(mm)}$ emissions to $N_2O_{(mm)}$ emissions for reporting purposes is performed by using the following equation:

$$N_2O_{(mm)} = (N2O\text{-}N)_{(mm)} \times 44/28$$

For calculation of total nitrogen excretion IPCC default annual average nitrogen excretion rates for each animal category were used (Table 6-21).

Table 6-21. Default N excretion values for livestock categories[42],[43]

Animal category	Nitrogen excretion(kg/head/year)
Sheep, goats	16
Horses	25
Poultry	0.6
Rabbits	8.1

[41] IPCC.2000. Agriculture. Eq. 4.18. P. 4.42.
[42] IPCC 1996. Agriculture. Table 4-6. P. 4.10.
[43] 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 10.19. P. 10.59.

Minks, nutria	4.59
Foxes, polar foxes	12.09

The annual amount of N excretion per head for cattle and swine were calculated on the total annual N intake and total annual N retention of the animal[44]. Annual average N intake per head for cattle and swine were calculated in accordance with the tables of forage sustenance and ration. The difference between intake and retention is N excretion. The emission factors for each manure management system were used from IPCC Guidelines (Table 6-22).

Table 6-22. Default emission factors for N_2O estimation from manure management[45]

Manure management system	Emission factor (kg N_2O-N/kg nitrogen excreted)
Pasture/ range/ paddock	0.02
Solid storage and dry lot	0.02
Liquid system, pits below confinements	0.001
Other management systems	0.005

Fractions of the total annual excretion of livestock managed in specific manure management systems are presented in Table 6-23.

Table 6-23. Percentage of manure production per animal waste management systems, %

	Solid storage and dry lot	Liquid system	Pasture/range	Other systems
Dairy cattle (see Table 6-24. Data on manure management systems)				
Non-dairy cattle (see Table 6-25. Data on manure management systems)				
Swine (see Table 6-26. Data on manure management systems)				
Sheeps				
1990-2009			73%	27%
Goats				
1990-2009			92%	8%
Horses				
1990-2009			92%	8%
Poultry				
1990-2009		28%	1%	71%
Rabbits				
1990-2009	100%			
Fur-bearing animals				
1990-2006	100%			
2007	93%	7%		
2008	85%	15%		
2009	78%	22%		
Nutria				
1990-2009	100%			

6.3.2.3 Calculated emissions

[44] IPCC.2000. Agriculture. Eq. 4.19. P. 4.45.
[45] IPCC 1996. Agriculture. Table 4-8. P. 4.14.

Nitrous oxide emissions from Manure Management were 319.6 Gg CO_2 eq. or 6.9% of total emissions in 2009. In 2009, to compared with 1990, nitrous oxide emissions from manure management decreased by 60.9% (Fig. 6-3). The quantities of N_2O emissions from manure, which are used for biogas production, are considered as negligible and were not calculated in this submission.

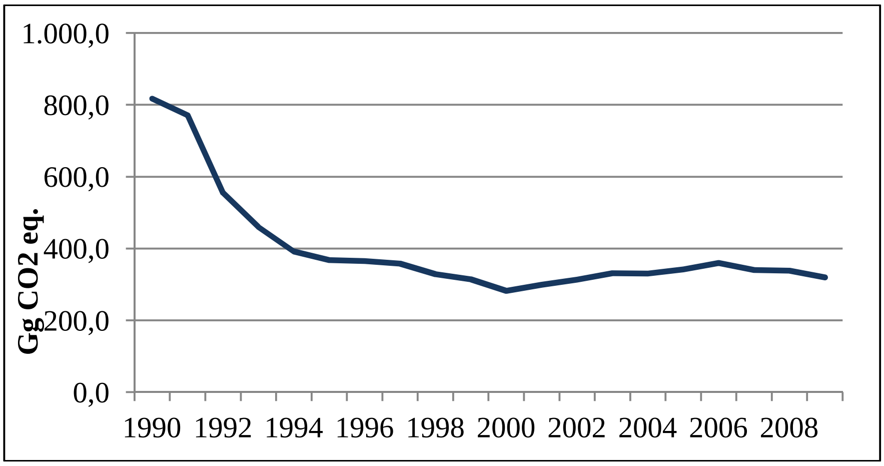


Fig. 6-3. **Nitrous oxide emission from manure management in 1990 – 2009 (Gg CO_2 eq.)**

Calculated nitrous oxide emissions for different manure management system present in Table 6-24.

Table 6-24. Calculated emissions for each manure management system.

Manure management system	N_2O emission (Gg CO_2 eq.)
Liquid system	10.2
Solid storage & dry lot	298.2
Other systems	11.2

6.3.2.4 Uncertainties

Animal number uncertainties and uncertainties related with manure management systems number were the same as for enteric fermentation. GPG 2000 (Table 4.13) refers that for Tier 1 method the uncertainty range for the default factors for Tier 1 method is estimated to be +50%/-100%[46]. Overall emission factor uncertainty was assumed to be 75%.

6.3.2.5 Source-specific recalculations

N_2O emission from manure management of fur-bearing animals, rabbits, nutria was added.
N-excretion for swines was recalculated using new data on animal herd structure and protein consumption.

6.3.2.6 Planned improvements

Collection of more accurate data on manure storage systems used in the Lithuanian agriculture is planned. Additional data should enable better and more reliable judgements on GHG emissions from manure management.

[46] IPCC. 2000. Agriculture. Table 4.13. P. 4.44.

In addition, experimental evaluation of country specific methane producing capacities (B_0) is planned in 2011-2013.

6.3a Rice cultivation

Rice is not cultivated in Lithuania, emissions reported as “NO”.

6.4 Agricultural soils

Agricultural soils include direct and indirect nitrous oxide emissions from agricultural soils.

6.4.1 Direct emissions from agricultural soils

Agricultural soils represent a very large source of nitrous oxide. A major direct source of nitrous oxide from agricultural soils is the use of synthetic fertilizer. Similarly the use of animal waste as fertilizer can lead to substantial emissions of nitrous oxide from agricultural soils.

6.4.1.1 Source category description

This source category includes direct nitrous oxide emissions from agricultural soils. For assessing of direct N_2O emissions from agricultural soils, anthropogenic nitrogen inputs were considered from the application of synthetic fertilisers and animal manure, the cultivation of N-fixing crops, the incorporation of crop residues into soils, soil nitrogen mineralization due to cultivation of organic soils.

6.4.1.2 Methodological issues

Nitrogen inputs to soils from main sources were calculated using IPCC Tier 1a method.

Activity data

Data about the consumption of synthetic fertilisers were collected from the UAB “Agrochema”, which is a single source of information on N fertilizer consumption in Lithuania.

UAB “Agrochema” is retail and wholesale trade company of fertilizers, chemical products for plant protection, seeds, peat products, forages and their supplements, farming goods and building materials, which also produces liquid fertilizers and their compounds. “Agrochema” is the main distributor of JSC “Achema” production in the Baltic States.

The data on consumption of fertilizers provided by UAB “Agrochema” is consistent with the International fertilizer industry association (IFIA) data.
Data of Area of cultivated land and crop were taken from the Department of Statistics „Agriculture in Lithuania 2009“.

Data from the study on economic evaluation of Lithuanian wetlands were used for assessing area of organic soils (histosols).[47]

Calculation of N_2O emissions

Direct nitrous oxide emissions from agricultural soils have been calculated using equation[48]:

[47] Lietuvos pelkių ekonominis vertinimas. Ataskaita, Aplinkos apsaugos politikos centras, 2010
[48] IPCC 2000. Agriculture. Eq. 4.20. P. 4.54.

$$N_2O_{DIRECT} – N = ((F_{SN} + F_{AM} + F_{BN} + F_{CR}) \times EF_1) + F_{OS} \times EF_2$$

where:

N_2O_{DIRECT} -N–emission of N_2O in units of nitrogen
F_{SN}– annual amount of synthetic fertilizer nitrogen applied to soils adjusted to account for the amount that volatilizes as NH_3 and NOx
F_{AM}– annual amount of animal manure nitrogen intentionally applied to soils adjusted to account for the amount that volatilizes as NH_3 and NOx
F_{BN}–amount of nitrogen fixed by N-fixing crops cultivated annually
F_{CR}–amount of nitrogen in crop residues returned to soils annually
F_{OS}–area of organic soils cultivated annually
E_{F1}–emission factor for emissions from N inputs (kg N_2O-N/kg N input)
E_{F2}–emission factor for emissions from organic soil cultivation (kg N_2O-N/ha-yr)

Conversion of N_2O-N emissions to N_2O emissions for reporting purposes is performed by using the following equation:

$$N_2O = N_2O\text{-}N \times 44/28$$

Synthetic N fertilizers (F_{SN}) (4.D.1.1). Synthetic Fertiliser Nitrogen, adjusted for Volatilisation (F_{SN}) was estimated by determining the total amount of synthetic fertiliser consumed annually (N_{FERT}), and then adjusting this amount by the fraction that volatilises as NH_3 and NOx ($Frac_{GASF}$)[49]:

$$F_{SN} = N_{FERT} \times (1\text{-}FRAC_{Gasf})$$

where:

N_{FERT}–total use of synthetic fertilizer, kg N/year
$Frac_{GASF}$ – fraction of total synthetic fertilizer nitrogen that is emitted as NOx+NH_3, kg N/kg N
$N_2O_{direct} = F_{SN} \times EF_1 \times 44/28$

To calculate annual amount of synthetic fertilizer nitrogen applied to soils IPCC default factors were used (Table 6-25).

Table 6-25. IPCC default factors used for estimation of synthetic fertiliser nitrogen[50]

Factors	Unit
EF_1	0.0125 kg N_2O-N/kg N
$Frac_{GASF}$	0.1 kg NH_3-N + NOx-N/kg of synthetic fertilizer nitrogen applied

Animal manure applied to soils (4.D.1.2). Animal manure nitrogen (F_{AM}) emits from agricultural soil through manure application to fields as organic fertilizer and animal pastures by grazing of animals were estimated by determining the total amount of animal manure nitrogen produced annually and then adjusting this amount to account for the animal manure that is volatilised as NH_3 and NOx ($Frac_{GASM}$)[51]:

$$F_{AM} = \Sigma_T(N_{(T)} \times Nex_{(T)}) \times (1 – Frac_{GASM}) [1\text{-} Frac_{FUEL\text{-}AM} + Frac_{PRP}]$$

[49] IPCC 2000. Agriculture. Eq. 4.22. P. 4.56.
[50] IPCC 1996. Agriculture. P. 4.89, 4.94.
[51] IPCC 2000. Agriculture. Eq. 4.23. P. 4.56.

where:

$N_{(T)}$ –number of head of livestock category T
$Nex_{(T)}$ – annual average N excretion per head of category T (kg N/animal/year)
$Frac_{FUEL}$ – fraction of livestock nitrogen excretion cotained in animal manure that is burned for fuel
$Frac_{PRP}$ (or $Frac_{GRAZ}$) - animal manure, deposited onto soils by grazing livestock
$N_2O_{direct} = F_{AM} \times EF_1 \times 44/28$

To calculate annual amount of Animal Manure nitrogen applied to soils IPCC default factors were used (Table 6-26).

Table 6-26. IPCC default factors used in the estimation of N_2O emission from animal waste applied to soils[52]

Factor	Unit
$Frac_{GASM}$	0.2 kg NH_3-N + NOx-N/kg of N excreted by livestock
N_2O EF	0.0125 kg N_2O-N/kg N
$Frac_{FUEL}$	0.0 kg N/kg nitrogen excreted[53]
$Frac_{PRP}$ ($Frac_{GRAZ}$)	See: Table 6-27. Data on manure management systems Table 6-28. Default emission factors for N_2O estimation from manure management Table 6-29. Percentage of manure production per animal waste management systems

N-fixing crops (4.D.1.3). N_2O emission (F_{BN}) of nitrogen stored crop was estimated in accordance with common leguminous plant harvest.

Table 6-26a. Harvest of legumes in Lithuania in 1990-2009 (thous. tonnes)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Harvest	200.2	194.2	27.5	35.3	39.6	47.5	87.4	106.4	104.1	63.8
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Harvest	73.0	52,2	62,9	48,5	57,5	58,9	34,9	56,4	62,3	85,7

The *IPCC Guidelines* also assumes that the mass ratio of residue to product is 1 (i.e. the total aboveground plant biomass is 2 times the crop product). Therefore, the amount of fixed N is estimated by multiplying the seed yield of pulses ($Crop_{BF}$) by a default value of 2 and then by the fraction of crop biomass that is nitrogen ($Frac_{NCRBF}$)[54]:

$$F_{BN} = 2 \times Crop_{BF} \times Frac_{NCRBF}$$

where:

$Crop_{BF}$ – production of pulses, kg dry biomass/year;
$Frac_{NCRBF}$ – fraction of nitrogen in N-fixing crop, kg N/kg of dry biomass;
$N_2O_{direct} = F_{BN} \times EF_1 \times 44/28$

To calculate the annual amount of nitrogen from N-fixing crops applied to soils IPCC default factors were used (Table 6-30).

52 IPCC 1996 Agriculture. P. 4.94, 4.97.
53 IPCC 1996. Agriculture. Workbook. Table 4-17. P. 4.35.
54 IPCC 2000. Agriculture. Eq. 4.25. P. 4.57.

Table 6-30. IPCC default factors used in the estimation of N_2O emission from N-fixing crops applied to soils[55]

Factor	Unit
FracNCRBF	0.03 kg N/kg of dry biomass;
N_2O EF	0.0125 kg N_2O-N/kg N

Crop residue (4.D.1.4). The amount of nitrogen returned to soils annually through incorporation of crop residues (F_{CR}) were estimated by determining the total amount of crop residue N produced (from both non-nitrogen-fixing crops and N-fixing crops). The annual production of residue N is estimated by multiplying annual crop production of N-fixing crops ($Crop_{BF}$) and other crops ($Crop_O$) (Table 6-27a) by their respective N contents ($Frac_{NCRBF}$ and $Frac_{NCRO}$) summing these two nitrogen values, multiplying by a

Table 6-27a. Crop harvest in Lithuania in 1990-2009 (thous. tonnes)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Winter cereals	1651.5	1192.2	1174.0	1370.1	907.4	902.0	1222.3	1429.0	1307.5	982.7
Spring cereals	1413.4	1961.1	1023.6	1302.4	1190.8	1004.5	1392.8	1516.3	1409.3	1065.9
Flax seed	10.2	10.2	3.1	1.2	3.5	6.5	3.2	2.9	2.7	3.7
linseed	0	0	0	0	0	0	0	0	0	0
Winter rape	23.9	12.3	7.5	1.6	1.1	4.9	1.7	0.8	2.3	4.8
Summer rape	4.1	0.2	01	1.5	12.1	14.0	20.9	36.4	69.6	110.3
Sugar beet	718.1	811.2	621.5	855.3	461.5	692.4	795.5	1001.9	949.2	869.9
Potatoes	1573.1	1508.3	1079.2	1772.6	1096.4	1593.5	2044.3	1829.8	1849.2	1708.1
vegetables	295,0	398,4	259,8	376,0	282,6	368,7	432,6	415,0	436,9	325,1
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Winter cereals	1410.1	1242.0	1329.8	1386.4	1663.0	1458.1	822	1553.3	1921.3	2440.5
Spring cereals	1247.6	1103.3	1209.3	1245.4	1196.4	1353.0	1035.8	1463.7	1500.6	1366.1
Flax seed	2.7	0.9	2.5	2.2	1.6	1.3	0.1	0.1	0.0	0.2
Linseed	0	0	0.2	0.5	0.2	0.7	0.6	0.2	0.2	0.2
Winter rape	11.9	22.4	43.9	13.9	65.6	72.6	45.8	141.8	178.7	269.6
Summer rape	69.1	42.4	61.7	105.6	139.1	128.6	123.8	170.1	151.5	146.2
Sugar beet	881.6	880.4	1052.4	977.4	904.9	798.5	717.1	799.9	339.1	682.0
Potatoes	1791.6	1054.4	1531.3	1445.2	1021.4	894.7	457.1	576.1	716.4	662.5
Vegetables	329,4	322,0	290,0	549,3	379,4	369,2	225,5	281,9	392,4	321,7

default value of 2 (to yield total aboveground crop biomass), and then adjusting for the amount of total aboveground crop biomass that is removed from the field as product ($Frac_R$)[56]

$$F_{CR} = 2 \times (Crop_O \times Frac_{NCRO} + Crop_{BF} \times Frac_{NCRBF}) \times (1 - Frac_R)$$

where:

2 – the factor converts the crop production to total crop biomass
$Crop_0$ – production of non-N-fixing crops, kg dry biomass/year
$Frac_{NCR0}$ – fraction of nitrogen in non-N-fixing crops, kg N/kg of dry biomass

[55] IPCC 1996. Agriculture. P. 4.89, 4.94.
[56] IPCC 2000. Agriculture. Eq. 4.28. P. 4.58.

$Crop_{BF}$ - production of pulses in country, kg dry biomass/year

IPCC default emission factors and other parameters are presented in Table 6-31.

Table 6-31. IPCC default factor used in the estimation of N_2O emission from crop residue returned to soils[57]

Factor	Unit
N_2O EF	0.0125 kg N_2O-N/kg dry biomass
$Frac_{NCRO}$	0.015 kg N/kg of dry biomass.
$Frac_{NCRBF}$	0.03 kg N/kg of dry biomass;
FracR	0.45 kg N/kg crop-N

Cultivation of histosols (4.D.1.5). N_2O emissions from histosols are based on the area with organic soils multiplied by the emission factor and Conversion of N_2O-N to N_2O emissions:

$$N_2O_{direct} = Area \times EF_2 \times 44/28$$

EF_2 - 8 kg N_2O-N/ha/year[58]

Calculated emissions

The major part of N_2O direct emissions from agricultural soils in 2009 were caused by synthetic fertilizers (54.2%), crop residues (19,9%) and of manure fertilisers (20,3%) of all direct emission. Direct N_2O emissions in 2009 from synthetic N fertilisers were 745.3, manure fertilisers – 279.2, N-fixing crops – 31.3, crop residues – 274.0, cultivation of histosols – 45.2 Gg CO_2 eq. (Fig. 6-4). For the variation of N_2O emission from agricultural soils in 1990-2009 the usage of nitric fertilisers had the biggest influence.

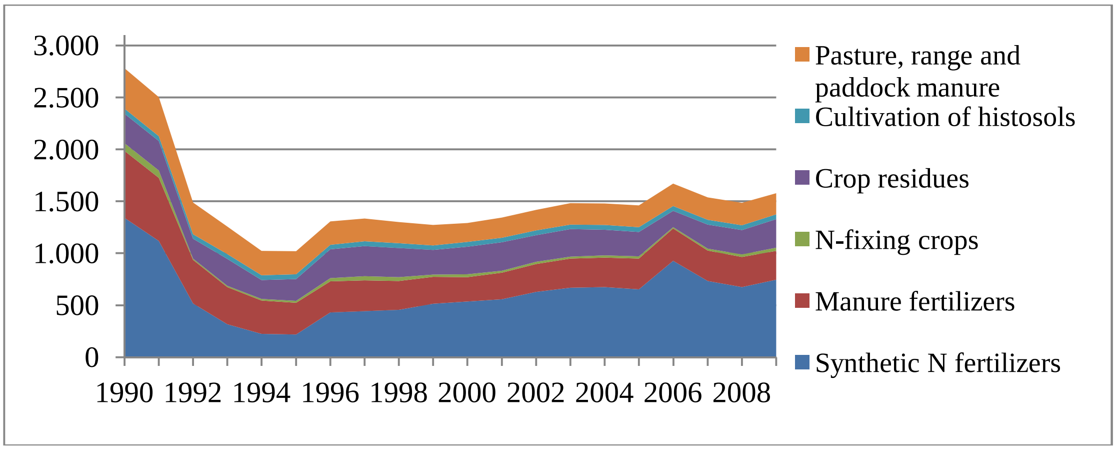


Fig. 6-4. Direct N_2O emissions from agricultural soils in 1990–2009 (Gg CO_2 eq.)

6.4.1.3 Uncertainties

It was assumed that overall uncertainty of activity data is about 20%. Emission factor uncertainty was assumed to be about 100%.

[57] IPCC 1996. Agriculture. P. 4.89, 4.94.
[58] IPCC 2000. Agriculture. P. 4.60.

6.4.1.4 Source-specific recalculations

Recalculation of N-excretion for swines using new data on animal herd structure and protein consumption caused certain changes in evaluated N_2O emissions from manure application on agricultural soils.

In the chapter "Cultivations of histosols" new data for the area of cultivated organic soils had been implemented. These changes reflect decreased emissions from direct soil emissions in the years 1990-2009 (Table 6-32).

Table 6-32. Reported in previous submission and recalculated direct N_2O soil emissions (Gg CO_2 eq.)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Previous submission	2.929,9	2.636,0	1.664,7	1.450,3	1.247,7	1.257,9	1.531,8	1.566,8	1.546,2	1.513,4
This submission	2.391,2	2.127,3	1.185,0	992,0	787,9	789,7	1.082,7	1.116,1	1.089,3	1.076,8

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Previous submission	1.539,4	1.585,9	1.655,1	1.705,7	1.702,5	1.679,1	1.881,7	1.752,6	1.654,3	
This submission	1.108,7	1.151,6	1.220,6	1.277,0	1.272,6	1.250,5	1.455,7	1.322,5	1.270,9	1.375,1

6.4.2 Pasture, range and paddock manure

Direct N_2O emissions from pasture, range and paddock manure were calculated according to the same methodology used for estimation of N_2O emissions from manure management (see Chapter "Calculation of N_2O emissions").

6.4.3 Indirect emissions from agricultural soils

In addition to the direct emission of N_2O from managed soils that occur through a direct pathway, emission of N_2O also take place through two indirect pathways. The first of these pathways is the volatilisation of N as NH_3 and oxides of N (NOx), and the deposition of these gases and their products $NH_4$and NO_3onto soils and the surface of lakes and other waters. The second pathway is the leaching and runoff from land of N from synthetic and organic fertiliser additions, crop residues, mineralization of N associated with loss of soil C in mineral and drained/managed organic soils through land-use change or management practices, and urine and dung deposition from grazing animals[59].

6.4.3.1 Source category description

As indirect emissions of N_2O, emissions from leaching and runoff of the applied or deposited on soils Nitrogen and atmospheric deposition on soils of NO_X and ammonium were estimated.

6.4.3.2 Methodological issues

[59] IPCC 2006. N_2O emissions from managed soils. P. 11.19.

Atmospheric deposition in our calculations includes the emission from livestock manure and use of synthetic fertilisers applied to agricultural soils.

According to the IPCC Guidelines, the amount of applied agricultural N that volatilises and subsequently deposits on nearby soils is equal to the total amount of synthetic fertiliser nitrogen applied to soils (N_{FERT}) plus the total amount of animal manure nitrogen excreted in the country multiplied by appropriate volatilisation factors. The volatilised N is then multiplied by an emission factor for atmospheric deposition (Table 6-33) to estimate N_2O emissions[60]:

$$N_2O_{(atmospheric\ deposition)} = (N_{FERT} \text{ x } Frac_{GASF} + N_{EX} \text{ x } Frac_{GASM}) \text{ x } EF_{deposited}$$

where :

N_{FERT} – total amount of synthetic nitrogen fertiliser applied to soils, kg N/year
$Frac_{GASF}$ –fraction of synthetic fertiliser nitrogen applied to soils that volatilises as NH3 and NOx (kg NH_3 – N and NOx–N/kg of N input)
N_{EX} –total amount of animal manure nitrogen excreted in a country, kg N/year
$Frac_{GASM}$ –fraction of livestock nitrogen excretion that volatilises as NH_3 and NOx (kg NH_3-N and NOx–N/kg of N excreted)
$EF_{deposited}$ – emission factor for atmospheric deposition (kg N_2O-N/kg NH_3-N and NOx–N emitted)

Conversion of N_2O-N emissions to N_2O emissions is performed by the following equation:

$$N_2O = N_2O\text{-}N \text{ x } 44/28$$

Table 6-33. IPCC default factors used in the estimation of indirect nitrous oxide emissions from atmospheric deposition[61]

Factor	Unit
N_2O EF	0.01 kg N_2O-N/kg NH_4-N & NO_X-N deposited
$Frac_{GASF}$	0.1kg NH_3-N + NOx-N/kg of synthetic fertiliser N applied
$Frac_{GASM}$	0.2kg NH_3-N + NOx-N/kg of N excreted by livestock

To estimate the amount of applied N that leaches or runs off (N_{LEACH}) in country using the method in the IPCC Guidelines, the total amount of synthetic fertiliser nitrogen (N_{FERT}) applied to the soils and the total amount of animal N excretion in the country are summed and then multiplied by the fraction of N input that is lost through leaching and run-off ($Frac_{LEACH}$) (Table 6-34):

$$N_{LEACH} = (N_{FERT} + Nex) \text{ x } Frac_{LEACH}$$

where :

N_{FERT}–total amount of synthetic nitrogen fertiliser applied to soils, kg N/year
N_{EX}–total amount of animal manure nitrogen excreted in a country, kg N/year
$Frac_{LEACH}$ – fraction of nitrogen input to soils that is lost through leaching and runoff (kg N/kg of nitrogen applied)

N_{LEACH} is then multiplied by the emission factor for leaching/runoff (EF) to obtain emissions of N_2O in units of N, N_2O:

[60] IPCC 1996. Agriculture. P. 4.40.
[61] IPCC 1996. Agriculture. P. 4.94, 4.105

$$N_2O_{(LEACH)} = N_{LEACH} \times EF_{leaxed}$$

where :

N_{LEACH} – N leaching in country (kg N/year)
EF_{leaxed} – emission factor for leaching and runoff (kg N_2O-N/kg N leaching and runoff) (Table 6-34).

Conversion of N_2O–N emissions to N_2O emissions is performed by the following equation:

$$N_2O = N_2O\text{–}N \times 44/28$$

Table 6-34. IPCC default factors used in the estimation of indirect nitrous oxide emissions from nitrogen leaching and run- off[62]

Factor	Unit
N_2O EF	0.025kg N_2O-N/kg N
$Frac_{LEACH}$	0.3 kg NH_3-N + NOx-N/kg of synthetic fertiliser N applied

6.4.3.3 Calculated emissions

Indirect N_2O emissions from atmospheric deposition in 2009 were 142.5 Gg CO_2 eq., from Nitrogen leaching and runoff – 782,7 Gg CO_2 eq. Indirect N_2O emission from agriculture consisted approximately 40.2% of total emissions from soils (Fig. 6-5).

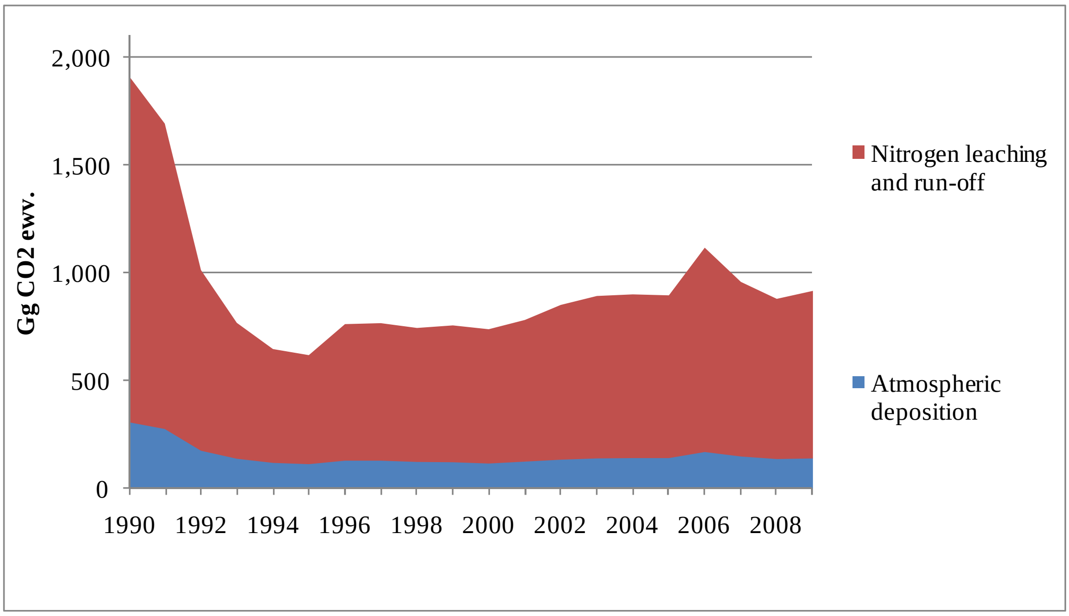


Fig. 6-5. Indirect N_2O emissions from agricultural soils in 1990–2009 (Gg CO_2 eq.)

6.4.3.4 Uncertainties

Information about emission factors, leaching and volatilisation fractions are sparse and highly variable. Expert judgement indicates that emission factor uncertainties are at least in order of magnitude and volatilisation fractions of about +/−50%[63].

[62] IPCC 1996. Agriculture. P. 4.105-4.106.
[63] IPCC 2000. Agriculture. P. 4.75.

6.4.3.5 Source-specific recalculations

Recalculations in the subsector “Indirect emissions from agricultural soils” are related with recalculations made in manure management subsector.

Table 6-31a. Reported in previous submission and recalculated indirect nitrous oxide emission from agricultural soils (Gg CO_2 eq.)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Previous submission	1.914,7	1.693,3	1.014,8	770,5	648,7	619,8	764,3	768,8	746,2	758,6
This submission	1.810,0	1.601,2	935,6	705,9	586,1	561,3	716,4	721,5	704,3	727,2
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Previous submission	740,0	783,7	853,1	894,5	902,6	897,3	1.118,6	960,4	881,3	918,5
This submission	714,1	754,4	823,9	871,2	878,1	874,4	1.099,7	935,0	889,0	925,1

6.5 Source-specific planned improvements

No improvements are planned.

6.6 Prescribed burning of savannas

Savannas do not exist in Lithuania.

6.7 Field burning of agricultural residues

Field burning of agricultural residues is prohibited by the legislation (Order of the Minister of Environment No 269 concerning the environmental protection requirements for burning of dry grass, reeds, straw and garden waste as amended. In force from September 9, 1999), therefore emission from field burning of agricultural residues is reported as “NO”.

7 LAND USE, LAND USE CHANGE AND FORESTRY (Sector 5)

7.1 Overview

7.1.1 National definitions for all categories used in the inventory

Forest land is defined in accordance Law on forests of the Republic of Lithuania: "Forest – a land area not less than 0.1 hectare in size covered with trees, the height of which in a natural site in the mature age is not less than 5 meters, other forest plants as well as thinned or vegetation-lost forest due to the acts of nature or human activities (cutting areas, burnt areas, clearings). Tree lines up to 10 meters of width in fields, at roadsides, water bodies, in living areas and cemeteries, single trees and bushes, parks planted and grown by man in urban and rural areas are not defined as forests. The procedures for care, protection and use of these plantings shall be established by the Ministry of Environment." Forest stands with stocking level (approximately equivalent to crown cover) less than 30% are not acceptable for high productivity forestry. This threshold is used for including of land areas into afforested land areas（Table 7-1）.

Table 7-1. Selected parameters defining forest in Lithuania for the reporting

Parameter	Value
Minimum land area	0.1 ha
Minimum crown cover	30 %
Minimum height	5 m

Cropland includes arable land and orchards and berry plantations.

Grassland includes meadows and natural pastures.

Wetlands are water bodies and swamps (bogs).

Settlements are urban territories and roads.

Other land is defined as land which does not assigned to other categories.

Information on extension of unmanaged forest and grassland

According to the Annex to draft decision -/CMP.1 (Land use. land-use change and forestry) contained in document FCCC/CP/2001/13/Add.1 definitions of forest management and grazing land management are the following:

Forest management is a system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner.

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

In accordance with these definitions, all forest land and grassland in Lithuania is managed and there is no unmanaged forest land or grassland.

7.1.2 Land use changes

Recorded land use variations in Lithuania (Table 7-2, Fig. 7-1) show significant fluctuations in 1987-1995. However, these fluctuations are mainly caused not so much by actual land use changes but by modifications of definitions used in statistics, dismantling of Soviet kolkhoz based agriculture system and introduction of private land ownership after the declaration of independence of Lithuania in 1990. From 1995, implementation of new principles of agricultural statistics was finalised and data fluctuations came to an end.

Table 7-2. National land use data 1990-2009 (thou. ha)

Years	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Forest	1,945.1	1,949.8	1,954.5	1,959.2	1,963.9	1,968.6	1,973.3	1,978.0	1,992.0	2,006.0
Cropland	2,314.0	3,022.9	2,928.4	2,872.8	2,629.9	2,908.5	2,909.9	2,920.8	2,932.9	2,925.3
Grassland	1,111.0	400.7	371.6	380.4	359.0	435.5	441.3	435.2	439.8	445.9
Wetlands	411.8	411.8	411.8	411.8	411.8	411.8	411.8	411.8	411.8	411.8
Settlements	316.7	316.7	316.7	316.7	316.7	316.7	316.7	316.7	316.7	316.7
Other land	431.4	428.1	547.0	589.1	848.7	488.9	477.0	467.5	436.8	424.3
TOTAL	**6,530**	**6,530**	**6,530**	**6,530**	**6,530**	**6,530**	**6,530**	**6,530**	**6,530**	**6,530**

Continued

Years	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Forest	2,020,0	2,034,0	2,045,0	2,069,0	2,091,0	2,121,0	2,136,0	2,143,0	2,150,0	2,160,0
Cropland	2,920.7	2,917.7	2,917.5	2,915.0	2,916.2	2,915.0	2,987.6	2,987.9	2,989.8	2,987.7
Grassland	449.4	452.3	451.8	452.8	451.4	453.0	480.7	476.6	475.6	475.9
Wetlands	408.3	409.3	408.3	407.5	403.8	383.6	382.1	380.7	379.7	378.8
Settlements	318.3	319.6	320.2	320.5	316.8	313.7	312.2	312.2	312.2	312.3
Other land	413.3	397.1	387.2	365.2	350.8	343.7	231.4	229.6	222.7	215.3
TOTAL	**6,530**	**6,530**	**6,530**	**6,530**	**6,530**	**6,530**	**6,530**	**6,530**	**6,530**	**6,530**

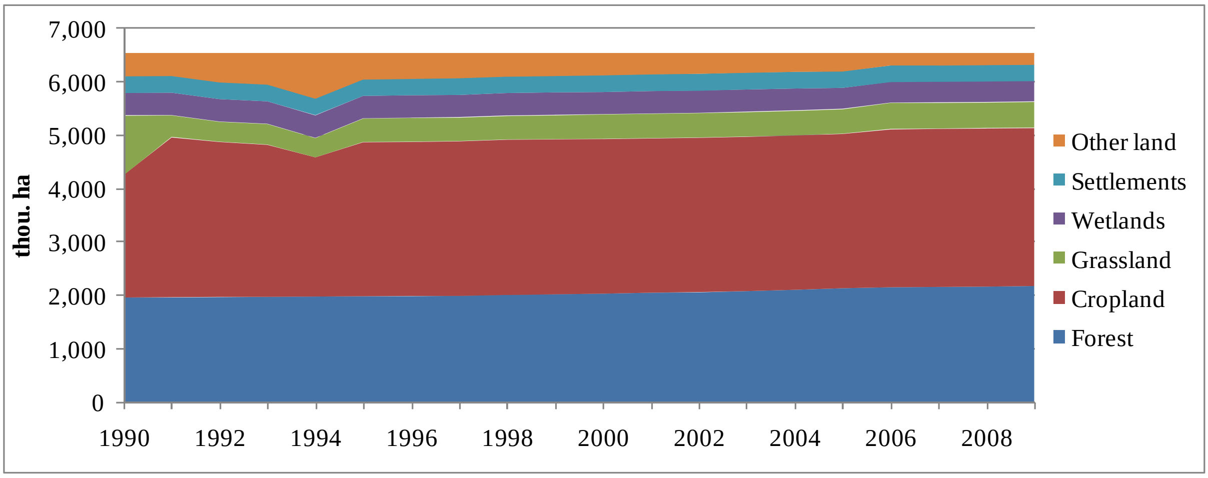


Fig. 7-1. Reported land use variations in Lithuania in 1990-2009

Forest fertilization is not applied in Lithuania. GHG emissions related to fertilization of agricultural soils were reported in Agriculture sector.

It was assumed that annual carbon stock changes in grasslands are negligible as grassland management activities in Lithuania are not changing. Liming is not applied on grasslands.

7.1.3 GHG sinks and releases

Summary of CO_2 emissions and sinks is provided in Table 7-3. Evaluated net CO2 sinks and releases in LULCF sector.

Table 7-3. Evaluated net CO_2 sinks and releases in LULCF sector

Year	Forest land	Cropland	Grassland	Wetland	Settlements	Other land	Total
1990	-5068.55	-	-	175.16	165.21	283.05	-4445.14
1991	-5109.18	-	-	121.99	79.46	136.14	-4771.59
1992	-5108.25	-	-	122.13	79.68	136.52	-4769.92
1993	-5107.33	-	-	112.85	79.90	136.90	-4777.66
1994	-5106.40	-	-	124.95	80.13	137.28	-4764.04
1995	-5105.47	-	-	124.67	80.35	137.66	-4762.79
1996	-5104.55	-	-	124.65	80.57	138.04	-4761.29
1997	-5103.62	-	-	117.17	80.79	138.42	-4767.25
1998	-5025.09	-	-	217.26	240.81	412.58	-4154.45
1999	-5022.34	-	-	217.10	240.96	412.85	-4151.42
2000	-5019.58	-	-	220.64	241.12	413.12	-4144.70
2001	-5213.93	-	-	220.98	241.31	413.45	-4338.19
2002	-5236.21	-	-	175.88	189.87	325.31	-4545.14
2003	-5125.56	-	-	307.29	413.71	708.82	-3695.74
2004	-5137.53	-	-	288.52	378.90	649.17	-3820.94
2005	-5066.44	-	-	375.31	515.38	883.01	-3292.73
2006	-4377.15	-	-	217.36	257.68	441.49	-3460.63
2007	-4440.95	-	-	131.14	120.44	206.35	-3983.02
2008	-4439.57	-	-	130.85	120.63	206.68	-3981.41
2009	-4413.14	-	-	163.42	172.49	295.53	-3781.70

7.2 Forest land

7.2.1 Source category description

7.2.1.1 Data sources

There are two main data sources used:

1) Lithuanian State Forest Cadastre (LSFC) based on standwise forest inventory;
2) National Forest Inventory (NFI) based on sampling and GIS methods.

Data sources of LSFC are standwise forest inventory with 10 years circle and relevant information of forest management from State Forest Enterprises and private forest owners. LSFC provides enough precise data about Forest land area since 1990. But it do not allow to observe land use changes. NFI provide objective and precise data associated with Afforestation, Reforestation, Deforestation and Forest Management since 1998. Also NFI data are used for harmonization of LSFC data in the period of 1990-1997 as well. All information about Forest land and Forest land use was provided by the State Forest Service.

Data on forest land area and its changes may be found in several sources of information. The source of forest area data is the *Lithuanian Statistical Yearbook of Forestry (2001-2009)*[64] published annually by the State Forest Service. The first *Yearbook* published in 2001 includes data for 1997 inventory (1 Jan. 1998).

Some additional information are provided in the *Lithuanian Country Report on Global Forest Resources Assessment (2005, 2010)* prepared by the State Forest Service. Specifically, the Report provides data of forest assessment in 1987 (1 Jan. 1988). Data on forest land areas changes are provided in *NFI annual reports (2007, 2008, 2009).*

The National Land Service under the Ministry of Agriculture provides data on the Lithuanian Land Fund including data on forest land area[65].

The National Forest Inventory by sampling method as a comprehensive and continuous monitoring of all Lithuanian forests was established in 1998. It was started by the State Forest Management and Inventory Institute under the Order No 129 of the Ministry of Agriculture and Forestry.

The aim of the NFI is to conduct a thorough monitoring of Lithuanian forests for efficient (of predefined accuracy) assessment of the main forest parameters in the country. The object of the national forest inventory is the whole territory of the country, which according to the Lithuanian Forest Law is qualified as land used for forests growing, independently of ownership category of holders. With the help of the NFI continuous control of the whole land area of the country is performed, ensuring observation of forest land changes (Deforestation, Afforestation).

The NFI is based on the method of continuous, combined, multistage sampling with partial replacement. Sampling of units is carried out systematically at random start by combining repeated inventory of permanent plots with the measurements of the temporary plots, and by combining overground measurements with the measurements and assessment on satellite image and aerial photos.

The first cycle of NFI began in 1998 and finished in 2002[66]. In 2003-2007, second cycle of NFI was carried out[67]. During the second inventory, which lasted five years, permanent plots allocated in 1998-2002 were remeasured. The results of NFI in 2003-2007 are important from the viewpoint that for the first time in the Lithuanian forest inventory practice gross volume increment, the extent of cuttings, the volumes of removable and dead trees on the country level were estimated by direct measurements, balance of the use of gross volume increment and changes of forest areas has been worked out.

7.2.1.2 Forest land area

Forest coverage in Lithuania was increasing continuously since the 2nd World War (Fig. 7-2). Average annual increase of forest area after the war was more than 14 thou. ha. From 1947 to 1960 expansion of forest area reached approximately 20 thou. ha per year. During sixties and nineties forest area was expanding at a slower rate, approximately 10 thou. ha per year.

[64] *State Forest Service*.
[65] *Land Fund of the Republic of Lithuania*
[66] Lithuanian National Forest Inventory 1998-2002. Sampling design, methods, results. State Forest Service, Kaunas, 2003
[67] Lithuanian National Forest Inventory 2003-2007. Sampling design, methods, results. State Forest Service, Kaunas, 2008

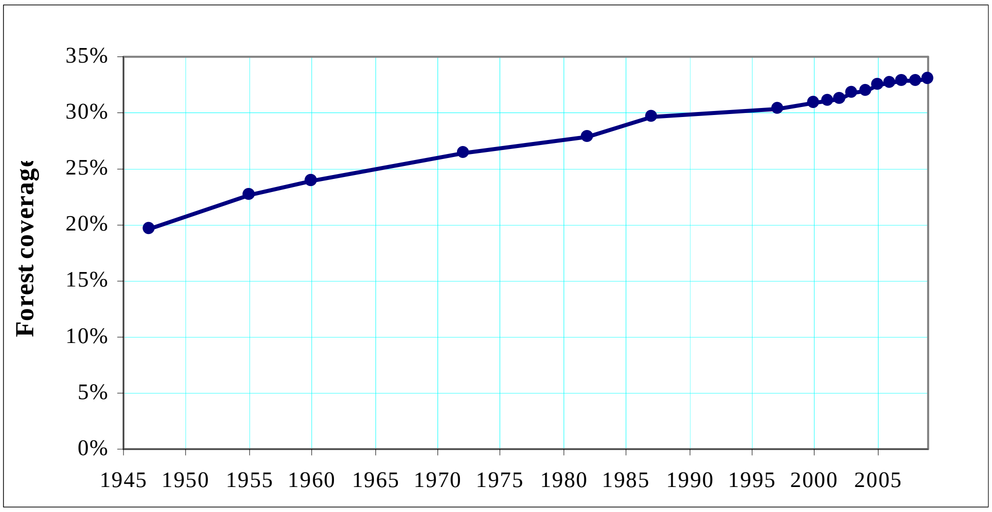


Fig. 7-2. Variation of forest coverage in Lithuania after the 2nd World War

Variations of total forest land area according coniferous and deciduous, area of afforestation and deforestation, area of 'Forest land remaining Forest land', and area of 'Land converted to Forest land' are provided in Table 7-4.

Table 7-4. Forest land area variations in 1990-2009 (thou. ha)

Year	Forest land			Changes of forest land area			Forest land remaining forest land	Land converted to forest land (≤ 20 years stands)
	Total	Coniferous	Deciduous	Affores-tation	Defores-tation	Annual change		
1990	1945.1	1018.8	926.3	10.7	0.9	9.8	1731.0	214.1
1991	1949.8	1021.3	928.5	5.1	0.4	4.7	1741.3	208.5
1992	1954.5	1023.8	930.7	5.1	0.4	4.7	1751.5	203.0
1993	1959.2	1026.2	933.0	5.1	0.4	4.7	1761.8	197.4
1994	1963.9	1028.7	935.2	5.1	0.4	4.7	1772.1	191.8
1995	1968.6	1031.1	937.5	5.1	0.4	4.7	1782.4	186.2
1996	1973.3	1033.6	939.7	5.1	0.4	4.7	1792.6	180.7
1997	1978.0	1036.1	941.9	5.1	0.4	4.7	1802.9	175.1
1998	1992.0	1089.5	902.5	15.3	1.3	14.0	1812.3	179.7
1999	2006.0	1059.1	946.9	15.3	1.3	14.0	1821.7	184.3
2000	2020.0	1070.0	950.0	15.3	1.3	14.0	1831.1	188.9
2001	2034.0	1068.6	965.4	15.3	1.3	14.0	1840.6	193.4
2002	2045.0	1063.4	981.6	12.0	1.0	11.0	1850.2	194.8
2003	2069.0	1080.2	988.8	26.2	2.2	24.0	1858.7	210.3
2004	2091.0	1089.1	1001.9	24.0	2.0	22.0	1867.4	223.6
2005	2121.0	1101.5	1019.5	32.8	2.8	30.0	1875.3	245.7
2006	2136.0	1103.7	1032.3	16.4	1.4	15.0	1884.7	251.3
2007	2143.0	1114.1	1028.9	7.6	0.6	7.0	1894.7	248.3
2008	2150.0	1114.8	1035.2	7.6	0.6	7.0	1904.8	245.2
2009	2160.0	1119.2	1040.8	10.9	0.9	10.0	1914.6	245.4

NFI provide data about distribution of forest land by forest soils composition too (Table 7-5). According NFI data the area of mineral soils amount 84 % and the area of organic soil - 16% of total forest area. The drained organic forest soils comprise 7.8% of total forest land. This area consist of 2.58% and 5.22% fertile drainaged organic forest soils.

Table 7-5. Forest land area according mineral and organic soils in 1990-2009 (thou. ha)

Year	Mineral soils	Organic soils			Total forest land
		Drained	Not drained	Total	
1990	1639.7	153.7	151.7	305.4	1945.1
1991	1643.7	154.0	152.1	306.1	1949.8
1992	1647.6	154.4	152.5	306.9	1954.5
1993	1651.6	154.8	152.8	307.6	1959.2
1994	1655.6	155.1	153.2	308.3	1963.9
1995	1659.5	155.5	153.6	309.1	1968.6
1996	1663.5	155.9	153.9	309.8	1973.3
1997	1667.5	156.3	154.3	310.5	1978.0
1998	1679.3	157.4	155.4	312.7	1992.0
1999	1691.1	158.5	156.5	314.9	2006.0
2000	1702.9	159.6	157.6	317.1	2020.0
2001	1714.7	160.7	158.7	319.3	2034.0
2002	1723.9	161.6	159.5	321.1	2045.0
2003	1744.2	163.5	161.4	324.8	2069.0
2004	1762.7	165.2	163.1	328.3	2091.0
2005	1788.0	167.6	165.4	333.0	2121.0
2006	1800.6	168.7	166.6	335.4	2136.0
2007	1806.5	169.3	167.2	336.5	2143.0
2008	1812.5	169.9	167.7	337.6	2150.0
2009	1820.9	170.6	168.5	339.1	2160.0

7.2.1.3 Living and dead trees volume in Forest land

Data on living and dead trees volume were provided by the State Forest Service (Table 7-6). The original data were calculated by sources of Lithuanian State Forest Cadastre and National Forest Inventory for 1990, 2000, 2005 and 2009. This data used for extrapolation of values for other years. Data shows that total volume of living tree stems increased from 413000.0 thousand m^3 in 1990 up to 476422.4 thousand m^3 in 2009. According to NFI data the mean growing stock volume for ‘Land converted to Forest land’ is 33.1 m^3 ha^{-1} in period 1990-2009.

The similar tendency as living trees was fixed with merchantable dead tree stems volume (Table 7-7). Total volume of dead tree stems increased from 10735.1 thousand m^3 in 1990 up to 19999.2 thousand m^3 in 2009. The tendency of not merchantable dead wood is not clear and assessment data is not significant. That is why assumed that carbon inputs and losses in not merchantable dead wood balance one another and net changes are close to zero. For *Global Forest Resources Assessment (2010)* by experts appreciate was assumed that total dead wood amount is 23 m^3 per ha and 10.9 million t organic carbon in all Forest land in 2010.

Table 7-6. Annual change of growing stock volume (thou. m^3)

Year	Growing stock volume			Annual change of growing stock volume		
	Coniferous	Deciduous	Total	Coniferous	Deciduous	Total
1990*	**234800.0**	**178200.0**	**413000.0**	**2020.0**	**1630.0**	**3650.0**
1991	236820.0	179830.0	416650.0	2020.0	1630.0	3650.0
1992	238840.0	181460.0	420300.0	2020.0	1630.0	3650.0
1993	240860.0	183090.0	423950.0	2020.0	1630.0	3650.0
1994	242880.0	184720.0	427600.0	2020.0	1630.0	3650.0
1995	244900.0	186350.0	431250.0	2020.0	1630.0	3650.0
1996	246920.0	187980.0	434900.0	2020.0	1630.0	3650.0
1997	248940.0	189610.0	438550.0	2020.0	1630.0	3650.0
1998	250960.0	191240.0	442200.0	2020.0	1630.0	3650.0
1999	252980.0	192870.0	445850.0	2020.0	1630.0	3650.0
2000*	**255000.0**	**194500.0**	**449500.0**	**2020.0**	**1630.0**	**3650.0**
2001	256540.0	195980.0	452520.0	1540.0	1480.0	3020.0
2002	258080.0	197460.0	455540.0	1540.0	1480.0	3020.0
2003	259620.0	198940.0	458560.0	1540.0	1480.0	3020.0
2004	261160.0	200420.0	461580.0	1540.0	1480.0	3020.0
2005*	**262700.0**	**201900.0**	**464600.0**	**1540.0**	**1480.0**	**3020.0**
2006	265288.4	202267.2	467555.6	2588.4	367.2	2955.6
2007	267876.8	202634.4	470511.2	2588.4	367.2	2955.6
2008	270465.2	203001.6	473466.8	2588.4	367.2	2955.6
2009*	**273053.6**	**203368.8**	**476422.4**	**2588.4**	**367.2**	**2955.6**

*Note: Original data in bold. Other data were extrapolated.

Table 7-7. Annual change of dead tree stem volume (thou. m^3)

Year	Dead trees volume			Annual change of dead trees volume		
	Coniferous	Deciduous	Total	Coniferous	Deciduous	Total
1990*	**6552.8**	**4182.4**	**10735.1**	**49.5**	**186.3**	**235.8**
1991	6602.3	4368.7	10971.0	49.5	186.3	235.8
1992	6651.8	4555.0	11206.8	49.5	186.3	235.8
1993	6701.3	4741.3	11442.6	49.5	186.3	235.8
1994	6750.7	4927.6	11678.4	49.5	186.3	235.8
1995	6800.2	5113.9	11914.2	49.5	186.3	235.8
1996	6849.7	5300.3	12150.0	49.5	186.3	235.8
1997	6899.2	5486.6	12385.8	49.5	186.3	235.8
1998	6948.7	5672.9	12621.6	49.5	186.3	235.8
1999	6998.2	5859.2	12857.4	49.5	186.3	235.8
2000*	**7047.7**	**6045.5**	**13093.2**	**49.5**	**186.3**	**235.8**
2001	7332.5	6779.3	14111.8	284.8	733.7	1018.6
2002	7617.4	7513.0	15130.4	284.8	733.7	1018.6
2003	7902.2	8246.7	16148.9	284.8	733.7	1018.6
2004	8187.0	8980.5	17167.5	284.8	733.7	1018.6
2005*	**8471.8**	**9714.2**	**18186.0**	**284.8**	**733.7**	**1018.6**
2006	8639.8	9999.5	18639.3	168.0	285.3	453.3
2007	8807.9	10284.8	19092.6	168.0	285.3	453.3
2008	8975.9	10570.1	19546.0	168.0	285.3	453.3

2009*	**9143.9**	**10855.4**	**19999.2**	**168.0**	**285.3**	**453.3**

*Note: Original data in bold. Other data were extrapolated.

7.2.1.4 Fellings

Annual volume increment of all Lithuanian forests, the size of fellings, mortality, accumulation and other parameters constituting the wood balance were assessed by the State Forest Service. Two types of volume increment were analysed: netto increment (growing stock volume accumulated in stands and volume of felled stems of living trees over bark) and gross increment (netto increment and volume of dead trees during the period of analysis). During 1990 – 2009 fellings intensity of commercial forests increased from 40 to 80 percent of mean annual netto increment. Growing stock volume accumulated in stands during period of analysis decreased from 50 to 20 percent. Increase of fellings volume is closely related to increase of mature stands area since 1990 to 2009. Dynamic of total gross annual volume increment, fellings, mortality and accumulation in all forest land during 1990-2009 is provided in Fig. 7-3.
Changes of accumulation of growing stock volume and volume of dead tree stems were used for estimation of annual carbon stock changes.

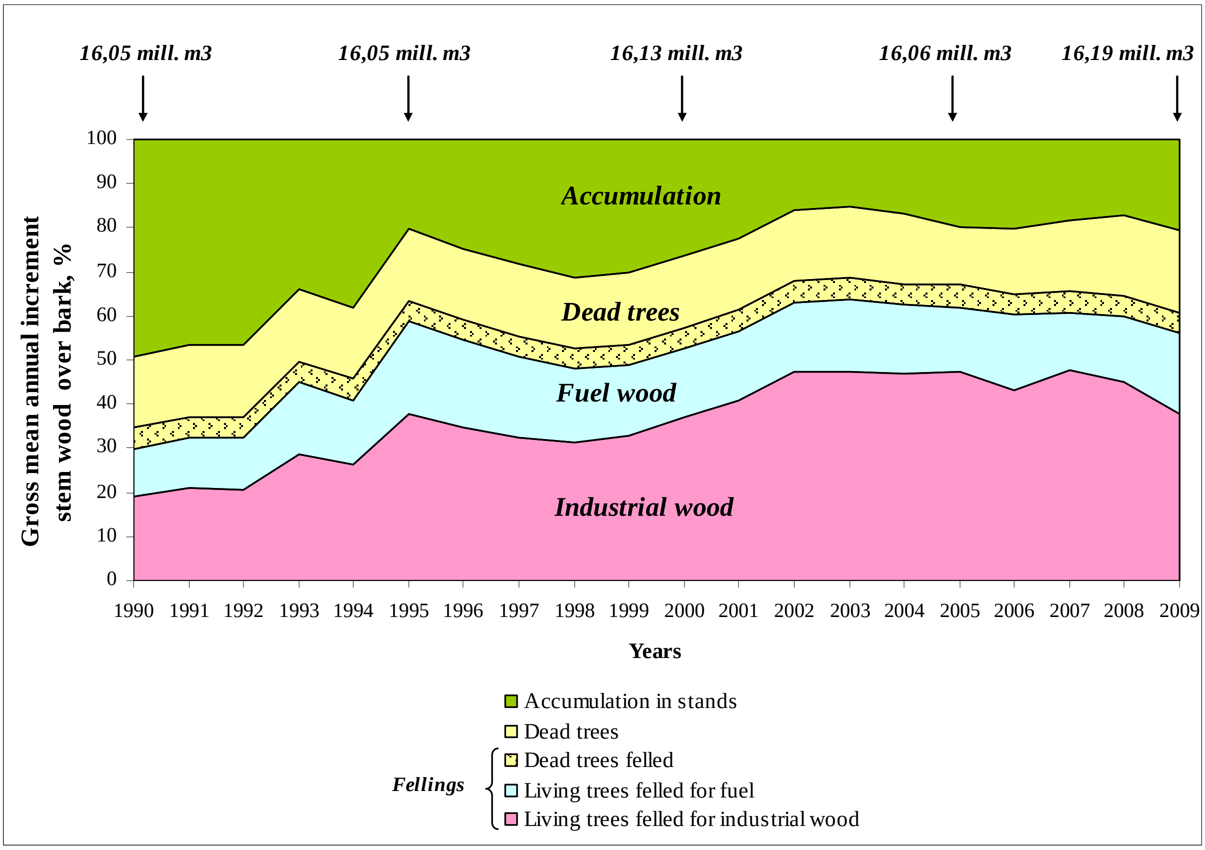


Fig. 7-3. Dynamic of gross annual volume increment, fellings, mortality and accumulation during 1990-2009

7.2.1.5 Biomass burning

Prescribed burning of forest biomass is not used in Lithuania.
Data on areas affected by forest fires are available from the *Statistical Yearbooks of Forestry* (1999-2009) and from the *Lithuanian Country Report on Global Forest Resources Assessment 2005* (1990-

1992 and 1998). Average value of available data were used for calculation of emissions during the remaining period (1993-1997).

7.2.1.6 Windbreaks and windfalls

Statistical Yearbooks of Forestry provides data on windbreaks and windfalls removals. However, according to the data collection principles used by State Forest Service, windbreaks and windfalls removals are included in round wood or fuel wood removals. Therefore, to avoid double counting, windbreaks and windfalls were not included in calculation of carbon losses due to disturbances.

7.2.1.7 Forest fertilization

Forest fertilization is not applied in Lithuania. Therefore, it was assumed that there are no direct emissions of N_2O from forest fertilization.

7.2.2 Methodological Issues

The algorithm for assessment of carbon stock:

$$\Delta C = \Delta C_{LB} + \Delta C_{DOM} + \Delta C_{Soils} \qquad (7.1)$$

Where:
ΔC – annual change in carbon stock in total forest land, t C yr^{-1};
ΔC_{LB} - annual change in carbon stock in living biomass (includes above- and below-ground biomass) in total forest land, t C yr^{-1};
ΔC_{DOM} - annual change in carbon stock in dead organic matter (includes dead wood and forest litter) in total forest land, t C yr^{-1};
ΔC_{Soils} - annual change in carbon stock in soils in total forest land, t C yr^{-1}.

7.2.2.1 Change in carbon stock in living biomass

Lithuania chose Method 2 which also called as the stock change method:

$$\Delta C_{LB} = (C_{t2} - C_{t1})/(t2 - t1) \text{ and } C = (AGB + BGB) \times CF \qquad (7.2)$$

Where:
ΔC_{LB} - annual change in carbon stock in living biomass (includes above- and below-ground biomass) in total forest land, t C yr^{-1};
C_{t2} – total carbon in biomass calculated at time t2, t C
C_{t1} – total carbon in biomass calculated at time t1, t C
AGB – above-ground biomass, t d. m.
BGB – below-ground biomass, t d. m.
CF – carbon fraction of dry matter (default = 0.5), t C $(\text{tonne d.m.})^{-1}$

7.2.2.2 Above-ground biomass

Calculation of above-ground biomass is based on volume of live trees stems with bark:

$$AGB = GS \times WD \times BEF \qquad (7.3)$$

Where:
AGB – above-ground biomass, t d. m.
GS – trees stems volume with bark, m^3

WD – basic wood density, t d. m. m^{-3}
BEF – biomass expansion factor

Basic wood density WD was estimated on the basis of data provided in Table 3A.1.9 of the *Good Practice Guidance for LULUCF*. Density values for coniferous and deciduous were calculated as weighed average values related to growing stock volume (see Table 7-8).

Table 7-8. Calculation of average basic wood density values

Species	Growing stock (mill. m^3). average 2002-2009	Basic wood density, tonnes d.m. m^{-3}	
		Separate species	Weighted average
Pine	190.6	0.42	
Spruce	762.4	0.40	
Total coniferous	**267.0**		**0.41**
Birch	83.2	0.51	
Aspen	34.0	0.35	
Black alder	41.2	0.45	
Grey alder	21.6	0.45	
Oak	11.2	0.58	
Ash	9.0	0.57	
Total deciduous	**200.1**		**0.47**
Overall total	**467.1**		**0.44**

Default values of biomass expansion factor BEF for conversion of trees stems volume with bark to above-ground tree biomass, were calculated by national tables of wood merchantable volume (for branches) and by leaves-needles biomass data of Usolcev (Усольцев В.А.. 2001; 2002; 2003). Rate of BEF for coniferous is 1.221 and 1.178 for deciduous. The rates of BEF are very similar with the rates in Table 3A.1.10 of the *Good Practice Guidance for LULUCF.*

7.2.2.3 Below-ground biomass

$$BGB = AGB \times (1 + R) \qquad (7.4)$$

Where:
BGB – below-ground biomass, t d. m.
AGB – above-ground biomass, t d. m.
R – root-to-shoot ratio, dimensionless

Default values of root-to-shoot ratio R are defined by data of Usolcev and Table 3.A.1.8 of *Good Practice Guidance for LULUCF*: 0.26 for coniferous and 0.19 for deciduous.

7.2.2.4 Carbon fraction of dry matter

Default value 0.5 tonne C (tonne d.m.)$^{-1}$ provided in the *Good Practice Guidance for LULUCF* was used for carbon fraction of dry matter *CF*.

7.2.2.5 Change in carbon stock in dead organic matter

IPCC Guidelines is provided two types of dead organic matter pools: 1) dead wood and 2) forest litter.

$\Delta C_{DOM} = C_{DW} + C_{LT}$

Where:
ΔC_{DOM} – annual change in carbon stocks in dead organic matter, t C yr^{-1}
C_{DW} – change in carbon stocks in dead wood, t C yr^{-1}
C_{LT} - change in carbon stocks in litter, t C yr^{-1}

Dead wood is calculated for 'Forest land remaining Forest land'. Biomass of dead trees stems is calculated by the same methods as living biomass. For 'Land converted to Forest Land' it was assumed that carbon inputs and losses in dead wood balance is equal one to another and net changes are close to zero.

It was assumed that carbon inputs and losses in litter in 'Forest Land remaining Forest land' balance is equal one to another and net changes are close to zero too. But some increase of litter carbon is closely connection with increase or decrease of area of 'Forest Land remaining Forest Land'. The area of 'Forest Land remaining Forest Land' increase in 10.7 thou. ha from area of 'Land converted to Forest Land' yearly since 1990 to 2009.

The average value of carbon stock in litter is 24 t per ha. It was calculated for Forest land by values of cold temperate dry and moist region from Table 3.2.1 of *Good Practice Guidance for LULUC* (*Lithuanian Country Report on Global Forest Resources Assessment 2005. 2010).* It was assumed that such average value of carbon in litter was accumulated in area of 'Land converted to Forest Land' in 20 year period, and after that comes as inputs in area of 'Forest Land remaining Forest Land'. The carbon losses in litter defined with losses area of 'Forest Land remaining Forest Land' by Deforestation (0.4 – 2.8 thou. ha per year in 1990 – 2009).

For 'Land converted to Forest Land' it was assumed that there is no dead organic matter at the moment of conversion. After conversion, dead organic matter starts to accumulate and reaches steady state in 20 years at the end of conversion period.

7.2.2.6 Change in carbon stock in soils

The shares of carbon inputs and losses in soils were calculated by same principle as in forest litter. Some increase of soil carbon is in close connection with increase or decrease of area of 'Forest Land remaining Forest Land'.

The average value of carbon stock in soils is 72 t per ha. There are 69 t per ha in mineral soils and 87 t per ha in organic soils. It was calculated for Forest land by values of cold temperate dry and moist region from Table 3.2.4 of *Good Practice Guidance for LULUC* (*Lithuanian Country Report on Global Forest Resources Assessment 2005. 2010).*

Carbon stock change in drained organic forest soils was calculated using equation 3.2.15 of the *IPCC Good Practice Guidance for LULUCF* :

$\Delta C_{FOS} = A_{Drainage} \times EF_{Drainage}$

Where:
ΔC_{FOS} - CO_2 emissions from drained organic forest soils, t C yr^{-1}
$A_{Drainage}$ - area of drained organic forest soils, ha
$EF_{Drainage}$ - emission factor for CO_2 from drained organic forest soils, t C ha^{-1} yr^{-1}

Default value of emission factor for drained organic soils in managed forests provided in Table 3.2.3 of the *IPCC Good Practice Guidance for LULUFC* (P. 3.42) was used in calculations. Default $EF_{Drainage}$ for temperate forests is 0.68 tonnes C ha^{-1} yr^{-1}.

7.2.2.7 Biomass Burning

Carbon release from burnt biomass was calculated using equation 3.2.19 of the *IPCC Good Practice Guidance for LULUCF* :

$L_{fire} = A \times B \times C \times D \times 10^{-6}$

Where:
L_{fire} – quantity of GHG released due to fire, tonnes of GHG
A – area burnt, ha
B – mass of 'available' fuel, kg d.m. ha^{-1}
C – combustion efficiency (or fraction of biomass combusted), dimensionless
D – emission factor, g (kg d.m.)$^{-1}$

Values of biomass stocks for remaining years were taken from the Table 3A.1.13 of the *Good Practice Guidance for LULUCF*. Mean value for wildfire of temperate forest is 19.8 t per ha. Combustion efficiency *C* is taken from Table 3A.1.12 of the *Good Practice Guidance for LULUCF* (0.45). Emission factor *D* is calculated as average of two values (1531 and 1580 g/kg) of CO_2 in Table 3A.1.16 of the *Good Practice Guidance for LULUCF*. The emission ratios of CH_4 (0.012) and N_2O (0.007) are taken from Table 3A.1.15 of the *Good Practice Guidance for LULUCF*.

7.2.3 Quantitative overview carbon emissions/removals from forest land

7.2.3.1 Carbon stock change in living biomass

The area and growing stock volume in 'Forest land remaining Forest land' were increased annually since 1990 to 2009 (Table 7-9). Area of 'Land converted to Forest land' had not stable increase or decrease tendency in 1990 – 2009. The fluctuation of growing stock volume was closely connected with area change in 'Land converted to Forest land', because selected default mean growing stock value (33.1 m^3 ha$^-$1) is stable.

Table 7-9. Annual increase/decrease of growing stock volume in forest land remaining forest land and land converted to forest land

Year	Forest land remaining forest land				Land converted to forest land (≤ 20 years stands)				Total, m^3
	Annual change of area, thou. ha	Conife-rous, m^3	Decidu-ous, m^3	Total, m^3	Annual change of area, thou. ha	Conife-rous, m^3	Decidu-ous, m^3	Total, m^3	
1990	9.8	2020105.7	1630078.6	3650184.4	-5.6	-105.7	-78.6	-184.4	3650000.0
1991	10.3	2020105.7	1630078.6	3650184.4	-5.6	-105.7	-78.6	-184.4	3650000.0
1992	10.3	2020105.7	1630078.7	3650184.4	-5.6	-105.7	-78.7	-184.4	3650000.0
1993	10.3	2020105.6	1630078.8	3650184.4	-5.6	-105.6	-78.8	-184.4	3650000.0
1994	10.3	2020105.6	1630078.8	3650184.4	-5.6	-105.6	-78.8	-184.4	3650000.0
1995	10.3	2020105.5	1630078.9	3650184.4	-5.6	-105.5	-78.9	-184.4	3650000.0
1996	10.3	2020105.4	1630079.0	3650184.4	-5.6	-105.4	-79.0	-184.4	3650000.0
1997	10.3	2020105.4	1630079.0	3650184.4	-5.6	-105.4	-79.0	-184.4	3650000.0
1998	9.4	2019914.5	1629933.6	3649848.1	4.6	85.5	66.4	151.9	3650000.0
1999	9.4	2019914.5	1629933.6	3649848.1	4.6	85.5	66.4	151.9	3650000.0
2000	9.4	2019914.5	1629933.6	3649848.1	4.6	85.5	66.4	151.9	3650000.0

2001	9.4	1539916.3	1479931.8	3019848.1	4.6	83.7	68.2	151.9	3020000.0
2002	9.7	1539977.8	1479978.8	3019956.6	1.3	22.2	21.2	43.4	3020000.0
2003	8.5	1539711.7	1479774.9	3019486.6	15.5	288.3	225.1	513.4	3020000.0
2004	8.7	1539753.0	1479805.9	3019558.9	13.3	247.0	194.1	441.1	3020000.0
2005	7.9	1539589.7	1479679.9	3019269.7	22.1	410.3	320.1	730.3	3020000.0
2006	9.3	2588277.4	367134.6	2955412.0	5.7	122.6	65.4	188.0	2955600.0
2007	10.1	2588441.5	367259.7	2955701.2	-3.1	-41.5	-59.7	-101.2	2955600.0
2008	10.1	2588442.1	367259.1	2955701.2	-3.1	-42.1	-59.1	-101.2	2955600.0
2009	9.8	2588380.5	367212.2	2955592.8	0.2	19.5	-12.2	7.2	2955600.0

The total living biomass was increased annually in 'Forest land remaining Forest land' since 1990 to 2009 (Table 7-10). The mean value of carbon stock yearly change is about 1000 Gg. The living biomass decrease periods for 'Land converted to Forest land' was fixed in 1990-1997 and in 2007-2008, and it closely connected with decrease of area in 'Land converted to Forest land'. The carbon stock change values are varying in -0.06 – 0.23 Gg per year interval.

Table 7-10. Annual increase in carbon stock due to living biomass increment in forest land

Year	**Forest land remaining forest land**				**Land converted to forest land (≤ 20 years stands)**				**Total Carbon stock change, Gg**
	Above-ground biomass stock change, t d. m.	Below-ground biomass stock change, t d. m.	Total living biomass stock change, t d. m.	Carbon stock change, Gg	Above-ground biomass stock change, t d. m.	Below-ground biomass stock change, t d. m.	Total living biomass stock change, t d. m.	Carbon stock change, Gg	
1990	1913794.5	434410.9	2348205.4	**1174.10**	-96.5	-22.0	-118.5	**-0.06**	**1174.04**
1991	1913794.5	434410.9	2348205.4	**1174.10**	-96.5	-22.0	-118.5	**-0.06**	**1174.04**
1992	1913794.5	434410.9	2348205.4	**1174.10**	-96.5	-22.0	-118.5	**-0.06**	**1174.04**
1993	1913794.5	434410.9	2348205.4	**1174.10**	-96.5	-22.0	-118.5	**-0.06**	**1174.04**
1994	1913794.5	434410.9	2348205.4	**1174.10**	-96.5	-22.0	-118.5	**-0.06**	**1174.04**
1995	1913794.5	434410.9	2348205.4	**1174.10**	-96.5	-22.0	-118.5	**-0.06**	**1174.04**
1996	1913794.5	434410.9	2348205.4	**1174.10**	-96.5	-22.0	-118.5	**-0.06**	**1174.04**
1997	1913794.5	434410.9	2348205.4	**1174.10**	-96.5	-22.0	-118.5	**-0.06**	**1174.04**
1998	1913618.5	434370.8	2347989.2	**1173.99**	79.5	18.1	97.6	**0.05**	**1174.04**
1999	1913618.5	434370.8	2347989.2	**1173.99**	79.5	18.1	97.6	**0.05**	**1174.04**
2000	1913618.5	434370.8	2347989.2	**1173.99**	79.5	18.1	97.6	**0.05**	**1174.04**
2001	1590276.6	356115.4	1946391.9	**973.20**	79.6	18.1	97.7	**0.05**	**973.24**
2002	1590333.4	356128.3	1946461.7	**973.23**	22.8	5.1	28.0	**0.01**	**973.24**
2003	1590087.2	356072.2	1946159.5	**973.08**	269.0	61.2	330.2	**0.17**	**973.24**
2004	1590125.1	356080.9	1946206.0	**973.10**	231.1	52.6	283.7	**0.14**	**973.24**
2005	1589973.6	356046.4	1946020.0	**973.01**	382.6	87.1	469.7	**0.23**	**973.24**
2006	1498985.3	375507.4	1874492.7	**937.25**	97.6	22.8	120.4	**0.06**	**937.31**
2007	1499136.7	375542.0	1874678.7	**937.34**	-53.8	-11.7	-65.5	**-0.03**	**937.31**
2008	1499136.7	375542.0	1874678.7	**937.34**	-53.8	-11.7	-65.5	**-0.03**	**937.31**
2009	1499079.9	375529.0	1874608.9	**937.30**	3.0	1.2	4.2	**0.002**	**937.31**

7.2.3.2 Carbon stock change in dead organic matter

Dead wood is calculated for 'Forest land remaining Forest land'. For 'Land converted to Forest Land' it was assumed that carbon inputs and losses in dead wood balance one another and net changes are close to zero. Table 7-11 provides values of biomass stock change and carbon stock change in dead wood. The data shoes tendency of annual accumulating of dead wood in forest land since 1990 to 2009.

Carbon stock change in forest litter is close connected with area increase in ‘Forest land remaining Forest land’.

Table 7-11. Annual increase in carbon stock due to dead organic matter increment in ‘Forest land remaining forest land’

Year	Dead wood				Forest litter			Total carbon stock change in dead organic matter, Gg
	Above-ground biomass stock change, t d. m.	Below-ground biomass stock change, t d. m.	Total biomass stock change, t d. m.	Carbon stock change, Gg	Increase in area, thou. ha	Carbon stock, t ha^{-1}	Carbon stock change, Gg	
1990	127932.1	26041.4	153973.5	77.0	9.8	24.0	235.1	312.1
1991	127932.1	26041.4	153973.5	77.0	10.3	24.0	246.4	323.4
1992	127932.1	26041.4	153973.5	77.0	10.3	24.0	246.4	323.4
1993	127932.1	26041.4	153973.5	77.0	10.3	24.0	246.4	323.4
1994	127932.1	26041.4	153973.5	77.0	10.3	24.0	246.4	323.4
1995	127932.1	26041.4	153973.5	77.0	10.3	24.0	246.4	323.4
1996	127932.1	26041.4	153973.5	77.0	10.3	24.0	246.4	323.4
1997	127932,1	26041.4	153973.5	77.0	10.3	24.0	246.4	323.4
1998	127932.1	26041.4	153973.5	77.0	9.4	24.0	225.8	302.8
1999	127932.1	26041.4	153973.5	77.0	9.4	24.0	225.8	302.8
2000	127932.1	26041.4	153973.5	77.0	9.4	24.0	225.8	302.8
2001	548827.1	114258.3	663085.4	331.5	9.4	24.0	225.8	557.3
2002	548827.1	114258.3	663085.4	331.5	9.7	24.0	232.4	564.0
2003	548827.1	114258.3	663085.4	331.5	8.5	24.0	203.6	535.2
2004	548827.1	114258.3	663085.4	331.5	8.7	24.0	208.1	539.6
2005	548827.1	114258.3	663085.4	331.5	7.9	24.0	190.3	521.9
2006	242060.1	51878.8	293938.9	147.0	9.3	24.0	223.6	370.5
2007	242060.1	51878.8	293938.9	147.0	10.1	24.0	241.3	388.3
2008	242060.1	51878.8	293938.9	147.0	10.1	24.0	241.3	388.3
2009	242060.1	51878.8	293938.9	147.0	9.8	24.0	234.6	381.6

The carbon stock increased by expand of are mineral and organic soils in ‘Forest land remaining Forest land’. Table 7-12 provides data about increase of area and carbon stock change in mineral and organic soils. The carbon emissions amount about 100 Gg per year in drained soils.

Table 7-12. Annual carbon stock change in soil

Year	Mineral soils			Organic soils					
				All organic soils			Drained soils		Carbon stock change, Gg
	Increase in area, thou. ha	Mean carbon stock, t ha^{-1}	Carbon stock change, Gg	Increase in area, thou. ha	Mean carbon stock, t ha^{-1}	Carbon stock change, Gg	Area, thou. ha	Carbon emissions, Gg	
1990	8.3	69.0	0.57	1.5	87.0	0.13	305.4	-104.49	-104.36
1991	8.7	69.0	0.60	1.6	87.0	0.14	306.1	-104.74	-104.60
1992	8.7	69.0	0.60	1.6	87.0	0.14	306.9	-105.00	-104.86
1993	8.7	69.0	0.60	1.6	87.0	0.14	307.6	-105.25	-105.11
1994	8.7	69.0	0.60	1.6	87.0	0.14	308.3	-105.50	-105.36

1995	8.7	69.0	0.60	1.6	87.0	0.14	309.1	-105.75	-105.61
1996	8.7	69.0	0.60	1.6	87.0	0.14	309.8	-106.01	-105.87
1997	8.7	69.0	0.60	1.6	87.0	0.14	310.5	-106.26	-106.12
1998	7.9	69.0	0.55	1.5	87.0	0.13	312.7	-107.01	-106.88
1999	7.9	69.0	0.55	1.5	87.0	0.13	314.9	-107.76	-107.63
2000	7.9	69.0	0.55	1.5	87.0	0.13	317.1	-108.51	-108.39
2001	7.9	69.0	0.55	1.5	87.0	0.13	319.3	-109.27	-109.14
2002	8.2	69.0	0.56	1.5	87.0	0.13	321.1	-109.86	-109.73
2003	7.2	69.0	0.49	1.3	87.0	0.12	324.8	-111.15	-111.03
2004	7.3	69.0	0.50	1.4	87.0	0.12	328.3	-112.33	-112.21
2005	6.7	69.0	0.46	1.2	87.0	0.11	333.0	-113.94	-113.83
2006	7.9	69.0	0.54	1.5	87.0	0.13	335.4	-114.75	-114.62
2007	8.5	69.0	0.58	1.6	87.0	0.14	336.5	-115.12	-114.98
2008	8.5	69.0	0.58	1.6	87.0	0.14	337.6	-115.50	-115.36
2009	8.2	69.0	0.57	1.5	87.0	0.13	339.1	-116.04	-115.90

7.2.3.3 Biomass burning

The mean burned biomass value per ha is default and carbon emissions are closely connected with burned area (Table 7-13). The most carbon emissions were fixed in 1992 (3.63 Gg) and in 2006 (4.49 Gg).

Table 7-13. Annual carbon stock change due to biomass burning

Year	Area burned, ha	Burned biomass, t d.m.	Carbon emissions, Gg
1990	134.0	2653.2	0.50
1991	64.0	1267.2	0.24
1992	971.0	19225.8	3.63
1993	355.0	7029.0	1.33
1994	355.0	7029.0	1.33
1995	355.0	7029.0	1.33
1996	355.0	7029.0	1.33
1997	355.0	7029.0	1.33
1998	54.0	1069.2	0.20
1999	342.9	6789.8	1.28
2000	327.1	6476.0	1.22
2001	111.1	2200.6	0.42
2002	716.8	14192.8	2.68
2003	436.2	8636.2	1.63
2004	253.2	5013.4	0.95
2005	50.8	1006.6	0.19
2006	1199.0	23740.2	4.49
2007	38.0	752.4	0.14
2008	112.4	2225.5	0.42
2009	315.3	6242.9	1.18

7.2.4 Uncertainties

The growing stock volume per 1 ha of all Lithuanian forests was estimated with 0.8% accuracy (under probability 0.683). The lowest standard error (1.3%) was estimated in pine (dominant species in Lithuania) stands and the highest (5.1%) in ash and oak stands.

Gross volume increment estimation errors are close to growing stock volume errors – gross volume increment was estimated with 0.7% accuracy, while the least error was estimated in pine stands – 1.2%, the highest in ash stands – 4.8% and oak stands – 4.4%.

For forest land remaining forest land it was assumed that overall uncertainty of activity data is 1%. Emission factor uncertainty was assumed to be about 5%.

For land converted to forest land it was assumed that overall uncertainty of activity data is 40%. Emission factor uncertainty was assumed to be about 10%.

7.2.5 Source specific recalculation

Lithuanian State Forest Service according to Order of the Ministry of Environment is responsible for calculation of CO_2 emissions for Forest land in LULUCF sector since 29 07 2010.
All calculations for 1990 – 2008 were checked and improved for NIR 2009. There were detected a few serious problems in previous calculations.
Firstly, data for calculations were taken from different sources. For 2008 calculations were used Stand Forest Inventory (SFI) data. For 2009 calculations were used National Forest Inventory (NFI) by sampling method data, in some cases harmonised with SFI data.
Secondly, for 2008 calculations was used total gross increment and not accounted volume of dead trees.
Thirdly, for carbon losses by fellings in 2008 was used merchantable wood volume instead volume of stemwood in 2009 calculations.
For NIR 2009 was selected Method 2 (stock change method) to guarantee the control of all process by using series of gross increment and its structure data. Having data about increment and its structure: volume of changes, fellings, dead trees estimated by the direct measurements on permanent plots since 1998 and by the boring of trees and measurements of stumps and dead trees for the period 1988-1997, accepted method allows more precisely to calculate CO_2 emissions.
All data used for calculation of CO_2 emissions were harmonized with data for Global **Forest Resources Assessment** (FRA 2010), with data in various questionnaires for **United Nations Economic Commission for Europe** (2010) and for Ministerial Conference on the Protection of Forest in Europe (SOEF 2011).
Impact of recalculation on CO_2 emissions from forest land is shown in Table 7-14.

Table 7-14. Impact of recalculation on CO_2 emissions (Gg) from forest land

	Previous submission	This submission	Difference	
			Gg	%
1990	-15,953	-5,068	10,885	-68.23
1991	-15,744	-5,109	10,636	-67.55
1992	-15,766	-5,105	10,662	-67.62
1993	-14,519	-5,106	9,413	-64.83
1994	-15,033	-5,105	9,928	-66.04
1995	-13,183	-5,104	8,079	-61.28
1996	-13,725	-5,103	8,622	-62.82
1997	-14,199	-5,102	9,097	-64.07
1998	-14,584	-5,025	9,559	-65.55

1999	-14,587	-5,021	9,566	-65.58
2000	-14,219	-5,018	9,201	-64.71
2001	-13,937	-5,214	8,723	-62.59
2002	-13,410	-5,234	8,176	-60.97
2003	-12,876	-5,124	7,752	-60.21
2004	-13,940	-5,137	8,803	-63.15
2005	-14,031	-5,066	8,965	-63.89
2006	-13,897	-4,373	9,525	-68.54
2007	-13,446	-4,441	9,005	-66.97
2008	-14,081	-4,439.2	9,641	-68.47

There was improved CO_2 emissions data for biomass burning in forest land (Table 7-15, Table 7-16, Table 7-17). In the last years was assumed, that in burned forest area burnt all volume of trees. But this fact is not match to reality. Values of biomass stocks for remaining years were taken from the Table 3A.1.13 of the *Good Practice Guidance for LULUCF*. Mean value for wildfire of temperate forest is 19.8 t per ha.

Table 7-15. Impact of recalculation on CO_2 emissions (Gg) from biomass burning in forest land

Year	Previous submission	This submission	Difference
1990	2.38	0.50	1.88
1991	1.14	0.24	0.90
1992	17.39	3.63	13.76
1993	5.66	1.33	4.33
1994	5.69	1.33	4.36
1995	5.71	1.33	4.39
1996	5.74	1.33	4.41
1997	5.77	1.33	4.44
1998	0.99	0.20	0.79
1999	6.34	1.28	5.06
2000	6.08	1.22	4.85
2001	2.07	0.42	1.66
2002	13.43	2.68	10.75
2003	8.24	1.63	6.61
2004	4.81	0.95	3.86
2005	0.97	0.19	0.78
2006	22.78	4.49	18.29
2007	0.72	0.14	0.58
2008	2.16	0.42	1.74

Table 7-16. Impact of recalculation on CH_4 emissions (Gg CO_2 eqv.) from biomass burning in forest land

Year	Previous submission	This submission	Difference
1990	0.80	0.17	0.63
1991	0.38	0.08	0.30

1992	5.84	1.22	4.62
1993	1.90	0.45	1.45
1994	1.91	0.45	1.46
1995	1.92	0.45	1.47
1996	1.93	0.45	1.48
1997	1.94	0.45	1.49
1998	0.33	0.07	0.26
1999	2.13	0.43	1.70
2000	2.04	0.41	1.63
2001	0.70	0.14	0.56
2002	4.51	0.90	3.61
2003	2.77	0.55	2.22
2004	1.62	0.32	1.30
2005	0.32	0.06	0.26
2006	7.65	1.51	6.14
2007	0.24	0.05	0.19
2008	0.72	0.14	0.58

Table 7-17. Impact of recalculation on N_2O emissions (Gg CO_2 eqv.) from biomass burning in forest land

Year	Previous submission	This submission	Difference
1990	0.08	0.02	0.06
1991	0.04	0.01	0.03
1992	0.59	0.12	0.47
1993	0.19	0.05	0.15
1994	0.19	0.05	0.15
1995	0.19	0.05	0.15
1996	0.20	0.05	0.15
1997	0.20	0.05	0.15
1998	0.03	0.01	0.03
1999	0.22	0.04	0.17
2000	0.21	0.04	0.17
2001	0.07	0.01	0.06
2002	0.46	0.09	0.37
2003	0.28	0.06	0.23
2004	0.16	0.03	0.13
2005	0.03	0.01	0.03
2006	0.78	0.15	0.62
2007	0.02	0.00	0.02
2008	0.07	0.01	0.06

7.3 Cropland

7.3.1 Source category description

Data on land use covering all area of Lithuania are provided in the *Statistical Yearbook: Agriculture in Lithuania*. Since 2004 data are provided from *National Land Service under the Ministry of Agriculture*. Variations of agricultural land use from 1986 as reported in the *Yearbook* are shown in Fig. 7-4. As may be seen from the diagram, substantial changes in land use were recorded from 1990 to 1995 while very insignificant variations occurred before and after this period.

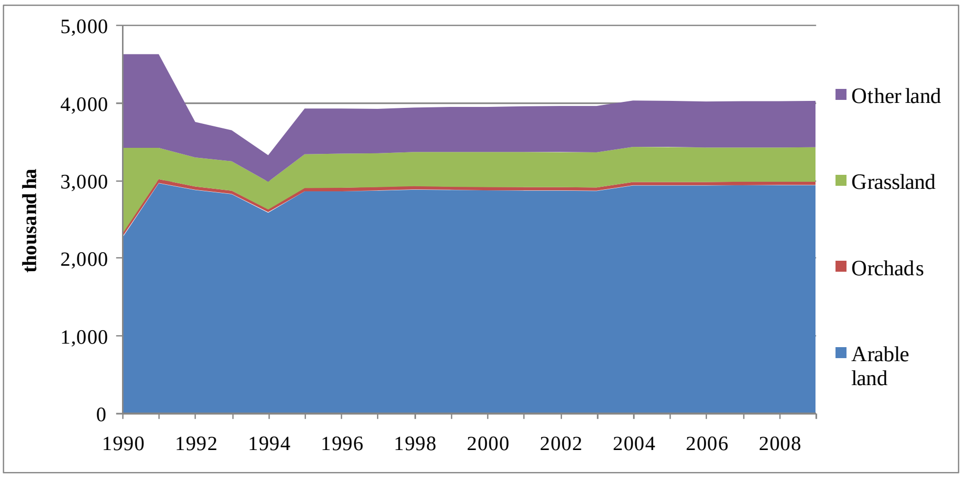


Fig. 7-4. Land use in Lithuanian agriculture sector

Source: Agriculture in Lithuania. Statistics Lithuania, 1990-2004 and National Land Service under the Ministry of Agriculture,2004-2009

Recorded variations in 1990-1995 are mainly related not so much to actual changes of land use but to modifications of definitions used in statistics, dismantling of Soviet kolkhoz based agriculture system and introduction of private land ownership after the declaration of independence of Lithuania. Land reform started immediately after the proclamation of independence in 1990 and the most important features of land reform were restitution of land ownership and, as a result of this, break up of kolkhoz farms to smaller private farms.

Substantial reduction of recorded grassland and corresponding increase of recorded cropland in 1991 was caused by change of definition of arable land which, from 1991 onwards, included sown perennial grasses assigned to meadows and pastures in the Soviet statistics. Further, following break up of kolkhoz farms, significant part of non-arable land formerly owned by kolkhozes and categorised as “other land” was assigned to specific land use categories, e.g. settlements, wetlands, etc. Other consequence of kolkhoz break-up was that some arable land became ownerless and temporary “disappeared” from the statistics. This phenomenon caused gradual reduction of recorded arable land from 1991 to the minimum level in 1994. From 1995, implementation of new principles of agricultural statistics was finalised and data fluctuations came to an end.

Therefore, though statistical data show substantial fluctuations, it was assumed that no significant conversion of cropland to other uses and conversion of land from other uses to cropland has taken place from 1990 onwards and cropland area was quite stable.

7.3.2 Methodological Issues

7.3.2.1 Changes in biomass stocks

As stated in the *Good Practice Guidance for LULUCF*, for annual crops, increase in biomass stocks in a single year is assumed equal to biomass losses from harvest and mortality in that same year and there is no net accumulation of biomass carbon stocks. Further, changes in dead organic matter and inorganic carbon were also assumed to be zero and were not included in calculations.

Carbon can be stored in the biomass of croplands that contain perennial woody vegetation which, in Lithuanian conditions, are horticultural plantations. Statistical data on areas of horticultural plantations in Lithuania are provided in the statistical database of the Statistics Lithuania (http://db.stat.gov.lt/sips/Database/sipsen/s4en/p401en/g413en/g413en.asp).

According to the data collected by the Statistics Lithuania, the total area of orchards and berry plantations in Lithuania was gradually decreasing from 45 thou. ha in 1990 to 32 thou. ha in 2004. However, it seems that major part of horticultural area reported in the statistics is taken by private gardens and small land plots at the summer houses containing fruit trees, mainly apple trees which, according to the *Good Practice Guidance for LULUCF*, should be classified as settlements (Section 3.6).

On the other hand, according to the data provided by the Lithuanian Institute of Horticulture, the total area of horticultural plantations in Lithuania is approximately 40.5 thou. ha including private gardens and it has not changed substantially during the last 15 years. The area of industrial horticultural plantations was approximately 6.5 thou. ha in 1990 and has increased to more than 9 thou. ha during the last 15 years.

Bearing in mind inconsistency of available data as well as lack of data on biomass accumulation and losses, changes in carbon stocks in horticultural plantations were not estimated.

It was assumed that land use and management have not changed and overall change in carbon content in soils was negligible.

7.3.2.2 Liming

Statistical data on liming of agricultural land in Lithuania are not available. There are approximately 800 thou. ha agricultural land that need liming. According to the Lithuanian Agrochemical Research Centre, approximately 200 thou. tonnes dolomite powder were used annually in Lithuania for soil liming up to 1990. Since then, liming was gradually decreasing to almost zero in 1996. This information was confirmed by two dolomite quarries which are the main suppliers of dolomite products in Lithuania. Both companies are not producing dolomite for soil liming for the last 10 years. Therefore, it was assumed that dolomite consumption was decreasing linearly from 200 thou. tonnes in 1990 to zero in 1996.

Equation 3.3.6 of the IPCC Good Practice Guidance for LULUCF (P. 3.42) was used for calculation:

$$\Delta C_{CC_{Lime}} = M_{Dolomite} \bullet EF_{Dolomite}$$

Where:

$\Delta C_{CC_{Lime}}$ = annual C emissions from agricultural lime application, tonnes C yr^{-1},

$M_{Dolomite}$ = annual amount of dolomite, tonnes yr_{-1},

$EF_{Dolomite}$ = emission factor, tonnes C (tonne dolomite)$^{-1}$.

Dolomite powder from dolomite deposits in Northern Lithuania was used for liming. According to information provided by dolomite quarrying company *AB Dolomitas*, content of $CaMg(CO_3)_2$ in dolomite rock is 98%. Stechiometric content of carbon in $CaMg(CO_3)_2$ is 13%, content of carbon in dolomite rock containing 98% of $CaMg(CO_3)_2$ is 13% ● 98% = 12.7%. So, emission factor $EF_{Dolomite}$ = 0.127 was used for calculating emissions from liming of agricultural lands.

7.3.3 Uncertainties

It was assumed that uncertainty of activity data is 30%. Emission factor uncertainty was assumed to be about 10%.

7.3.4 Source specific recalculations

No recalculation was made.

7.4 Grassland

Data on grassland area are provided in the *Statistical Yearbook: Agriculture in Lithuania*. Variations of grassland area are discussed in Section 7.3.

Changes in carbon stocks in grassland were not estimated. As grassland management activities in Lithuania are not changing, it was assumed that annual carbon stock changes are close to zero. Liming is not applied on grasslands.

7.5 Wetland

Data on wetland area were taken from the Land Fund of the Republic of Lithuania. The area includes two categories reported in the statistics – water bodies and swamps (bogs). CO2 emissions associated with peat extraction were evaluated.

7.5.1 Source category description

Peat extraction areas are recorded by the Lithuanian Geological Service from 1992. Extraction area was fairly stable from 1992 to 2001 fluctuating in approximately 12% range (Fig. 7-5). From 2002 extraction area has been reduced by approximately 20%. It was assumed that peat extraction area in 1990 and 1991 was the same as in 2002.

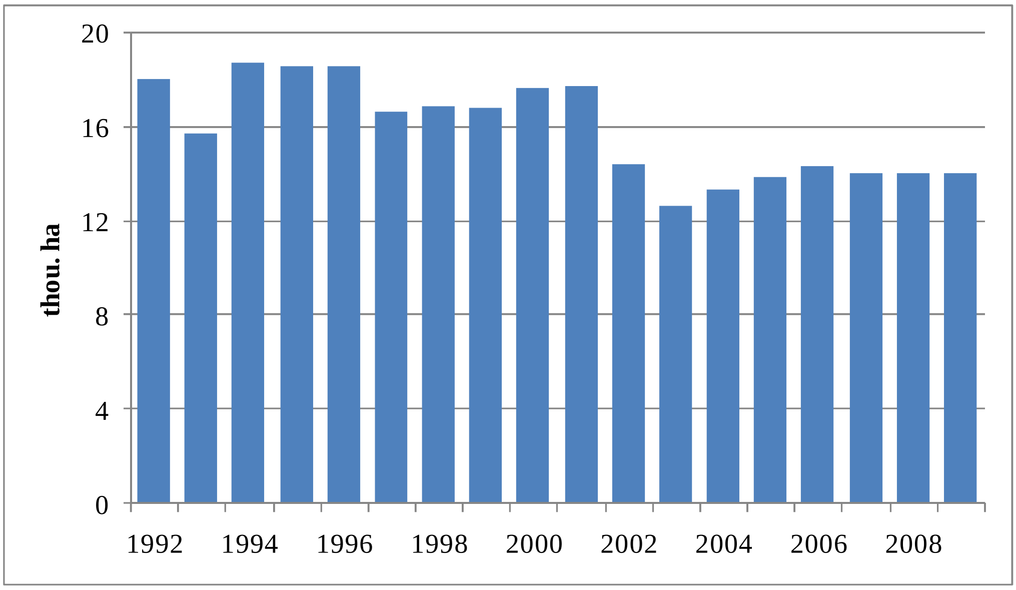


Fig. 7-5. Variation of peat extraction areas

Source: Lithuanian Geological Survey

7.5.2 Methodological Issues

The method provided in the *Good Practice Guidance for LULUCF* addresses emissions from removal of vegetation from land prepared for peat extraction and changes in soil organic matter due to oxidation of peat in the aerobic layer on the land during the extraction. As the total peat extraction area shows slightly decreasing trend, it was assumed that emissions from removal of vegetation for peat extraction are negligible and were not taken into account. CO2 emissions due to oxidation of peat were calculated using modified equation 3.5.5 of the *Good Practice Guidance for LULUCF*.

As data on areas of nutrient rich and nutrient poor organic soils were not available, emission factor for changes of carbon stocks in soils converted to peat extraction *EF* for nutrient rich peat land from Table 3.5.2 of the *Good Practice Guidance for LULUCF* was used.

For calculation of carbon stock changes caused by conversion of forest land to wetlands it was assumed that all above ground forest biomass as well as dead wood and surface soil (litter) organic matter was removed entirely as a result of conversion.

7.5.3 Uncertainties

CO_2 emissions from wetlands were evaluated as a result of forest land conversion to wetlands. Converted areas are relatively very small and it was assumed that uncertainty of activity data can be about 80%. Emission factor uncertainty was assumed to be about 20%.

7.5.4 Source specific recalculation

Recalculation on GHG emissions from wetlands included estimation of CO_2 emissions from forest land converted to wetlands which were not calculated in previous submissions. Impact of recalculations is shown in Table 7- 18.

Table 7-18. Impact of recalculations on CO_2 emissions (Gg) from wetlands

Year	Previous submission	This submission	Difference
1990	104.60	175.16	70.56
1991	104.70	121.99	17.29
1992	104.80	122.13	17.33
1993	95.40	112.85	17.45
1994	107.50	124.95	17.45
1995	107.10	124.67	17.57
1996	107.10	124.65	17.55
1997	99.50	117.17	17.67
1998	100.50	217.26	116.76
1999	100.40	217.10	116.70
2000	103.90	220.64	116.74
2001	104.20	220.98	116.78
2002	91.10	175.88	84.78
2003	99.20	307.29	208.09
2004	91.50	288.52	197.02
2005	62.50	375.31	312.81
2006	63.80	217.36	153.56

2007	106.80	131.14	24.34
2008	106.00	130.85	24.85

7.6 Settlements

Area of settlements is defined in the *Land Fund of the Republic of Lithuania* (urban territory and roads).

Carbon stock changes in settlements remaining settlements were not estimated and assumed to be close to zero. For calculation of carbon stock changes caused by conversion of forest land to settlements it was assumed that all above ground forest biomass as well as dead wood and surface soil (litter) organic matter was removed entirely as a result of conversion.

7.6.1 Uncertainties

CO_2 emissions from settlements were evaluated as a result of forest land conversion to settlements. Converted areas are relatively very small and it was assumed that uncertainty of activity data can be about 80%. Emission factor uncertainty was assumed to be about 20%.

7.6.2 Source specific recalculation

Recalculation on GHG emissions from settlements included estimation of CO_2 emissions from forest land converted to settlements which were not calculated in previous submissions. Impact of recalculations is shown in Table 7- 19.

Table 7-19. Impact of recalculations on CO_2 emissions (Gg) from settlements

Year	Previous submission	This submission	Difference
1990	87.60	165.21	77.61
1991	87.80	79.46	-8.34
1992	88.10	79.68	-8.42
1993	88.30	79.90	-8.4
1994	88.50	80.13	-8.37
1995	88.80	80.35	-8.45
1996	89.00	80.57	-8.43
1997	89.30	80.79	-8.51
1998	89.50	240.81	151.31
1999	89.80	240.96	151.16
2000	90.00	241.12	151.12
2001	90.30	241.31	151.01
2002	90.50	189.87	99.37
2003	133.20	413.71	280.51
2004	104.10	378.90	274.8
2005	18.40	515.38	496.98
2006	17.10	257.68	240.58
2007	138.40	120.44	-17.96
2008	137.00	120.63	-16.37

7.7 Other land

Carbon stock changes in other land were not estimated and assumed to be close to zero.

For calculation of carbon stock changes caused by conversion of forest land to other land it was assumed that all above ground forest biomass as well as dead wood and surface soil (litter) organic matter was removed entirely as a result of conversion.

7.7.1 Uncertainties

CO_2 emissions from other land were evaluated as a result of forest land conversion to other land. Converted areas are relatively very small and it was assumed that uncertainty of activity data can be about 80%. Emission factor uncertainty was assumed to be about 20%.

7.7.2 Source specific recalculation

Recalculation on GHG emissions from other land included estimation of CO_2 emissions from forest land converted to other land which were not calculated in previous submissions. Impact of recalculations is shown in Table 7- 20.

Table 7-20. Impact of recalculations on CO_2 emissions (Gg) from other land

Year	Previous submission	This submission	Difference
1990	79.60	283.05	203.45
1991	79.80	136.14	56.34
1992	80.10	136.52	56.42
1993	80.30	136.90	56.6
1994	80.50	137.28	56.78
1995	80.70	137.66	56.96
1996	80.90	138.04	57.14
1997	81.20	138.42	57.22
1998	81.40	412.58	331.18
1999	81.60	412.85	331.25
2000	81.80	413.12	331.32
2001	82.10	413.45	331.35
2002	82.30	325.31	243.01
2003	121.10	708.82	587.72
2004	94.70	649.17	554.47
2005	16.70	883.01	866.31
2006	15.60	441.49	425.89
2007	125.80	206.35	80.55
2008	125.00	206.68	81.68

7.8 Planned improvements

Information about land areas for estimating carbon stocks and emissions and removals of GHG associated with LULUCF activities is not complete. Additional collection and analysis of information available in various institutions are planned in order to avoid possible overlaps and omissions in reporting land areas. In 2011 special attention will be given to collect all necessary data to estimate emissions and removals from all mandatory categories such as cropland and grassland, CH_4 and N_2O emissions from biomass burning (other than for forest land remaining forest land) etc.

Under the recently approved Governmental Resolution setting up the permanent working group for national GHG inventory preparation, the representative of the State Land Fund was involved to the working group. The State Land Fund is an institution responsible for the data on land use collection, monitoring, analysis and maintaining the State's land use database. Currently the available data is being assessed, analyzed and the results of this analysis will be presented in the NIR 2012.

8 WASTE (CRF sector 6)

8.1 Overview of waste sector

8.1.1 Status of the sector

The amount of municipal waste disposed of in landfills in 2009 was 1,055 thou. tonnes, less than in 2008 by 100 thou. tonnes. Since 2000 the amount of disposed of municipal waste remains comparatively stable.

The majority of landfills in the past were not complying with environmental and sanitary requirements because of poorly chosen sites, poor engineering equipment and improper use of it, and insufficient control of waste taken to the landfills.

As a result of implementation of the landfill directive 1999/31/EC, 10 municipal waste management regions were established in Lithuania and new landfills complying with the requirements of the landfill directive were constructed. Most of old landfills and dumps were closed and major part of wastes including waste from small towns and rural areas are currently disposed of in new managed landfills. The fraction of waste disposed of in the newly constructed regional landfills complying with the requirements of the landfill directive increased from 5.2% of the total amount of disposed municipal waste in 2007 to 72.2% in 2008 and 84.1% in 2009.

Statistics for 2003 show that 38% of all wastewater was treated fully with phosphorus and nitrogen removal; 47% were treated with mechanical and biological treatment; 14,4% were treated mechanically and only 0,6 % was discharged without any treatment. Comparing with 2001, the amount of treated wastewater in the total balance has increased twofold. Construction and reconstruction of wastewater treatment plants is supported by the EU funding.

Wastewater treatment sludge makes about one third of all non-hazardous waste. As there is no sludge management system in Lithuania established yet, wastewater treatment sludge is stored at the production places. Some is also used for agricultural purposes, if quality standards are met. The amount of sludge has slightly decreased recently. In 2000 about 244 thousand tonnes were collected, in 2001 – 240 thousand tonnes and in 2002 – 230 thousand tonnes.

8.1.2 Greenhouse gas sources and generation

Emissions of greenhouse gases from the waste sector in Lithuania originate from following sources:

- solid waste disposal on land;
- wastewater handling (industrial and domestic/commercial wastewater);
- human sewage;
- waste incineration.

GHG emissions in waste sector are summarised in Table 8-1.

Table 8-1. Summary of GHG emissions in waste sector, Gg CO_2 eqv.

Year	Solid waste disposal	Wastewater handling	Waste incineration	Total
1990	753	855	4.2	1,612
1991	771	757	4.5	1,532
1992	786	605	1.4	1,393
1993	798	583	3.9	1,385
1994	806	541	1.2	1,348
1995	812	525	4.3	1,341
1996	817	529	1.4	1,347
1997	822	561	1.4	1,384
1998	826	585	1.5	1,413
1999	830	485	0.7	1,316
2000	834	537	1.9	1,373
2001	840	541	2.5	1,383
2002	842	472	2.3	1,316
2003	847	524	6.3	1,377
2004	832	553	3.2	1,388
2005	828	529	5.9	1,363
2006	827	550	5.5	1,383
2007	829	573	0.8	1,403
2008	887	564	0.7	1,451
2009	892	551	0.7	1,443

Key sources from waste sector and its contribution to total amount of GHG emissions are presented in Table 8-2.

Table 8-2. Key sources of GHG in waste sector 2009 (Gg CO_2 equivalent)

Key Category	GHG emissions, Gg CO2 eq.	Level assessment
Excluding LULUCF		
6.A.Solid Waste Disposal on Land, CH4	891.59	4.4%
6.B.Waste-water Handling, CH4	475.14	2.3%
Including LULUCF		
6.A.Solid Waste Disposal on Land, CH4	891.59	3.5%
6.B.Waste-water Handling, CH4	475.14	1.9%

Variations of emissions by separate gases and sources are shown in Fig. 8-1, Fig. 8-2, Fig. 8-3 and Fig. 8-4.

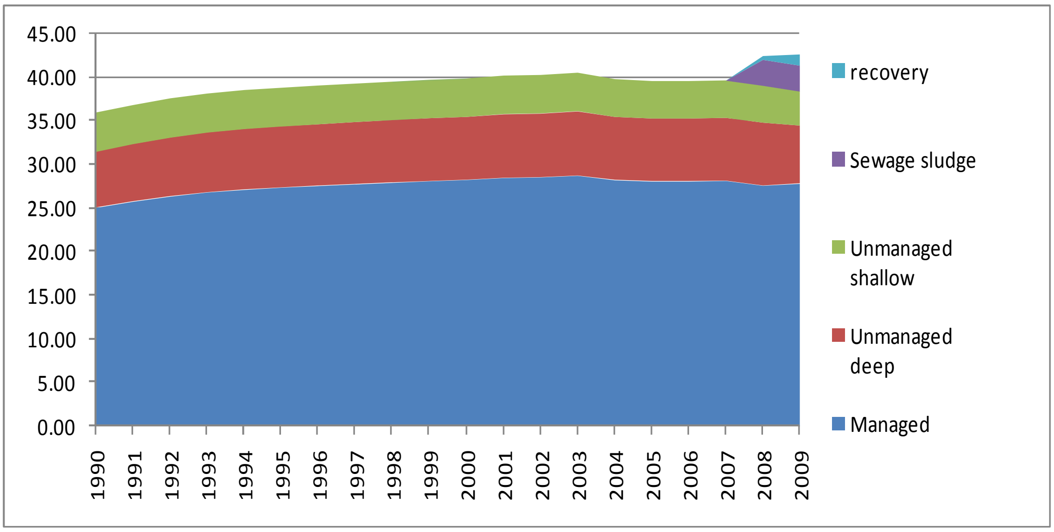


Fig. 8-1. Variations of methane emissions from solid waste disposal on land

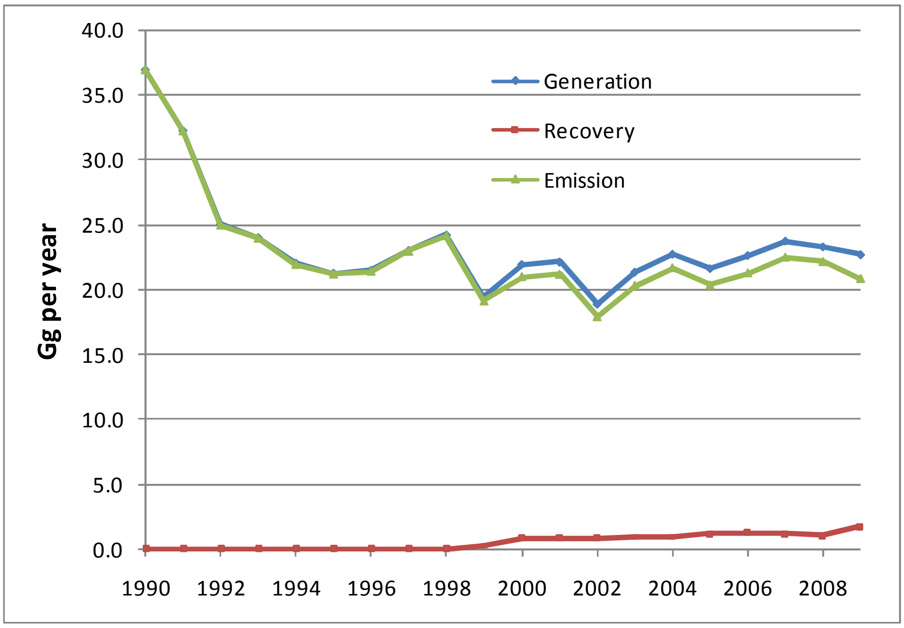


Fig. 8-2. Variation of methane emissions from wastewater handling

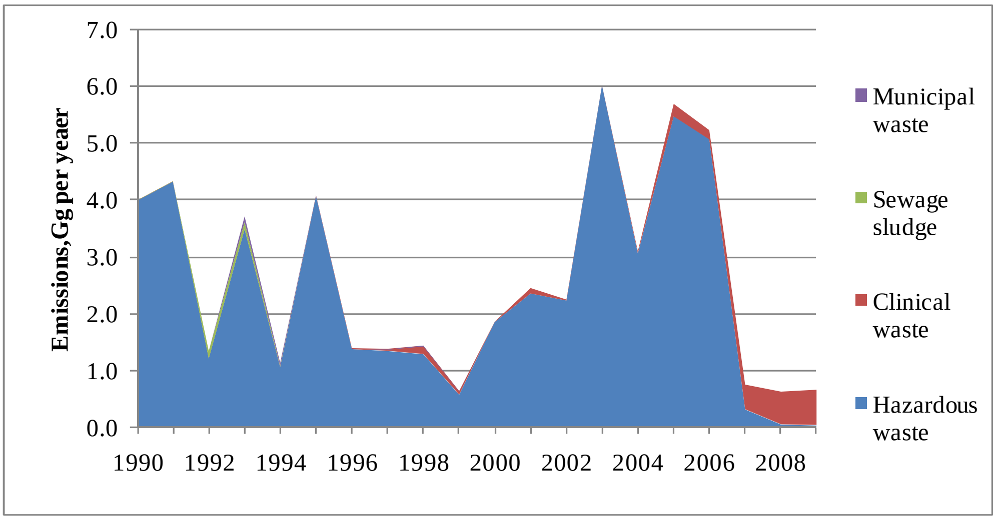


Fig. 8-3. Variations of CO_2 emissions from waste incineration

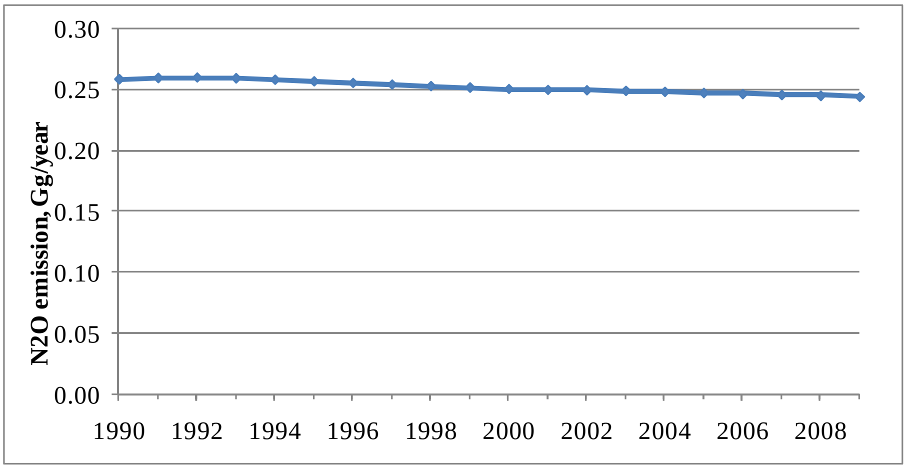


Fig. 8-4. Variation of N_2O emission from human sewage

8.2 Solid waste disposal on land

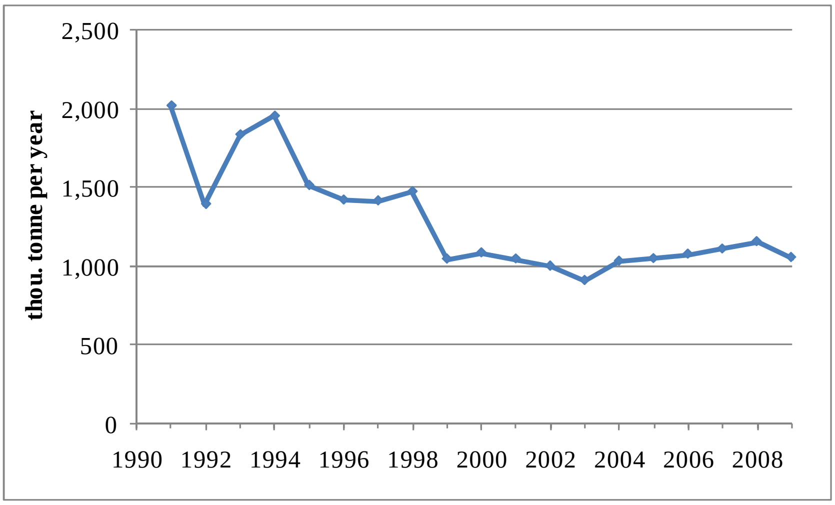
8.2.1 Source category description

8.2.1.1 Municipal waste generation and disposal

Data on waste generation and disposal were started to collect in 1991, data on waste disposal before 1991 are not available[68]. The data provided by the Lithuanian Environmental Protection Agency (EPA) responsible for environmental statistics in Lithuania show that waste generation and disposal in 1991-1994 were fluctuating very substantially and were almost twice as high as in 1999-2009.

[68] http://gamta.lt/cms/index?rubricId=c73f596a-6443-403c-96bf-1d08f8a66ddb

Collection of statistical data on waste generation and disposal was started in Lithuania in 1991. According to initially recorded data, about 1.5 to 2 million tonnes of municipal and industrial waste was disposed of in landfills annually during early nineties (Fig. 8-5).



Source: Lithuanian EPA

Fig. 8-5. Recorded municipal and industrial waste disposal in landfills

Waste was not weighed in early stages of data collection and the amount of waste disposed of in landfills at that time was evaluated on volume basis. It is generally agreed that the amount of generated and disposed waste in early nineties was overestimated. In the report on the status of environment in Lithuania in 2001 published by the Lithuanian Ministry of Environment[69] it was assumed that generation of municipal waste should be about 750 thou. tonnes annually.

Starting from 1999 amount of waste disposed of in landfills has stabilised at approximately 1 million tonnes. It was agreed in the discussion at the Ministry of Environment[70] that this figure should be the most realistic evaluation of municipal waste disposal for the period 1990-1998.

Reliability of data on waste disposal was further discussed at the Ministry of Environment on October 27, 2010 with the leading Lithuanian experts in waste management statistics[71]. It was concluded at the meeting that information on waste generation and disposal in Lithuania are recorded from 1991 but the data collected in 1991-1998 are clearly not reliable and overestimated. At that time there were no weighing of waste at the disposal sites and the amounts of waste disposed of were estimated visually causing substantial errors. Waste collectors were interested in showing higher amounts of collected waste and used to apply higher factors for volume-to-weight conversion.

Reliability of information about waste disposal has increased with improved control and monitoring of reporting and recording process, and accumulated experience. It should be considered that waste disposal data collected from 1999 are consistent and could be used for evaluating methane generation in landfills.

[69] Aplinkos būklė 2001, p. 85. Lietuvos Respublikos aplinkos ministerija, Vilnius, 2002
[70] Meeting at the Ministry of Environment with the Head of Waste Division Ingrida Kavaliauskienė and senior specialist Ingrida Rimaitytė, September 25, 2009
[71] Meeting at the Ministry of Environment with participation of Ingrida Kavaliaiuskienė, Head of the Waste Management Strategy Division of the Ministry of Environment, Audrius Naktinis, Chief Specialist of the Waste Management Division of the Ministry of Environment and Sandra Netikšaitė, Chief Specialist of the Pollution and Waste Management Accounting Division, Lithuanian Environmental Protection Agency

The experts also concluded that there is no reason to believe that waste generation and disposal in 1991-1998 were substantially different from generation and disposal in 1999-2008, i.e. the total annual amount of waste disposed of in Lithuania should have been about or a bit more than 1 million tonnes or about 300 kg per person per year.

Based on comparison of variation of data on GDP and waste disposal per capita (Fig. 8-6) it is reasonable to assume that changes of waste generation and disposal per capita are correlated with the changes of GDP but annual changes in waste generation are approximately 10 times lower than changes of GDP.

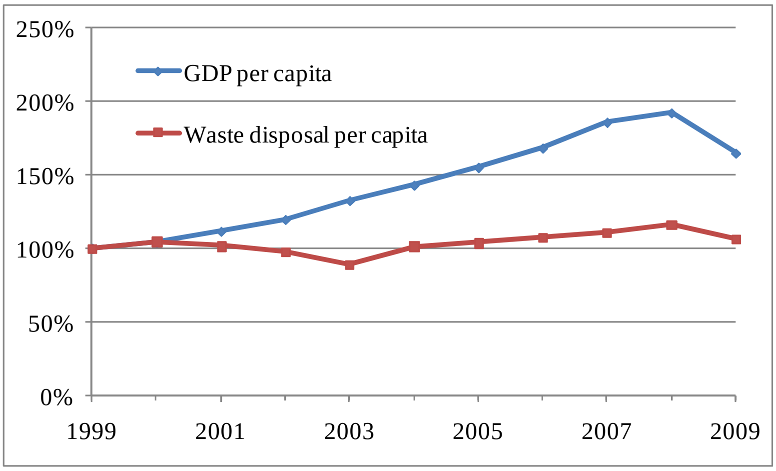


Fig. 8-6. Variations of GDP and waste disposal per capita in 1999-2009

Evaluated changes of waste generation and disposal per capita in 1991-1998 based on assumption that annual change in waste generation and disposal comprises one tenth of annual variation of GDP per capital are shown in Table 8-3.

Table 8-3. Variation of GDP per capita and evaluated changes of waste generation and disposal per capita

	Per capita	
	GDP	**Waste generation and disposal**
1991	-5.8%	-0.58%
1992	-21.2%	-2.12%
1993	-15.8%	-1.58%
1994	-9.1%	-0.91%
1995	5.4%	0.54%
1996	6.0%	0.60%
1997	8.3%	0.83%
1998	8.4%	0.84%

The meeting of experts at the Ministry of Environment agreed that calculated waste disposal data for 1991-1998 based on assumption that annual change of per capita amount of waste disposed of in landfills makes 10% of per capita GDP change provide much more realistic information than the data collected by statistics.

Actual statistical data on municipal and industrial waste disposal in landfills were used for calculation of methane emissions from landfills in 1999-2008. For the period 1990-1998 waste disposal was evaluated using estimated annual changes shown in Table 8-3 and population number provided by the Statistics Lithuania (see Fig. 8-7 and Fig. 8-8).

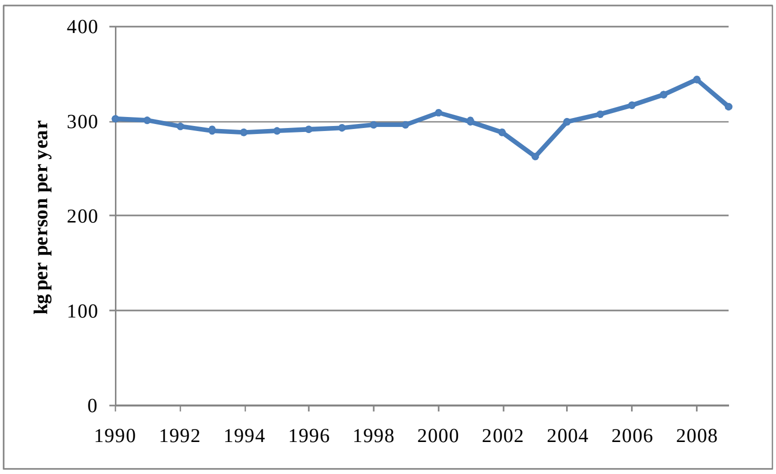


Fig. 8-7. Waste generation per capita in 1990-2009

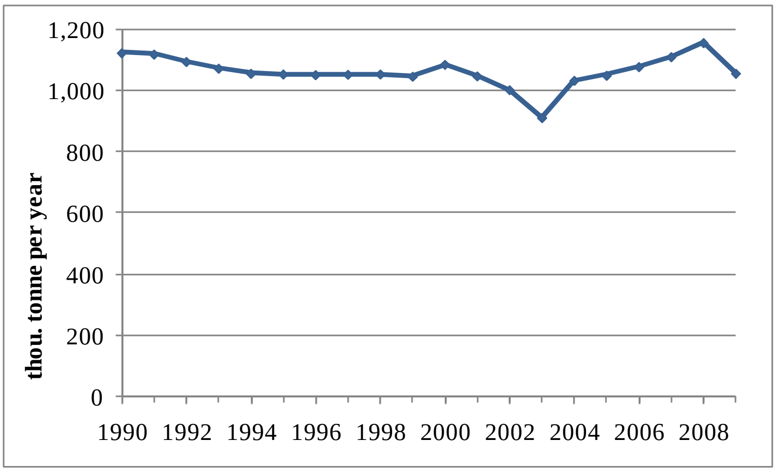


Fig. 8-8. Total waste generation in 1990-2009

8.2.1.2 Biodegradable waste of industrial and commercial origin

Together with mixed municipal waste, certain amount of biodegradable waste is disposed of in the landfills by industries and commercial organisations.

Waste statistics data collected by the Lithuanian Environmental Protection Agency are ordered in accordance with two classification systems: European waste list and mainly substance oriented waste statistical nomenclature developed by the Eurostat and provided in the EU waste statistics regulation (EC) No 2150/2002 as amended[72]. Generic statistical nomenclature is more suitable for identifying

[72] *Official Journal L 332 , 09/12/2002 P. 0001 - 0036,* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:332:0001:0036:EN:PDF

biodegradable components within the waste data and was used for further assessment of methane generating waste.

The following categories were selecting from the Eurostat statistical nomenclature for including in calculation of methane emissions from landfills:

- 07.2. Paper and cardboard wastes
- 07.5. Wood wastes
- 07.6. Textile wastes
- 09.1. Waste of food preparation and products
- 09.2. Green wastes
- 09.3. Slurry and manure

Reported data on disposal of biodegradable waste of industrial and commercial origin in landfills in 2001-2009 are provided in Table 8-4.

Table 8-4. Reported data on disposal of biodegradable waste of industrial and commercial origin in landfills in 2001-2009

Waste category	2001	2002	2003	2004	2005	2006	2007	2008	2009
07.2 Paper and cardboard wastes	0.8	0.7	1.4	0.4	0.5	0.2	0.7	0.1	0.0
07.5 Wood wastes	2.0	3.0	2.9	4.6	24.0	4.8	0.8	4.6	5.1
07.6 Textile wastes	3.1	3.8	1.7	2.9	2.5	1.8	2.0	1.4	2.0
09.1 Waste of food preparation and products	28.3	79.2	0.1	2.3	1.9	1.9	3.3	3.2	2.6
09.2 Green wastes	4.3	4.6	3.8	5.1	7.6	13.8	9.3	6.5	8.0
09.3 Slurry and manure	61.7	62.4	62.6	0.0	0.1	0.0	0.2	0.2	0.0
Total	**100.3**	**153.7**	**72.6**	**15.2**	**36.7**	**22.5**	**16.2**	**16.0**	**17.8**

The data on disposal of biodegradable waste of industrial and commercial origin are available only from 2001 when statistical nomenclature started to be used in Lithuania.

Data provided in the Table show that disposed amounts of certain types of was such as waste of food preparation and products or slurry and manure were decreasing significantly during the last decade as a result of implementation and enforcement of stricter regulations. Therefore it is not possible to use average values of disposal in 2001-2009 for extrapolation of disposal data for the period when data were not available. Instead, average of 2001-2003 was used for the period prior to 2001.

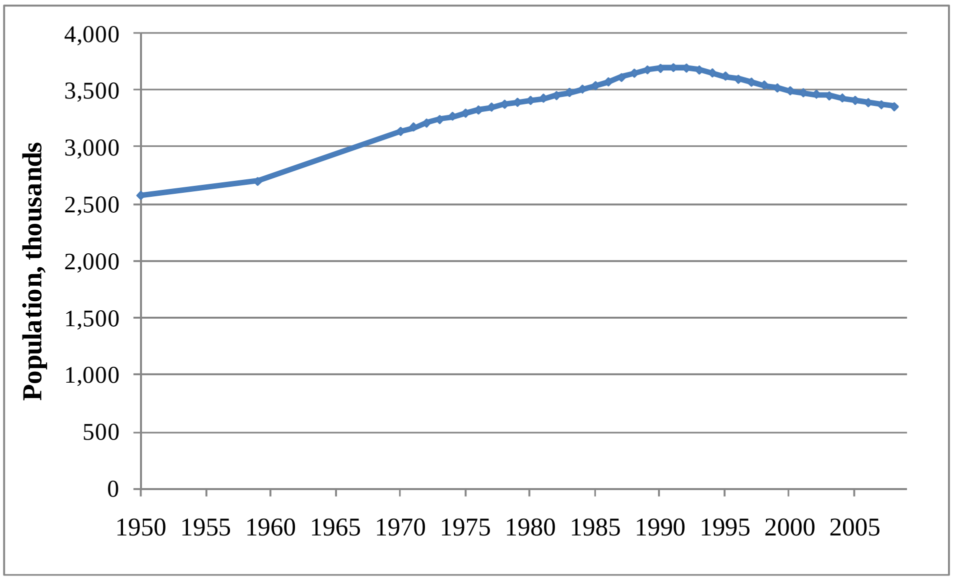
For calculation of methane emissions, data on disposal of industrial and commercial waste were added to data on disposal of mixed municipal waste, fractions of biodegradable materials (paper and cardboard, wood, food, etc.) in waste mixture were recalculated accordingly.

8.2.1.3 Historic waste disposal

Using the first order decay method for calculation of methane emissions from landfilled biodegradable waste requires historical data on waste disposal as the model takes into consideration long-term digestion process. Therefore information on historic waste disposal is necessary.

The amount of waste disposed of in landfills in 1950-1989 was evaluated on the basis of the following considerations.

The number of Lithuanian population from 1950 to 1990 was growing continuously at the rate approximately 1 per cent per year but started declining after declaration on independence (Fig. 8-9).



Source: Statistics Lithuania

Fig. 8-9. Variation of population in Lithuania from 1950

Economic indicators characterizing standard of welfare in Soviet command economy in 1950-1990 and economic indicators of free market economy since declaration of independence in 1990 are completely different and their direct comparison is not possible.

Economic development in the Soviet period was characterized by the "total public product". The changes of the total public product[73] evaluated by the Statistics Lithuania are shown in Fig. 8-10. It should be noted, however, that it was measured in current prices and did not reflect correctly the change in living standard.

[73] GDP: Conversion from material product balances to the system of national accounts in 1980-1990 at current prices. Lithuanian Department of Statistics, Vilnius, 1994

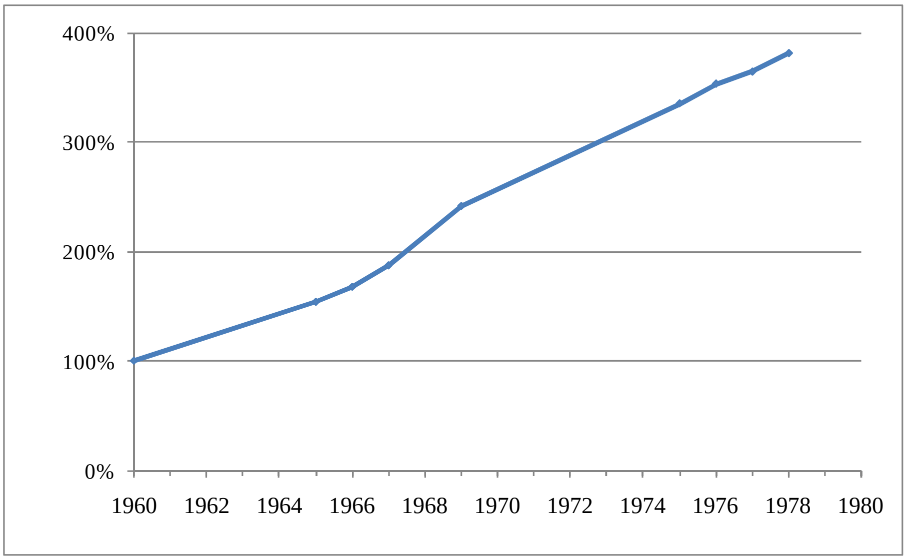


Fig. 8-10. **Variation of the total public product from 1960 to 1978**

The Statistics Lithuania have recalculated economic indicators of the last decade of the Soviet power in Lithuania and obtained GDP values which are comparable to GDP after transition to free market economy[74]. Relative variation of population and GDP per capita from 1980 (1990 = 100%) are shown in Fig. 8-11.

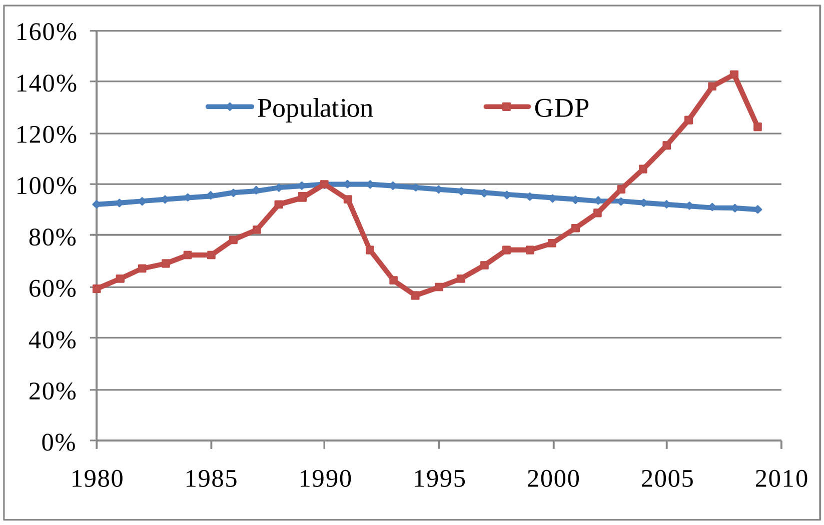


Fig. 8-11. **Relative variation of population and GDP per capita from 1980 (1990 = 100%)**

It is obvious that generation of waste per capita depends on the standard of living but growth of waste generation rate is slower than GDP growth.

It was assumed for evaluation of waste generation in the period 1950 to 1990 that waste generation was increasing continuously and the growth rate was dependent on two factors: population and

[74] Ibid.

standard of living. As it was quoted above, population growth during the period was close to 1% determining at least 1% growth in the total waste generation.

On top of this it was assumed that increasing standard of living has additionally caused increase of per capita waste generation by 1% annually. Variation of waste disposal from 1950 to 1990 based on these assumptions is shown in Fig. 8-12.

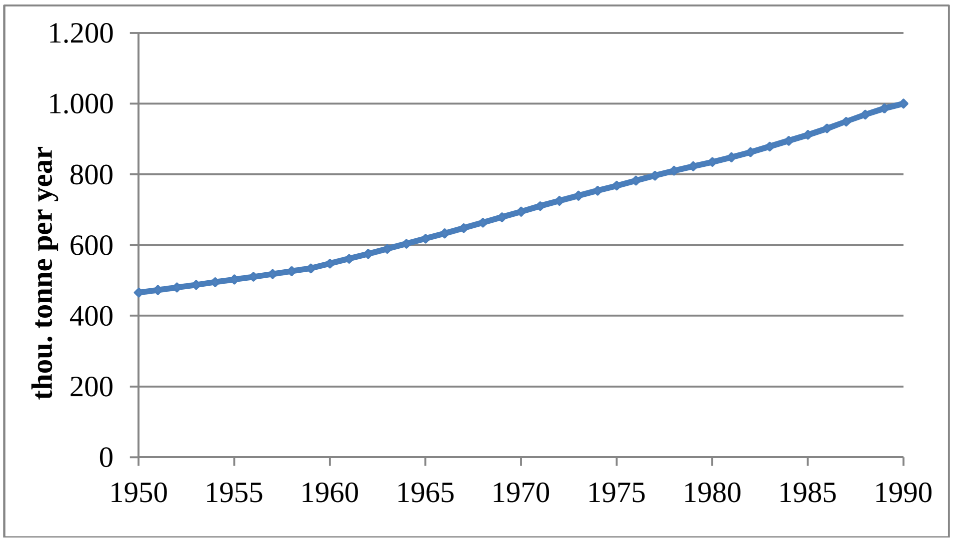


Fig. 8-12. Assumed variation of waste disposal from 1950 to 1990

8.2.1.4 Waste disposal practices

Historically Lithuanian landfills can be divided into three categories:

1) landfills of major cities (county centres),
2) landfills of smaller towns, and
3) small landfills and dumps in rural areas.

Waste management in landfills of major cities include controlled placement of waste, periodic covering and mechanical compacting. These landfills correspond to the definition of managed landfills.

Landfills of smaller towns are comparatively deep (>5 m of waste) but their management, especially in the past, was poor. These landfills correspond to the definition of deep unmanaged landfills.

Small landfills and dumps in rural areas were assigned to unmanaged shallow landfills (<5 m waste).

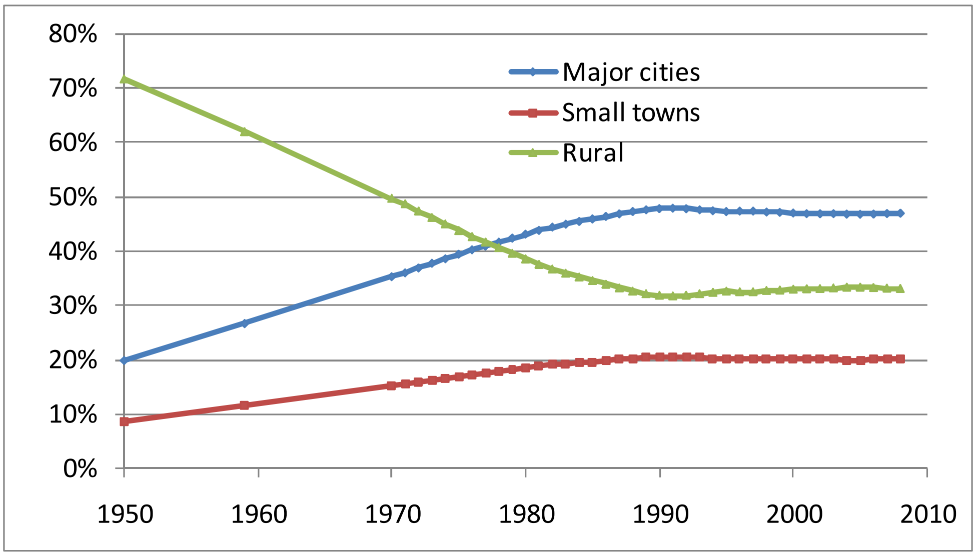
The amounts of waste disposed of in the landfills of each type were evaluated in the following way.

Variations of urban and rural population in Lithuania in 2001-2008 are shown in Table 8-5. The data on population separately in major cities and towns from 1950 are not available, however, as can be seen from the Table, the share of major cities in the total urban population is fairly constant and makes approximately 70%. It was assumed that this ratio continued for the whole period under discussion starting from 1950. Estimated variations of population in major cities, towns and rural areas from 1950 are provided in Fig. 8-13.

Table 8-5. Variations of urban and rural population (thou.) in Lithuania in 2001-2008

	2001	2002	2003	2004	2005	2006	2007	2008
Major cities	1,629	1,622	1,616	1,604	1,593	1,585	1,580	1,574
Towns	702	699	691	685	682	679	676	672
Total urban	2,330	2,322	2,307	2,289	2,275	2,265	2,256	2,246
Rural	1,151	1,147	1,147	1,146	1,139	1,130	1,120	1,112
Total	3,481	3,469	3,454	3,436	3,414	3,394	3,376	3,358

Source: Statistics Lithuania



Source: Statistics Lithuania

Fig. 8-13. Estimated variations of population in major cities, towns and rural areas from 1950

Conditions described above were applicable until 2007. From 2007 disposal practices started to change. Implementation of the Landfill directive 1999/31/EC requires construction of new solid waste landfills corresponding to the requirements set in the directive and closure of all existing landfills not complying with the requirements.

As a result, 10 municipal waste management regions were established in Lithuania and new landfills complying with the requirements of the landfill directive were constructed. Old landfills and dumps were closed and all wastes including waste from small towns and rural areas are currently disposed of in new managed landfills. Dates of start of disposal of all wastes in managed regional landfills complying with the requirements of landfill directive are shown in Table 8-6.

Table 8-6. Dates of start of disposal of all wastes in managed regional landfills complying with the requirements of landfill directive

Region	**Start of disposal of all wastes in managed regional landfills**
Alytus	January 2008
Marijampolė	April 2009
Tauragė	April 2009
Šiauliai	July 2007
Vilnius	January 2008
Telšiai	January 2008
Klaipėda	July 2008
Kaunas	July 2009

Utena	April 2008
Panevėžys	October 2009

Evaluated disposal of municipal waste in new regional landfills is shown in Table 8-7.

Information on waste disposal in new modern landfills was provided by regional waste management companies responsible for operation of regional waste management systems.

Table 8-7. Disposal of municipal waste in new regional landfills in 2007-2009

Region	2007			2008			2009		
	Popu-lation, %	Disposal		Popu-lation, %	Disposal		Popu-lation, %	Disposal	
		%	thou. tonnes		%	thou. tonnes		%	thou. tonnes
Alytaus	5.2%			5.2%	100%	62	5.2%	100%	56
Kauno	20.0%			20.0%	86%	202	20.0%	92%	197
Klaipėdos	11.3%			11.3%	76%	100	11.3%	79%	96
Marijampolės	5.4%			5.4%			5.4%	59%	34
Panevėžio	8.4%			8.4%			8.4%	57%	51
Šiaulių	10.3%	50%	58	10.4%	80%	97	10.3%	61%	67
Tauragės	3.8%			3.8%			3.8%	79%	32
Telšių	5.1%			5.2%	100%	60	5.1%	100%	55
Utenos	5.1%			5.1%	100%	60	5.1%	100%	55
Vilniaus	25.4%			25.2%	90%	266	25.4%	95%	258
Total			**58**			**846**			**902**
Fraction of the total municipal waste			**5.2%**			**72.2%**			**84.1%**

The amount of waste disposed in regional landfills (58 thou. tonnes in 2007, 846 thou. tonnes in 2008 and 902 thou. tonnes in 2009) were added to the amount disposed of in managed landfills, the remaining amount was divided among the three types of landfills depending on the number of population in major cities, towns and rural areas and evaluated generation of municipal waste per capita.

In the discussion at the Ministry of Environment[75] it was agreed that the ratio of waste generation in major cities, towns and rural areas is approximately 2:1.5:1. Based on this assumption, waste generation per capita in major cities, towns and rural areas were calculated as:

$$G_R = \frac{WT}{2 \times P_C + 1.5 \times P_T + P_R},$$

$$G_C = 2 \times G_R,$$

$$G_T = 1.5 \times G_R$$

where G_C,G_T and G_R are annual waste generation per capita in cities, towns and rural areas (kg per capita per year), WT is the total waste generation (tonne), P_C, P_T and P_R are cities, towns and rural population (thousands) accordingly.

[75] Meeting at the Ministry of Environment with the Head of Waste Division Ingrida Kavaliauskienė and senior specialist Ingrida Rimaitytė, September 25, 2009

The amounts of waste disposed of in managed, deep unmanaged and shallow unmanaged landfills (corresponding to waste delivered for disposal from major cities, towns and rural areas) were calculated by multiplying corresponding population numbers by waste generation per capita. Evaluated waste disposal in managed, deep unmanaged and shallow unmanaged landfills from 1950 is shown in Fig. 8-14.

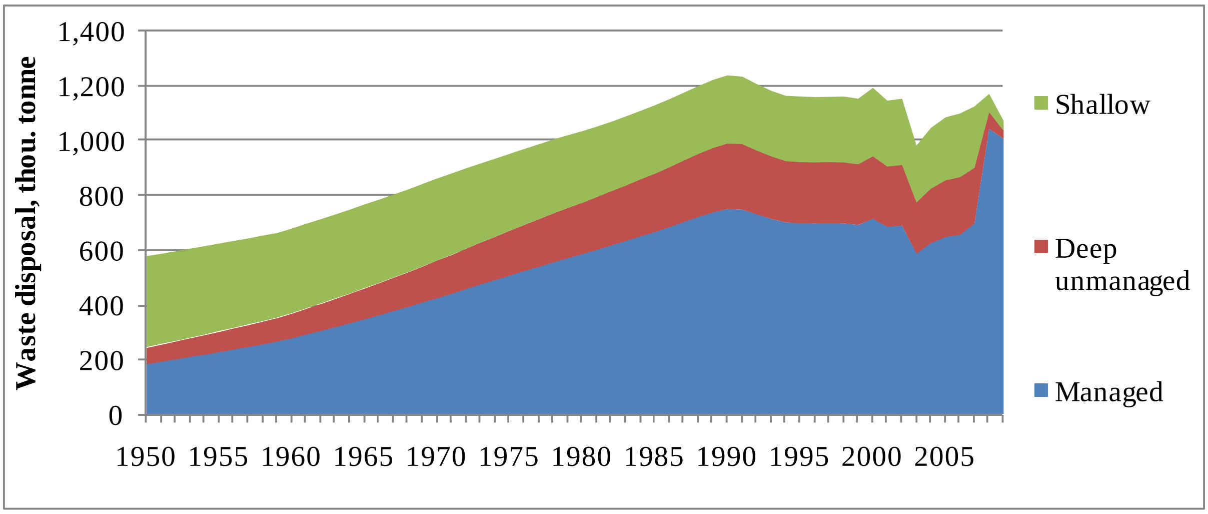


Fig. 8-14. Evaluated waste disposal in managed, deep unmanaged and shallow unmanaged landfills from 1950

8.2.1.5 Waste composition

Average composition of MSW provided in the MoE report "Status of the Environment" is based on experimental measurements carried out from 1996 in various regions of Lithuania (Table 8-8). As there were no experimental measurements carried out before 1996, it is very difficult to make any assessment of waste composition before that time. However, as may be seen from the data in the Table, there are no clear changes in composition in time or in different regions. Based on this, it was assumed that waste composition was quite stable during all period under investigation and the data from the MoE report[76] "Status of the Environment 2004" was used for calculation of methane emissions from waste disposed on land.
Average composition of MSW is provided in the MoE report "Status of the Environment 2004[77]:

Plastics	9%
Paper/cardboard	14%
Glass	9%
Metal	3%
Textile	4%
Biodegradable (kitchen) waste	42%
Composite packaging	2%
Construction and demolition waste	4%
Hazardous waste	2%
Leather, rubber	1%
Wood	2%
Sand, sweepings	4%
Other	4%

[76] Status of the Environment 2004, p. 85-86. Ministry of Environment of the Republic of Lithuania, Vilnius, 2005, http://www.am.lt/VI/en/VI/files/0.889071001141635235.pdf
[77] Ibid.

Table 8-8. **Measured waste composition in various regions of Lithuania**

<table>
<tr><th rowspan="2">Waste composition</th><th colspan="4">Kaunas</th><th colspan="3">Kaunas region 2003</th><th>Klaipėda</th><th colspan="3">Vilnius</th><th>Utena</th><th colspan="4">Panevėžys, 2004</th></tr>
<tr><th>1996</th><th>1997</th><th>1998</th><th>1999</th><th>City</th><th>Towns</th><th>Rural</th><th>2000</th><th>1999</th><th>2001</th><th>County average</th><th>2003</th><th>city</th><th>towns</th><th>rural</th><th>overall</th></tr>
<tr><td>Biowaste</td><td>39%</td><td>46%</td><td>35%</td><td>41%</td><td>41%</td><td>53%</td><td>34%</td><td>56%</td><td>47%</td><td>52%</td><td>42%</td><td>43%</td><td>43%</td><td>39%</td><td>28%</td><td>38%</td></tr>
<tr><td>Paper</td><td>10%</td><td>7%</td><td>12%</td><td>12%</td><td>8%</td><td rowspan="2">10%</td><td rowspan="2">10%</td><td rowspan="2">19%</td><td rowspan="2">13%</td><td rowspan="2">9%</td><td rowspan="2">13%</td><td rowspan="2">15%</td><td rowspan="2">6%</td><td rowspan="2">9%</td><td rowspan="2">1%</td><td rowspan="2">5%</td></tr>
<tr><td>Cardboard</td><td>6%</td><td>7%</td><td>9%</td><td>1%</td><td>8%</td></tr>
<tr><td>Plastic</td><td>7%</td><td>10%</td><td>11%</td><td>10%</td><td>7%</td><td>5%</td><td>5%</td><td>8%</td><td>7%</td><td>13%</td><td>9%</td><td>8%</td><td>6%</td><td>8%</td><td>5%</td><td>6%</td></tr>
<tr><td>Glass</td><td>9%</td><td>6%</td><td>8%</td><td>8%</td><td>9%</td><td>7%</td><td>12%</td><td>9%</td><td>10%</td><td>6%</td><td>9%</td><td>6%</td><td>9%</td><td>5%</td><td>11%</td><td>9%</td></tr>
<tr><td>Metal</td><td>3%</td><td>3%</td><td>3%</td><td>4%</td><td>3%</td><td>3%</td><td>3%</td><td>2%</td><td>4%</td><td>4%</td><td>3%</td><td>3%</td><td>2%</td><td>2%</td><td>4%</td><td>3%</td></tr>
<tr><td>Wood</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1%</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Other burnable</td><td>14%</td><td>14%</td><td>16%</td><td>11%</td><td>14%</td><td>9%</td><td>9%</td><td></td><td></td><td></td><td></td><td>6%</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Other non-burnable</td><td>12%</td><td>7%</td><td>6%</td><td>13%</td><td>5%</td><td>8%</td><td>18%</td><td></td><td></td><td></td><td></td><td>10%</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Hazardous</td><td></td><td></td><td></td><td></td><td>1%</td><td>1%</td><td>1%</td><td>1%</td><td></td><td></td><td></td><td>0%</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Other</td><td></td><td></td><td></td><td></td><td>4%</td><td>4%</td><td>8%</td><td>5%</td><td>19%</td><td>16%</td><td>24%</td><td>8%</td><td>34%</td><td>38%</td><td>52%</td><td>40%</td></tr>
</table>

Source: Feasibility studies for establishment of regional waste management systems in Kaunas, Klaipėda, Vilnius, Utena, Panevėžys regions, Lithuania

As it was indicated above, fractions of biodegradable materials in landfilled waste were recalculated taking into account disposed of biodegradable waste of industrial and commercial origin (see Section 8.2.1.2). Content of biodegradable components in landfilled waste evaluated for calculation of methane generation by IPCC model is shown in Table 8-9.

Table 8-9. Content of biodegradable components in landfilled waste evaluated for calculation of methane generation

	2001	2002	2003	2004	2005	2006	2007	2008	2009
Paper and cardboard	12.8%	12.2%	13.1%	13.8%	13.6%	13.7%	13.9%	13.8%	13.8%
Wood	2.0%	2.0%	2.2%	2.4%	4.1%	2.4%	2.0%	2.4%	2.4%
Textile	3.9%	3.8%	3.9%	4.2%	4.1%	4.1%	4.1%	4.1%	4.1%
Food	40.8%	43.3%	38.9%	41.6%	40.8%	41.3%	41.7%	41.7%	41.5%
Garden	0.4%	0.4%	0.4%	0.5%	0.7%	1.3%	0.8%	0.6%	0.7%
Sludge	5.4%	5.4%	6.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

8.2.1.6 Methane recovery

Though currently all old landfills are already closed, methane recovery has been started in 2008 only in Kaunas and Utena regions.

Data on methane recovery provided by the Kaunas Regional Waste Management Centre[78] and Utena Regional Waste Management Centre[79] are shown in

Table 8-10. Methane recovery from landfills in Kaunas and Utena regions, thou. Nm^3

	2008	2009
Kaunas region	911.8	2,808.90
Utena region	97.2	277.3

Recalculation of recovered methane to weight units was performed using the following relations:

Calorific value of recovered biogas = 20.2 MJ/m^3,[80] and
33.49 MJ contained in methane gas correspond to 0.52 kg of carbon[81]

8.2.2 Methodological issues

The *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (*1996 Guidelines*, IPCC, 1997) and the *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (*GPG2000*, IPCC, 2000) describe two methods for estimating CH_4 emissions from solid waste disposal sites (SWDS): the mass balance method (Tier 1) and the First Order Decay (FOD) method (Tier 2). However, the use of the mass balance method is strongly discouraged in the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* as it produces results that are not comparable with the FOD method which produces more accurate estimates of annual emissions. Therefore, methane emissions from solid waste disposal sites were estimated using IPCC waste model based on the first order decay method provided in the *2006 IPCC Guidelines*.

[78] Letter from the Kaunas Regional Waste Management Centre No 356 from September 30, 2010
[79] Letter from the Utena Regional Waste Management Centre No S-328 from September 28, 2010
[80] Energy balance 2008, Statistics Lithuania, Vilnius, 2009
[81] Jakubėnas, JSC Achema, personal communication

8.2.2.1 MSW fraction disposed of in landfills

Data provided by the EPA describes specifically the fraction of MSW sent to SWDS, therefore factor $MSW_F$was taken as 100%.

8.2.2.2 Methane correction factor

Waste management in landfills of major cities include controlled placement of waste, periodic covering and mechanical compacting. These landfills correspond to the definition of managed landfills with methane correction factor = 1.

Landfills of smaller towns are comparatively deep (>5 m of waste) but their management, especially in the past, was poor. These landfills correspond to the definition of deep unmanaged landfills with methane correction factor = 0.8.

Small landfills and dumps in rural areas were assigned to unmanaged shallow landfills (<5 m waste) with methane correction factor = 0.4.

8.2.2.3 Other parameters

Other parameters were taken as IPCC default values:

DOC (Degradable organic carbon) (weight fraction, wet basis)

Food waste	0.15
Paper	0.4
Wood	0.43
Textiles	0.24

Methane generation rate constant (years^{-1})

Food waste	0.185
Paper	0.06
Wood	0.03
Textile	0.06

Methane generation rate constant was chosen for the wet climate condition under the boreal and temperate climate zone provided in the 2006 IPCC Guidelines. The reason for the selection of this value is that Lithuania is situated in the temperate climate zone, i.e. North of subtropics and South of subarctic area, and its climate is characterized as wet, i.e. precipitation exceeds evaporation. More information on Lithuania's climatic conditions are provided in the chapter 6.1 of this report.

DOC_f (fraction of DOC dissimilated)	5
Delay time (months)	6
Fraction of methane in developed gas	0.5
Conversion factor, C to CH_4	1.33
Methane oxidation	0

Estimated methane emissions in 1990-2009 are shown in Fig. 8-15.

CH_4 emission from sludge

In 2010 NIR, emission from sludge was not evaluated and ERT applied an adjustment calculating the missing emission estimates, in accordance with table 1 of the technical guidance on methodologies for adjustments under Article 5, paragraph 2 of the Kyoto protocol, using method 1: "Default IPCC tier

1". Calculated CH_4 emission from sludge for year 2008 resulted 2,92 Gg (Report of the individual review of the annual submission of Lithuania submitted in 2010").
As all necessary country specific data to estimate emission from sludge was not collected so far, the same emission for year 2009 was applied.

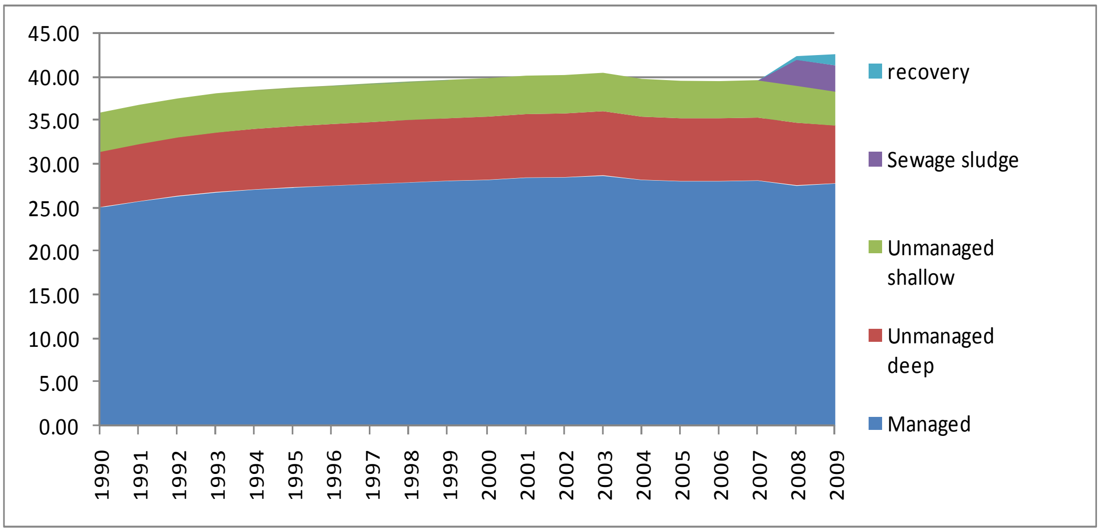


Fig. 8-15. Estimated methane emissions in 1990-2009

8.2.3 Uncertainties

It was assumed that uncertainty in establishing activity data was about 30% and uncertainty in emission factors was about 50%.

8.2.4 Source specific recalculations

Biodegradable wastes of industrial and commercial origin were included in calculations of CH_4 emissions which increased estimated emission result by approximately 5 to 7 per cent (see Table 8-11).

Table 8-11. Impact of recalculations on CH_4 emissions (Gg) from solid waste disposal on land

	Previous submission	This submission	Difference	
			Gg	%
1990	33.2	35.9	2.6	7.9%
1991	34.0	36.7	2.7	7.9%
1992	34.7	37.5	2.7	7.9%
1993	35.2	38.0	2.8	7.9%
1994	35.6	38.4	2.8	7.9%
1995	35.9	38.7	2.8	7.8%
1996	36.1	38.9	2.8	7.8%
1997	36.3	39.1	2.8	7.8%
1998	36.5	39.3	2.9	7.8%
1999	36.7	39.5	2.9	7.8%
2000	36.8	39.7	2.9	7.8%
2001	37.1	40.0	2.9	7.8%
2002	37.2	40.1	2.9	7.7%

2003	37.2	40.3	3.2	8.6%
2004	36.7	39.6	2.9	7.9%
2005	36.9	39.4	2.6	6.9%
2006	37.1	39.4	2.3	6.3%
2007	37.4	39.5	2.1	5.7%
2008	37.4	42.2	4.8	13.0%

8.2.5 Planned improvements

The following improvements in reporting on the solid waste disposal on land sector are planned and will be implemented in the NIR 2012:

- To improve descriptions on explanations on the methodology and assumptions used in the uncertainty analysis for solid waste disposal on land sector;
- To elaborate sector-specific QA/QC procedures in solid waste disposal on land sector.

In 2011 Ministry of Environment is planning to amend Order of 14 July 1999 on Waste management rules No 217. By this amendment, the list of companies obliged to account waste and to report on waste generation and management will be expanded. This will enable to get more reliable information on waste amounts generated in Lithuania.

8.3 Wastewater

Methane emissions from wastewater treatment were calculated based on BOD measurements as municipal and industrial wastewater are discharges through the combined centralised sewage collection systems (see below).

8.3.1 Activity Data

IPCC Guidelines recommend calculation of CH_4 emissions separately from domestic and from industrial wastewater assuming that organic matter is measured as BOD in municipal wastewater and as COD in industrial wastewater. However in Lithuania in most cases industrial wastewater, pre-treated if necessary, is discharged to centralised municipal sewage collection networks and treated together with the domestic wastewater in centralised municipal treatment plants.

Information of wastewater treatment and discharge in Lithuania is collected by the Lithuanian Environmental Protection Agency (EPA). Collected data include both BOD and COD, however, as can be seen from Table 8-12, both parameters are determined for the same samples without specification of municipal and industrial wastewater sources. Therefore, there is no possibility to separate industrial and municipal wastewater streams.

Table 8-12. Number of discharge points for which data on BOD and COD are provided in the statistics

Year	Number of discharge points included in the statistics		
	BOD	COD	Both BOD and COD
1991	657	46	45
1992	674	42	40
1993	612	37	34
1994	614	29	28
1995	641	35	33
1996	694	39	36

1997	697	42	41
1998	721	53	51
1999	745	52	50
2000	766	62	60
2001	724	59	56
2002	766	95	83
2003	781	162	158
2004	781	325	323
2005	808	452	447
2006	769	436	436

The data on wastewater composition and discharge are collected by the EPA from 1991. There are some very large fluctuations in data in the beginning of the monitoring period. These data were analyzed and some correction were made.
Bearing in mind that water usage and wastewater discharges have shrunk very substantially after declaration of independence with steeply increasing energy and water prices, wastewater discharge in 1990 was evaluated by linear extrapolation of 1991-1993 data.

Reported BOD load to the Raseiniai mechanical treatment plant in 1992 was 284 tonnes BOD. Bearing in mind that the plant provides service for approximately 12 thousand population, this amount corresponds to BOD generation of 2267 kg per capita per year which is roughly 100 times higher than expected. It was considered as an obvious outlier and corresponding figure was divided by 100.

According to the data provided for 1992, 284 tonnes of BOD (or about 10% of the total amount)were generated by some small construction company which was not included in the records neither before nor after 1992. Once again it was considered to be an obvious outlay and corresponding data were deleted from the database.

BOD data reported by the Šiauliai wastewater treatment facility in 1992 and 1994 were roughly 10 times higher than during the remaining period. These deviations were considered as outlays and were reduced 10 times accordingly.

Actually all industrial wastewater containing organic contaminants (BOD) is discharged through municipal sewerage systems. However, wastewater generators covered by data discussed above cover only population that has connection to sewerage networks. Substantial part of population in Lithuania has no connection to sewerage networks (Table 8-13)

Table 8-13. Fraction of population having no connection to sewerage networks

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Fraction	46.7%	46.1%	43.6%	42.3%	41.7%	39.0%	39.0%	42.4%	41.4%

BOD load from this fraction of population was evaluated according to methodology provided in Revised 1996 IPCC Guidelines (v. 3, p. 6.23, Table 6.5) using default BOD_5 generation value 18.25 kg per person per year. The total BOD load is sum of BOD discharge from sources connected to sewerage networks and calculated BOD load from population having no connection to sewerage networks.

Evaluated variations of the total BOD load compared to theoretical load calculated using default BOD value per person (18.25 kg BOD_5 per person per year, Revised 1996 IPCC Guidelines, v. 3, p. 6.23, Table 6.5) and population data are provided inFig. 8-16.

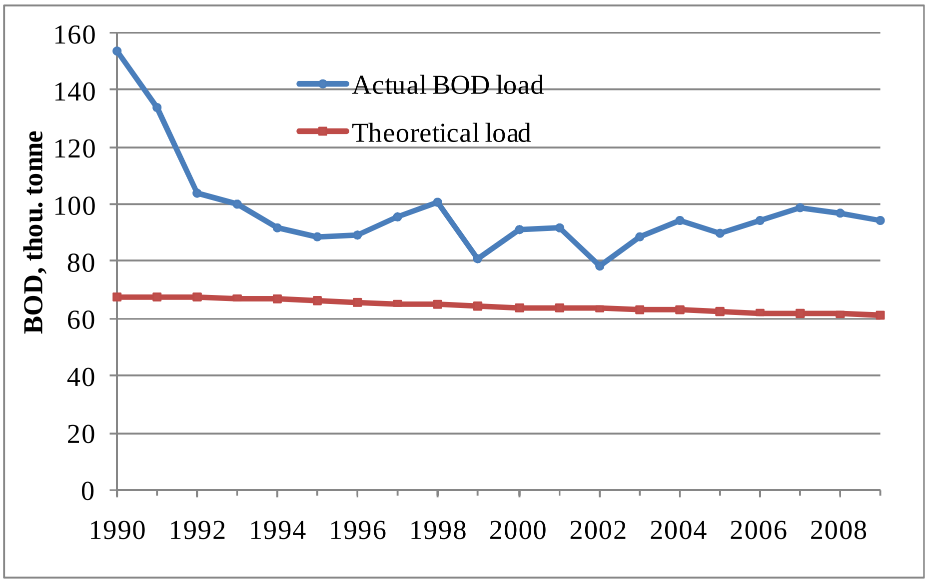


Fig. 8-164. Evaluated variations of BOD discharges compared to theoretically calculated values

As can be seen from the diagram, actual values are higher than theoretical, especially in the beginning of the period. The difference is caused by industrial wastewater discharged in municipal sewerage networks. Industrial BOD load was especially high in 1991-1992 when Soviet style industries were still in operation. On the other hand, high BOD loads in 1990 and 1991 could be caused by wasteful water consumption in the Soviet period which dropped dramatically after introduction of market economy.

8.3.2 Methodological issues

The *IPCC Guidelines (1996)* propose a separate calculation for wastewater and for sludge removed from the wastewater. However, as noted in the *GPG 2000*, the distinction is inappropriate for most countries as sludge is rarely collected separately. Sludge separation will not affect the overall estimate unless there are country specific B_o measurements for sludge and wastewater. Typically, the theoretical default B_o values for sludge and wastewater are the same. If default factors are being used, emissions from wastewater and sludge can be estimated together.

The IPCC default methodology for household wastewater was used for calculation of methane emissions. CH_4 emissions were calculated using equation 5.6 from IPCC GPG 2000 (p. 5.16) but substituting calculated BOD load with actual data:

$$Emission\ (Gg) = BODL \times SBF \times EF \times FTA,$$

Where:
BODL is BOD load, thou. tonnes per year,
SBF is fraction of BOD that readily settles, default = 0.5,
EF is emission factor (g CH_4/g BOD), default = 0.6,
FTA is fraction of BOD in sludge that degrades anaerobically, default = 0.8.

Methane is recovered in Utena (from 1999), Kaunas (from 2000) and Klaipėda (from 2009) wastewater treatment facilities. Data on methane recovery were provided by the facilities. Recalculation to energy units were made using conversion factors provided by the Statistics Lithuania. Data on methane recovery are provided in the Table below.

Table 8-13a. Methane recovery in wastewater facilities.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
M m^3	0.55	2.10	2.13	2.12	2.28	2.36	2.85	3.10	2.85	2.57	4.27
TJ	10.9	41.4	42.1	41.9	45.0	46.7	56.4	61.2	56.3	50.7	84.4

8.3.3 Uncertainties

It was assumed that uncertainty in establishing activity data was about 30% and uncertainty in emission factors was about 50%.

8.3.4 Source specific recalculations

No source specific recalculations were made.

8.3.5 Planned improvements

The following improvements in the wastewater sector reporting are planned and will be implemented in the NIR 2012:

- To improve descriptions on explanations on the methodology and assumptions used in the uncertainty analysis in the wastewater sector;
- To elaborate sector-specific QA/QC procedures in wastewater sector;
- To update the estimation equation used to estimate CH_4 emissions from wastewater handling;
- To provide detailed description of the wastewater handling AD trends from 1990 to 2009.

In order to improve precision and reliability of data on GHG emissions from wastewater management, more accurate and reliable information on wastewater and sludge treatment systems is needed. Collection and analysis of data on status and conditions of wastewater and sludge management systems in relation to GHG emissions are planned in 2011-2012.

In 2011 EPA is planning to prepare amendment to MoE Order of 20 December 1999 No408 on State's Statistical Accounting and Reporting on Water Resources Use. By this amendment companies administering wastewater treatment installations will be obliged to report additional information concerning wastewater sludge treatment methods and sludge disposal conditions.

8.4 Emissions from human sewage

The emissions of N_2O from human sewage were calculated according to IPCC methodology, by multiplying annual per capita protein intake by number of people in country and default emission factor (0.01 kg N_2O-N/kg sewage-N produced) with default fraction of nitrogen in protein (0.16 kg N/kg protein). Protein intake per capita was evaluated by the Nutrition Centre under the Ministry of Health (77.4 g/capita/day in 1998 and 78.1 g/capita/day in 2002). Linear interpolation of these data were used for calculation of emissions.

8.5 Waste incineration

8.5.1 Activity data

No managed municipal waste incineration is taking place at present. Some types of waste (hospital health care waste, waste oils etc.) in minor amounts take place at the only hazardous waste incineration facility and industrial companies without energy production. Hazardous waste

incineration facility's capacity is up to 2000 tonnes of waste per year. Hazardous and clinical wastes here are incinerated in rotary kiln incinerator with operating temperature 800-1350^{o}C.
Activity data on incinerated amounts of hazardous and clinical health care waste were obtained from Environment Protection Agency waste database (Table 8-14).

The amount of incinerated hazardous waste fluctuates quite strongly. There were no dedicated waste incineration facility in Lithuania until 2006 and waste was incinerated on random basis in existing production facilities which means that the decisions on whether to incinerate or not to incinerate are taken on ad hoc basis, therefore may fluctuate in quite wide range (it is worth noting that the total amount of incinerated waste is very small, even at its maximum).

Table 8-14. Waste incineration 1990-2009 (thou. tonnes)

	Hazardous	Clinical Health care	Sewage sludge	Municipal	Total
1990	2.43	0.01	0.01	0.00	2.45
1991	2.63	0.01	0.01	0.00	2.65
1992	0.73	0.01	0.32	0.00	1.06
1993	2.12	0.00	0.30	0.18	2.61
1994	0.64	0.01	0.05	0.09	0.79
1995	2.48	0.01	0.00	0.01	2.50
1996	0.83	0.02	0.00	0.00	0.85
1997	0.81	0.04	0.00	0.00	0.85
1998	0.78	0.17	0.00	0.03	0.98
1999	0.34	0.07	0.00	0.01	0.42
2000	1.12	0.00	0.00	0.00	1.12
2001	1.43	0.11	0.00	0.00	1.54
2002	1.35	0.02	0.00	0.00	1.37
2003	3.66	0.00	0.00	0.00	3.67
2004	1.86	0.04	0.00	0.00	1.90
2005	3.33	0.26	0.00	0.00	3.59
2006	3.09	0.19	0.00	0.00	3.28
2007	0.18	0.52	0.00	0.00	0.70
2008	0.02	0.69	0.00	0.00	0.71
2009	0.01	0.74	0.00	0.00	0.76

8.5.2 Methodological issues

Carbon dioxide emissions from waste incineration were calculated according to IPCC methodology. Default values, provided in IPCC Good Practice Guidance were used: fraction of carbon content, fraction of fossil carbon and burn out efficiency of combustion of incinerators. Variations of CO_2 emissions from waste incineration are shown in Fig. 8-17.

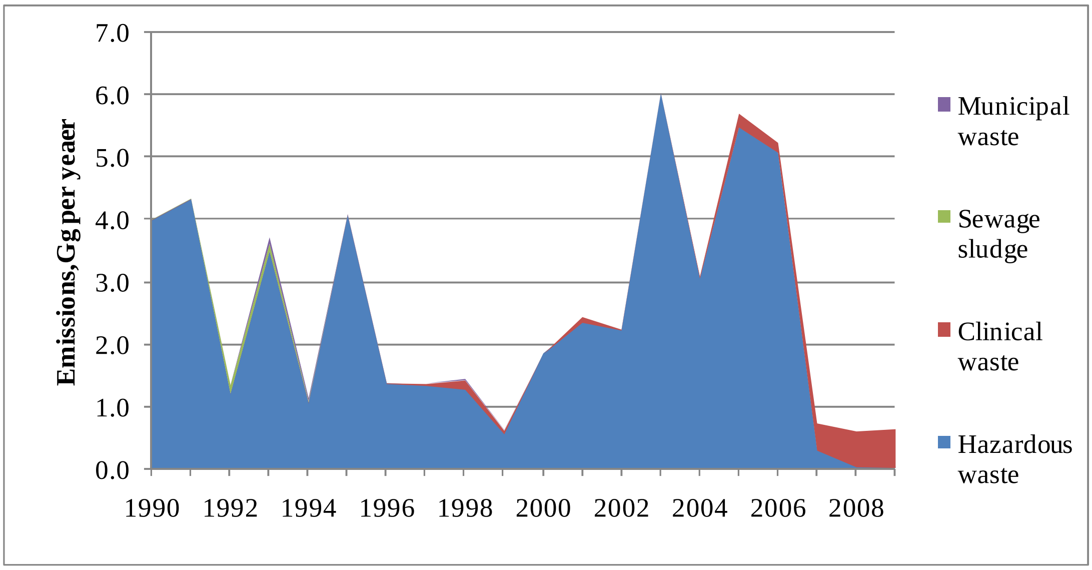


Fig. 8-17. Variations of CO_2 emissions from waste incineration

Following the request of ERT in 2010 to provide a rationale of the recalculation of CO_2 emission in 2010 NIR, which resulted in a 52.8 per cent decrease in the estimate for 2007 compared with the 2009 submission, it should be explained, that the reason of this recalculation was an error in 2009 submission: emissions were calculated from hazardous waste plus clinical waste, but data on hazardous waste provided by the Environmental Protection Agency already included clinical waste and waste oils, i.e. clinical waste were included twice in calculations, waste oils also were double counted as emissions from burning of waste oils were included in energy sector. This error was corrected in 2010 submission.

In this report N_2O emissions from waste incineration are presented for the first time. N_2O emissions were estimated using methodology provided in IPCC GPG 2000. Average mean of default values range (225 kg/N_2O/Gg waste) for rotating plants was used. Variations of N_2O emissions from waste incineration are shown in Table 8-15.

Table 8-15. N_2O emission from waste incineration 1990-2009

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
N_2O emission, Gg CO_2 eqv.	0.17	0.19	0.07	0.18	0.05	0.17	0.06	0.06	0.07	0.03
Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
N_2O emission, Gg CO_2 eqv.	0.08	0.11	0.10	0.26	0.13	0.25	0.23	0.05	0.05	0.05

8.5.3 Uncertainties

It was assumed that uncertainty in establishing activity data was about 25% and uncertainty in emission factors was about 30% for CO_2 and 100% for N_2O.

8.5.4 Source specific recalculations

N_2O emission estimates from waste incineration were added.

9 OTHER (CRF SECTOR 7)

Not applicable.

10 RECALCULATIONS AND IMPROVEMENTS

More transparent National Inventory report (NIR) was prepared providing more precise descriptions of the methodologies, activity data and emission factors.
List of improvements made in response to ERT recommendations in the 2010 individual review report is provided in the Annex 8.

10.1 Source specific recalculations

Energy

Following the remarks of the ERT in 2010, CO_2 emissions from combustion of motor gasoline, jet kerosene, gas/diesel oil, residual fuel oil, LPG and non liquefied petroleum gas were recalculated using revised country specific emission factors (based on research protocols of UAB "ORLEN Lietuva" Quality Research Center). It is considered, that these emission factors are more accurate than emission factors used in previous submissions, as fuels used in Lithuania are mainly produced by oil refinery UAB "ORLEN Lietuva" and imports of the fuels specified above comprise only a minor fraction of the fuels used in Lithuania.

Additional recalculations were made due to change of statistical data on use of specific fuels (annual revision of energy balance by Statistics Lithuania).

Emission factors for CO_2, CH_4 and N_2O emissions from international bunkers were reviewed and corrected. The effect of recalculations performed in energy sector is presented in the table 3-11.

Industrial processes

Mineral products
For the years 2005-2009 CO_2 emissions from cement production have been recalculated using data provided in the EU ETS reports of the plant.
Following the recommendation of ERT in 2010, N_2O emission from nitric acid production was recalculated for all time series using plant specific EFs calculated by using measured and registered in automated monitoring system data. More detailed description of the recalculation is presented in the chapter 4.4.2.

Chemical industry
CO_2 emission from ammonia production was recalculated for all time series using updated data on natural gas consumption and carbon content of natural gas as provided by the company.

Consumption of F-gases
In this NIR, emissions of F-gases from the following sources were calculated for the first time:
- Domestic refrigerators;
- Mobile air conditioners;
- metered dose inhalers (both actual and potential);
- other applications using ODS substitutes.

Emissions from stationary refrigeration were disaggregated into industrial and commercial.
Notation keys “NE” were changed to “NO” for 2.F.5 and 2.F.7 subsectors.

Solvents and other products use
N_2O emission from the use of N_2O for anaesthesia was calculated for the first time.

Agriculture

Enteric fermentation
CH_4 emission from enteric fermentation of fur-bearing animals, rabbits, nutria was added.
CH_4 emissions recalculated using new, more accurate data on swine fodder composition.
CH_4 emission from enteric fermentation from fur-bearing animals, rabbits and nutria was added.

Manure management
CH_4 and N_2O emission from manure management of fur-bearing animals, rabbits, nutria was added.
Average weight of non-dairy cattle was corrected in accordance with the latest available data resulting in slight changes of methane emissions.
As data of cattle manure management systems for the period 1991-2007 were interpolated, there were two recalculations made in the 2011 submission – emissions of dairy cattle and emissions of non-dairy cattle
N-excretion for swines was recalculated using new data on animal herd structure and protein consumption.

Agricultural soils
In the chapter "Cultivations of histosols" new data for the area of cultivated organic soils had been implemented.
Recalculations in the subsector "Direct emissions from agricultural soils" and "Indirect emissions from agricultural soils" are related with recalculations made in manure management subsector.

LULUCF

All data related to forestry including releases and sinks of GHG were recalculated using NFI database maintained at the State Forest Service. Recalculation has taken into account changes recorded during forest inventory and afterwards, including forest felling and reforestation/deforestation activities as well as changes in forest ownership. Impact of recalculation on CO_2 emissions from forest land are shown in Tables 7-14, 7-15, 7-16, 7-17 (see chapter 7.2.5 Source specific recalculations).

Recalculation of emissions from wetlands included estimation of CO_2 emissions from forest land converted to wetlands, settlements and other land which were not calculated in previous submissions.

Waste

Biodegradable wastes of industrial and commercial origin were included in calculations of CH_4 emissions.
CH_4 emissions from sludge storage were added (as accepted adjustment of the ERT in 2010).
N_2O emission estimates from waste incineration were added.

10.2 Planned improvements

Energy

The following improvements were added to the inventory improvement plan in the energy sector and will be implemented in the NIR 2012:

- Further improve transparency providing more detailed description of methods and EF used;
- To provide more explanations for the difference between the emission estimates in sectoral and reference approach;
- To address time-series inconsistency in the AD on international bunker fuels used for aviation;
- To reassess uncertainty of activity data and emission factors used for uncertainty calculation;

- Calculation of emissions from road transport using Copert 4 programme;
- To investigate the possibility of using data provided in the EU ETS, reported by the operators for the energy sector emission estimates.

Major part of liquid fuels to the Lithuanian market is supplied by the UAB Orlen Lietuva refinery. CO_2 emission factors for liquid fuels (gasoline, diesel oil, LPG, jet kerosens, residual fuel oil) used in 2011 submission were reviewed and corrected based on analysis of liquid fuels supplied by the refinery. However, certain part of fuels is placed on the Lithuanian market by other suppliers. Further analysis of market conditions is planned in order to evaluate suitability of emission factors established for fuels supplied by UAB Orlen Lietuva refinery for estimating overall GHG emissions from fuel combustion.

In 2012 will start a Norway Grants capacity building project between Lithuania and Norway "Cooperation on GHG inventory". The partner of this programme will be Norwegian Climate and Pollution Agency, which is national entity responsible for GHG inventory preparation in Norway. One of the outcomes of this project will be a study on EFs used for energy sector in Lithuania. It is expected that results of this study will be presented in 2013 submission.

Industry

A number of improvements were added to the inventory improvement plan in the industrial processes sector. The following tasks will be implemented in the NIR 2012:

- to improve transparency and provide more detailed descriptions of the methods, EFs and AD used as the source, to include analysis and explanation of the trends in GHG emissions for the specific subsectors;
- to include results of category-specific QA/QC activities accomplished during the preparation of the inventory in the category descriptions;
- to verify production and EFs data provided by the industry using data from the EU ETS;
- to verify the reported 5 per cent calcinated fraction in cement production and provide an explanation for the difference between plant-specific CKD correction factor and the default value from the IPCC GPG;
- to estimate transport refrigeration emissions;
- to calculate emission from foam blowing for the whole time series using national data;
- to collect all necessary activity data needed to report emission from mobile air conditioners for the 1990-2005 period;
- to fill in the gaps of reporting on F-gases emissions for the years 1990–1994. If the analysis will show that emissions occurred during this period, emissions will be calculated using extrapolation, as actual data is not available for historical years;
- to fill in the gaps of reporting on F-gases potential emission (domestic refrigeration, mobile air conditioning, foam blowing, transport refrigeration);
- to review the rates of refrigerant consumption and leakage, including SF_6 from electrical equipment as recommended by the ERT in 2010.

As already mentioned, in 2012 will start a Norway Grants capacity building project between Lithuania and Norway "Cooperation on GHG inventory". The partner of this programme will be Norwegian Climate and Pollution Agency, which is national entity responsible for GHG inventory preparation in Norway. One of the activity and outcome of this project will be a study on F-gases use in Lithuania. It is expected that this study will cover all remaining reporting gaps in this area, but results of this study will be presented only in 2013 submission, at the earliest.

In accordance with the Order of the Minister of Environment issued in 2008, users of F-gases provided initial data on imports and use of F-gases in 2009. However, collected data are not complete, data providers from industrial companies have misunderstood certain requirements included in the Order of the MoE. Review and analysis of set reporting requirements are planned with a view of compiling an additional explanatory note for data providers with detailed explanations on how the reports should be compiled and what information should be provided. In addition, a workshop for industries importing and using F-gases is planned. From 2012 the EPA will install electronical data base for the compilation of f-gases data forms by data providers via internet.

Agriculture

Collection of more accurate data on manure storage systems used in the Lithuanian agriculture is planned. Additional data should enable better and more reliable judgements on GHG emissions from manure management.
In addition, experimental evaluation of country specific methane producing capacities (B_0) is planned in 2011-2013.

LULUCF

Information about land areas for estimating carbon stocks and emissions and removals of GHG associated with LULUCF activities is not complete. Additional collection and analysis of information available in various institutions are planned in order to avoid possible overlaps and omissions in reporting land areas. In 2011 special attention will be given to collect all necessary data to estimate emissions and removals from Land converted to Cropland and Grassland categories (CRF categories 5.B.2 and 5.C.2).

Under the recently approved Governmental Resolution setting up the permanent working group for national GHG inventory preparation, the representative of the State Land Fund was involved to the working group. The State Land Fund is an institution responsible for the data on land use collection, monitoring, analysis and maintaining the State's land use database. Currently the available data is being assessed, analyzed and the results of this analysis will be presented in the NIR 2012.

Waste

The following improvements in the waste sector reporting are planned and will be implemented in the NIR 2012:

- To improve descriptions on explanations on the methodology and assumptions used in the uncertainty analysis for each category in the waste sector;
- To elaborate sector-specific QA/QC procedures in waste sector;
- To update the estimation equation used to estimate CH_4 emissions from wastewater handling;
- To provide detailed description of the wastewater handling AD trends from 1990 to 2009;
- To collect national data to estimate CH_4 emission from sludge.

In order to improve precision and reliability of data on GHG emissions from wastewater management, more accurate and reliable information on wastewater and sludge treatment systems is needed. Collection and analysis of data on status and conditions of wastewater and sludge management systems in relation to GHG emissions are planned in 2011-2012.

In 2011 Ministry of Environment is planning to amend Order of 14 July 1999 on Waste management rules No 217. By this amendment, the list of companies obliged to account waste and to report on waste generation and management will be expanded. This will enable to get more reliable information on waste amounts generated in Lithuania.

In 2011 EPA is planning to prepare amendment to MoE Order of 20 December 1999 No408 on State's Statistical Accounting and Reporting on Water Resources Use. By this amendment companies administering wastewater treatment installations will be obliged to report additional information concerning wastewater sludge treatment methods and sludge disposal conditions.

PART II: SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1

11 KP-LULUCF

11.1 General information

11.1.1 Definition of forest and any other criteria

Estimation of anthropogenic emissions by sources and removals by sinks since 1990 is associated with Afforestation, Reforestation and Deforestation since 1990 under Article 3.3 and Forest Management under Article 3.4 of the Kyoto Protocol. Forest land is defined in accordance to Law on Forests of the Republic of Lithuania: “Forest – a land area not less than 0.1 hectare in size covered with trees, the height of which in a natural site in the maturity age is not less than 5 meters, other forest plants as well as thinned or vegetation-lost forest due to the acts of nature or human activities (cutting areas, burnt areas, clearings). Tree lines up to 10 meters of width in fields, at roadsides, water bodies, in living areas and cemeteries, single trees and bushes, parks planted and grown by man in urban and rural areas are not defined as forests. The procedures for care, protection and use of these plantings shall be established by the Ministry of Environment.” Forest stands with stocking level (approximately equivalent to crown cover) less than 0.3 (or crown cover less than 30%) are not acceptable for high productivity forestry. This threshold is used for including of land areas into afforested land areas (Table 11-1). The same forest parameters were elected in Lithuania’s Initial report under the Kyoto protocol.

Table 11-1. Selected parameters defining forest in Lithuania for the reporting

Parameter	Range	Value
Minimum land area	0.05 – 1 ha	0.1 ha
Minimum crown cover	10 – 30 %	30 %
Minimum height	2 – 5 m	5 m

11.1.2 Elected activities under Article 3, paragraph 4, of the Kyoto Protocol

In the first commitment period 2008-2012 Lithuania has chosen to account emissions and removals from Forest Management under Article 3.4 of the Kyoto Protocol, but did not elect Cropland Management, Grazing Land Management and Revegetation.

There are two main data sources in Lithuania: 1) Lithuanian State Forest Cadastre (LSFC) and 2) National Forest Inventory (NFI) based on sampling method with integration of geographic information systems (GIS). LSFC provides data about Forest land area and other statistics since 1990. NFI provides data associated with Afforestation, Reforestation, Deforestation and Forest Management since 1998.

LSFC data is based on total standwise forest inventory with 10 years circle and relevant information of forest management from State Forest Enterprises and private forests. NFI data as more objective and precise are used for harmonization of LSFC data in the period of 1990-1997. All information about Forest land and Forest land use is provided by Lithuanian State Forest Service.

11.1.3 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

The definition of Afforestation, Reforestation and Deforestation is in accordance with the GPG (IPCC 2003). The main information about areas of Afforestation, Reforestation and Deforestation is based on the NFI data, which is carried out continuously since 1998. Historical data of Reforestation is not applicable. Clear cuttings in forests are not considered as Deforestation.
Data of Afforestation, Reforestation and Deforestation for the period 1990 – 1997 will be estimated as the result of comparison and analysis of data of LSFC and NFI during 1998 - 2009. Data series about areas change of Afforestation, Reforestation and Deforestation since 1990 provided in Table 11-2.
For 2008 calculation, Afforestation/Reforestation area (234,52 kha) in KP-LULUCF is not equal to the 'Land converted to forest land' area (245,22 kha) in Convention LULUCF tables, because of the different assessment period. For the 'Land converted to forest land' 20 years period was used, but area of Afforestation/Reforestation for KP-LULUCF was assessed only since 1990 (19 years period). In the future submissions, the areas of 'Land converted to forest land' and Afforestation/Reforestation will coincide (starting from 2009 inclusive).

Table 11-2. Area of Afforestation/ Reforestation and Deforestation (thousand ha)

Year	Afforestation/ Reforestation		Deforestation	
	Total area	**Organic soils area**	**Total area**	**Organic soils area**
1990	10.70	1.68	0.90	0.14
1991	5.13	0.81	0.43	0.07
1992	5.13	0.81	0.43	0.07
1993	5.13	0.81	0.43	0.07
1994	5.13	0.81	0.43	0.07
1995	5.13	0.81	0.43	0.07
1996	5.13	0.81	0.43	0.07
1997	5.13	0.81	0.43	0.07
1998	15.29	2.40	1.29	0.20
1999	15.29	2.40	1.29	0.20
2000	15.29	2.40	1.29	0.20
2001	15.29	2.40	1.29	0.20
2002	12.02	1.89	1.02	0.16
2003	26.22	4.12	2.22	0.35
2004	24.03	3.77	2.03	0.32
2005	32.77	5.14	2.77	0.43
2006	16.38	2.57	1.38	0.22
2007	7.65	1.20	0.65	0.10
2008	7.65	1.20	0.65	0.10
2009	10.92	1.71	0.92	0.14
Total (1990-2009)	**245.44**	**38.53**	**20.74**	**3.26**

The definition of Forest Management is in accordance with the GPG (IPCC 2003) too. All forest areas are considered as managed in Lithuania. There are different intensities of forest management depending on functional designations of forestry. Forest land area as Forest management for KP-LULUCF calculation is provided in Table 11-3.

Table 11-3. Area of Forest management (thousand ha)

Year	Total area	Organic soils area
2008	1915.48	300,73
2009	1914.56	300.59

For 2008 calculation, Forest management area (1915,48 kha) in KP-LULUCF is not equal to the 'Forest land remaining forest land' area (1904,78 kha) in Convention LULUCF tables because of the different assessment period. For the 'Forest land remaining forest land' 20 years period was used, but area of Forest Management under KP-LULUCF was assessed only since 1990 (19 years period).

In the future submissions, the areas of 'Forest land remaining forest land' and Forest management will coincide (starting from 2009 inclusive).

11.1.4 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.

Lithuania has elected only Forest management under Article 3.4 activities, therefore there is no hierarchy among Article 3.4 activities.

11.2 Land-related information

11.2.1 Spatial assessment unit used for determining the area of the units of land under Article3.3

The total area of Afforestation, Reforestation and Deforestation units was estimated following Reporting Method 1 of the IPCC GPG LULUCF. The spatial assessment unit for the submission of the Kyoto Protocol LULUCF covers the entire territory of Lithuania as one stratum. The methodology for reporting is based on the NFI, which uses a permanent sample plots distributed on 4 × 4 km grid across all over Lithuanian territory. Four permanent sample plots of 500 m^2 size with distance of 250 m between each are established at each grid cross point. Every permanent sample plot is assessed regularly for Afforestation, Reforestation and Deforestation area estimation. Territory outside forest land is assessed every 5 years, using remote sensing material, forest management data and if land is afforested, new permanent sample plots are established. Sample plots occurring on the boundaries of different land use categories are divided into smaller units, i.e. sectors. These NFI primary sampling units provide detailed data for estimation of Afforestation, Reforestation and Deforestation. In this way the polygon that divides the different areas of land uses within the sub-plot is measured using polar-coordinates. To ensure sampling objectivity GPS (Global Positioning System) receivers are used for plot positioning and sample plot centre is ascertained with ±1-2 m accuracy.

Supplementary information about Lithuanian NFI is included in the Annex V.

11.2.2 Methodology used to develop the land transition matrix

The land transition matrix is based on the NFI data. Primary data of LSFC comes from State Forest Inventory (Standwise Forest Inventory with 10 year circle). NFI presents detailed data about forest land areas structure by prevailing tree species, age, site types as well as forest land transition every year.
Table 11-4 presents areas and changes in areas between the previous and the current inventory year.

Table 11-4 Land transition matrix for 2009 (kha)

To current inventory year / From previous inventory year		Article 3.3 activities		Article 3.4 activities				Other[1]	Total area at the beginning of 2009
		A/R	D	FM	CM	GLM	REV		
Article 3.3 activities	A/R	234,52	0,00						234,52
	D		19,82						19,82
Article 3.4 activities	FM		0,92	1.914,56					1.915,48
	CM	NA	NA		NA	NA	NA		NA
	GLM	NA	NA		NA	NA	NA		NA
	REV	NA			NA	NA	NA		NA
Other[1]		10,92	0,00	0,00	NA	NA	NA	4.349,26	4.360,18
Total area at the end of 2009		245,44	20,74	1.914,56	NA	NA	NA	4.349,26	6.530,00

Abrevations used: A – afforestation, R – reforestation, D – deforestation, FM – forest management, CM – cropland management, GLM – grazing land management, REV – revegetation, NA – not applicable
[1] "Other" includes the total area of the country that has not been reported under an Article 3.3 or an elected Article 3.4 activity.

11.2.3 Maps and/or database to identify the geographical locations, and the system of identification codes for the geographical locations

Lithuania elected the reporting method 1 for lands subject to Article 3.3 and Article 3.4 activities. The area of country is reported as single region. The total forest land area estimated using LSFC maps (M 1:10 000) and database. The sources of land use changes and tree biomass estimation are the National Forest Inventory database. NFI permanent sample plots allocated on entire Lithuanian territory by systematic distribution pattern. Geographical locations are identified by the coordinates of centres of the NFI sample plots. One permanent sample plot represents 400 ha of forests.

11.3 Activity-specific information

11.3.1 Methods for carbon stock change and GHG emission and removal estimates

11.3.1.1 Description of the methodologies and the underlying assumptions used

Methods for estimating carbon stock changes in forests are the same used for the UNFCCC LULUCF reporting (chapter 7.2.2).

Carbon stock changes in living biomass
Data on living and dead trees volume were provided by the State Forest Service. The original data were calculated by sources of Lithuanian State Forest Cadastre and National Forest Inventory for 1990, 2000, 2005 and 2009. This data used for extrapolation of values for other years.
Method 2 (stock change method) according to IPCC GPG for LULUCF was used to guarantee the control of all process by using series of gross increment and its structure data. Having data about increment and its structure: volume of changes, fellings, dead trees estimated by the direct measurements on permanent plots since 1998 and by the boring of trees and measurements of stumps and dead trees for the period 1988-1997, accepted method allows more precisely to calculate CO_2 emissions.
Calculation of above-ground biomass is based on volume of live trees stems with bark. Basic wood density WD was estimated on the basis of data provided in Table 3A.1.9 of the IPCC GPG for LULUCF. Density values for coniferous and deciduous were calculated as weighed average values related to growing stock volume.
Default values of biomass expansion factor for conversion of trees stems volume with bark to above-ground tree biomass, were calculated by national tables of wood merchantable volume (for branches) and by leaves-needles biomass data.

Carbon stock changes in dead wood, litter and soil organic matter
Biomass of dead trees stems is calculated by the same methods as living biomass.
The average value of carbon stock in litter is 24 t per ha. It was calculated for Forest land by values of cold temperate dry and moist region from Table 3.2.1 of IPCC GPG for LULUC (Lithuanian Country Report on Global Forest Resources Assessment 2005. 2010).
The average value of carbon stock in soils is 72 t per ha. There are 69 t per ha in mineral soils and 87 t per ha in organic soils. It was calculated for Forest land by values of cold temperate dry and moist region from Table 3.2.4 of IPCC GPG for LULUC (Lithuanian Country Report on Global Forest Resources Assessment 2005. 2010).
For calculation of carbon stock changes caused by conversion (Deforestation) of forest land to settlements and other lands it was assumed that all above ground forest biomass as well as dead wood and surface soil (litter) organic matter was removed entirely as a result of conversion.

Biomass burning
Prescribed burning of forest biomass is not used in Lithuania.
Data on areas affected by forest fires are available from the *Statistical Yearbooks of Forestry* (1999-2009) and from the *Lithuanian Country Report on Global Forest Resources Assessment 2005* (1990-1992 and 1998). Average value of available data was used for calculation of emissions during the remaining period (1993-1997). Carbon release from burnt biomass was calculated using equation 3.2.19 of the IPCC GPG for LULUCF. Values of biomass stocks, combustion efficiency, emission factors were taken from IPCC GPG for LULUCF as well.
As data on forest area affected by fires is not available separately for Afforestation/Reforestation activities, emission estimates resulting from wildfires were included under Forest management.

Forest fertilization is not applied in Lithuania. Therefore, it was assumed that there are no direct emissions of N_2O from forest fertilization.

Lime is not applied to soils in Lithuania since 1996. It was assumed that there are no direct emissions from liming.

According to the data collection principles used by State Forest Service, windbreaks and windfalls removals are included in round wood or fuel wood removals. Therefore, to avoid double counting, windbreaks and windfalls were not included in calculation of carbon losses due to disturbances.

11.3.1.2 Justification when omitting any carbon pool or GHG emissions/removals from activities under Article 3.3 and elected activities under Article 3.4

The carbon stock changes in the soil and in the forest litter of Forest land remaining forest is not expected to occur and hence following the GPG LULUCF (IPCC, 2003) tier 1 approach. The carbon stock changes in the soil and in the forest litter relate only with changes of area in Forest land remaining forest. Data of biomass burning is negligible, practically is not significant with high level of uncertainties and therefore will be improved in future.
For estimation of carbon stock change of dead wood was assumed to be zero and reported as ‘NA’. By NFI 1998-2010 data changes of dead wood are not significant in the Afforestation/Reforestation lands, but some results will be provided for the next year submission. Lithuania has not data sources for carbon stock changes in forest litter and soils (except drainage in organic soils) of Afforestation/Reforestation lands and reported ‘NA’.

11.3.1.3 Information on whether or not indirect and natural GHG emissions and removals have been factored out

No factoring out has been performed in the emission and removal estimates.

11.3.1.4 Changes in data and methods since the previous submission (recalculations)

No recalculations were performed since the last submission, most of estimations for 2008 are presented for the first time.

11.3.1.5 Uncertainty estimates

Currency of data is NFI data. Standard error for the total forest land area is 1%.Standard error for land converted to forest is 9% and for land of Deforestation is 30%. Standard error of growing stock volume increment is 1.3% for total forest land. A standard error of harvesting stock is 4.7%.

11.3.1.6 Information on other methodological issues

In it's Initial report under the Kyoto protocol Lithuania has chosen to account for the emissions and removals under Articles 3.3 and 3.4 at the end of the commitment period. Lithuania will further develop the methods for area estimation as well as the methods to estimate removals and emissions of greenhouse gases. Taking into account this, the estimates presented in this submission for years 2008 and 2009 may change in the final report at the end of the commitment period.

11.3.1.7 The year of the onset of an activity, if after 2008

Not relevant for Lithuania.

11.4 Article 3.3

11.4.1 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

The data of NFI cover the period starting from 1998. Data of Afforestation, Reforestation and Deforestation for period 1990-1997 will be estimated as the result of comparison and analysis data of LSFC and NFI during 1998 – 2011 years.

11.4.2 Information on how harvesting or forest disturbance that is followed by the *re-establishment of forest is distinguished from deforestation*

According to Lithuanian Forest Law the clear cut areas should be reforested during 3 years and are under strict control of forest management and State inspection.

Temporarily unstocked areas after harvesting remain forests and are not accounted as deforestation.
Deforestation is inventoried by NFI. NFI measures records all visible changes from forest land to non-forest land area on every sample plot, e.g. after building of roads and ditches, establishment of peat exploitation areas and other.

11.4.3 Information on the size and geographical location of forest areas that have lost forest *cover but which are not yet classified as deforested*

Clear-cuts area in forests land is not considered as Deforestation in Lithuania. In 2008 the area of clear fellings was 14,909 ha and in 2009 - 13,558 ha.

11.4.4 Emissions and removals under Article 3.3

The Afforestation/ Reforestation activities were a net source of 252.05 Gg CO_2 in 2008 and 378.18 Gg CO_2 in 2009 (Table 11-5). For the Afforestation/ Reforestation it was assumed that carbon inputs and losses in dead wood balance are equal and net change is close to zero (NA). Quality data for forest litter and mineral soils is not available (NA). The Deforestation activities were a net source of 401.61 Gg CO_2 in 2008 and 574.35 Gg CO_2 in 2009 (Table 11-6).

Table 11-5. Carbon stock change and emission/removals of CO_2 in Afforestation/ Reforestation

Year	Carbon stock change in living biomass, Gg		Carbon stock change in dead organic matter, Gg		Carbon stock change in soil, Gg		Total carbon stock change, Gg	Emision/ removals of CO_2, Gg
	Above-ground	Below-ground	Dead wood	Forest litter	Mineral soil	Organic soil		

2008	66.23	15.11	NA	NA	NA	-12.60	**68.74**	**-252.05**
2009	94.71	21.62	NA	NA	NA	-13.19	**103.14**	**-378.18**

Table 11-6. Carbon stock change and emission/removals of CO_2 in Deforestation

Year	**Carbon stock change in living biomass, Gg**		**Carbon stock change in dead organic matter, Gg**		**Carbon stock change in soil, Gg**		**Total carbon stock change, Gg**	**Emision/ removals of CO_2, Gg**
	Above-ground	Below-ground	Dead wood	Forest litter	Mineral soil	Organic soil		
2008	-37.24	-8.50	-1.90	-15.51	-37.58	-8.80	**-109.53**	**401.61**
2009	-53.27	-12.17	-2.76	-22.15	-53.69	-12.60	**-156.64**	**574.35**

11.5 Article 3.4

11.5.1 Information that demonstrates that activities under Article 3.4 have occurred since *1 January 1990 and are human-induced*

Forests in January 1990 were under Forest management, since Lithuania considers all forest land managed and human-induced.
NFI system ensure data provision about results of human-induced activities in Lithuanian forest area from 1998. Data for early period is modelled by experts comparing and analysing NFI and LSFC data.

11.5.2 Information relating to Cropland Management, Grazing Land Management and *Revegetation, if elected, for the base year*

Lithuania has not chosen to account emissions and removals from Cropland Management, Grazing Land Management and Revegetation under Article 3.4 of the Kyoto Protocol.

11.5.3 Information relating to Forest Management

Information relating to Forest management is received objectively from NFI. Permanent sample plots are hidden, what means that they can be identified only during NFI measurements and are not visible and known for forest owners or managers, who could subjectively influence forest management results.
Net removals and emissions results from Forest management are provided in Table 11-7.

Table 11-7. Net removals and emissions from Forest management in 2008 and 2009 (Gg CO_2 eq)

	2008	**2009**
Net CO_2 removals	-4.186,62	-4.033,51
CH_4 and N_2O emission	23,08	23,47
Total	-4.163,54	-4.010,04

11.5.3.1 That the definition of forest for this category conforms with the definition in item 11.1 above

In accordance with definitions in item 11.1 above, all forest land is managed and there is no unmanaged forest land in Lithuania.

11.5.3.2 That forest management is a system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner (paragraph 1 (f) of the annex to decision 16/CMP.1 (Land use, land –use change and forestry)

Forest represent one of the major Lithuanian natural resources serving for the welfare of the state and its citizens, preserving the stability of the landscape and environment quality. Despite the forest ownership form, forest, primarily, is the national property that shall be preserved for the future generations at the same meeting the ecological, economic and social needs of the society. Being a source of supply with timber and other forest products, forest is the essential factor of the ecological balance providing living places for numerous animal and plant species, stopping the soil erosion, absorbing the carbon dioxide and purifying the air, protecting the ground and the surface waters, providing opportunities for recreation of the urban and rural people.

With the purpose of ensuring a sustainable forestry development, satisfying of the forest-related needs of various groups of the society, and ensuring preservation of forests for further generations, acknowledging a long forest growth duration, and taking into regard the differences of the ownership forms and their relationship, by promoting conditions for proper management of forests with the purpose of economic benefits for the country, a long-term forestry policy has been formed in Lithuania in compliance to the policies of other branches of the economy of the country, based on the traditions of the country and requirements of the European Union legal norms, international conventions, resolutions, agreements, programmes, and national legal acts.

The following instruments are used for the purpose of implementation of the forestry policy: well-organised, qualified forestry administration independent from any temporal political changes; the Forest Law and other legal acts; taxes revenues and financial support; education and training; management of the forestry information; public relations.

The Lithuanian forestry policy is being formed upon the following principles:

1) responsibility for the continuous and sustainable use of the forest resources
Considering the role of forests as the major source of the renewable natural resources for the society, the forestry policy ensures the responsibility of forest owners, forest governors and users for the state of forests and a sustainable use of resources and their restoration. The state, trough the execution of the state regulating functions of all forests of the country, developing of the forest infrastructure, forest protection against the natural calamities, widespread diseases and pests, provides legal, financial and other preconditions for the preservation of forests, rational use of the forest resources, meeting the social needs of the society and for the environment protection;

2) compliance to the national legal system and international agreements
The Lithuanian forestry policy is formed following the Constitution of the Republic of Lithuania and other legal acts, and also the Convention on the Conservation of European Wildlife and Natural Habitat, signed in 1979 in Bern, the Biodiversity Convention signed in Rio de Janeiro in 1992, and Forest Protection Principles adopted at the United Nations conference "Environment and Development", the Strasbourg 1990, Helsinki 1993, and Lisbon 1998 resolutions of the Ministerial Conferences on Protection of Forests in Europe , the principles of the European Union forestry strategies, European Union directives on forestry and environment protection issues;

3) participation and co-operation of all interested groups of the society
The policy takes into regard the opinion of all interested groups of the society, complies and balances the interests of forest owners, forest governors and users, wood processors, environmental organisations, and other social groups related to forest and forestry-related economy. All major forestry policy statements shall be in compliance with separate stakeholders and submitted for public consideration of the society;

4) variety of forest ownership forms and their equality of rights

The equality of rights for economic activities in forests of all ownership forms is implemented. Equal legal and other conditions both for the management and economic activities in private as well as state-owned forests are created. During the development of the Lithuania forestry, the market economy relationship and free competition principles are strengthened at the private as well as in the state-owned forestry sector;

5) forestry complexity
Forestry is being developed in a complex manner upon the basis of multiple use taking into regard its significance and relations to the consumers of the forest products and services, wood processing industry structures as well as other groups of society having their interests in forests and forestry;

6) continuation of the forestry traditions
The Lithuanian forestry has traditions tested through the course of time, which are taken into consideration during the transfer of the experience of foreign countries. Forestry reforms and reorganisations, implementation of novelties on the forestry management and other issues shall be performed consistently, taking into consideration the practical know-how of the specialists, public opinion, and interests of the state.

Mission of the State in the forestry development is:

- To form and implement a rational forestry development policy, which would ensure ecologically, economically and socially balanced development of the forestry sector.
- To ensure the stability of the forest ecosystems, preservation of the biodiversity, increase of the forest productivity, improvement of their quality and healthiness.
- To preserve the valuable forest genetic fund by using the national forest genetic resources for the establishing and creating of new objects of forest seed basis.
- To increase the forest cover of Lithuania by planting forests on uncultivated and poor-quality soils as well as other non-used land areas where forest planting would contribute to the formation of the Lithuanian natural carcass.
- To ensure the variety of forest ownership forms and the efficiency of forestry state regulation.
- To ensure meeting of the general forest-related social needs of the society.
- To create a favourable legal, economic and institutional environment for the effective and competitive functioning of the forest economy, wood industry and a variety of forest business enterprises in a free market.
- To encourage innovations, competitiveness, development of markets and establishment of working places.
- To ensure the maintenance of the scientific potential and its rational application as well as the preparation of high-qualification forestry specialists.

11.6 Other information

11.6.1 Key category analysis for Article 3.3 activities and any elected activities under Article 3.4

Key category analysis for KP-LULUCF was developed according to section 5.4 of the IPCC GPG for LULUCF.
Categories under Articles 3.3 and 3.4 were considered as key if their contribution was greater than the smallest category considered key in the UNFCCC inventory (including LULUCF). The results are presented in Table 11-8.

Table 11-8. Key categories for Article 3.3 and 3.4. activities.

Key categories of emissions and removals	Gas	Criteria used for key category identification	
		Associated category in UNFCCC inventory is key	Category contribution is greater than the smallest category considered key in the UNFCCC inventory (including LULUCF)
Forest Management	CO_2	Forest land remaining forest land	Yes
Forest Management	CH_4	Forest land remaining forest land	No
Forest Management	N_2O	Forest land remaining forest land	No
Afforestation and Reforestation	CH_4	Conversion to forest land	No
Afforestation and Reforestation	CO_2	Conversion to forest land	Yes
Afforestation and Reforestation	N_2O	Conversion to forest land	No
Deforestation	CH_4	Forest land remaining forest land	No
Deforestation	CO_2	Forest land remaining forest land	Yes
Deforestation	N_2O	Forest land remaining forest land	No

11.7 Information relating to Article 6

No projects in this sector under Article 6 (Joint implementation projects) are implemented in Lithuania.

12 INFORMATION ON ACCOUNTING OF KYOTO UNITS

12.1 Background information

The standard electronic format (SEF) tables are included in the submission (see “2011-01-12 SEF Registry Data for EC_LT.xls” attached to the submission). The SEF tables include information on the AAU, ERU, CER, t-CER, l-CER and RMU in the Lithuania’s registry as well as information on transfers of the units in 2010 to and from other Parties of the Kyoto Protocol.

12.2 Summary of information reported in the SEF tables

At the beginning of the 2010 there were 211 667 698 AAUs in the Lithuania’s national holding account and 3 309 036 EUAs converted from AAUs in the entity holding accounts. At the end of 2010 202 353 017 AAUs were left in National holding account, 396 371 0 AAUs, 771 357 CERs and 512 342 ERUs were held in the entity holding accounts.

9 880 407 AAUs, 461 637 ERUs and 1 550 891 CERs were surrendered by Lithuania’s operators and retired to Lithuania’s national retirement account.

The registry did not contain any RMUs, t-CERs or l-CERs and no units were in the Article 3.3/3.4 net source cancellation accounts and the t-CER and l-CER replacement accounts.

Total of 219 493 361 Kyoto protocol units were stored in the ETR accounts at the end of 2010.
Lithuania’s assigned amount is 227 306 177 tonnes CO2 eq.

12.3 Discrepancies and notifications

No discrepancies and notifications occurred in 2010.

12.4 Publicly accessible information

The information required to be publicly accessible by the decision 13/CMP/1 is available in the user interface of the Lithuania’s ETR – http://etr.am.lt. . It is also accessible via Registry management office web page on www.laaif.lt.

12.5 Updating CPR

Each Party included in Annex I shall maintain, in its national registry, a commitment period reserve which should not drop below 90 per cent of the Party’s assigned amount calculated pursuant to Article 3, paragraphs 7 and 8, of the Kyoto Protocol, or 100 per cent of five times the most recently reviewed inventory, whichever is lowest.

In the case of the Lithuania, the relevant size of the Commitment Period Reserve is five times the most recent inventory (2009), which is calculated below:

5 x 20,390.4 = **101,952.05 Gg CO_2 eqv**

13 INFORMATION ON CHANGES IN NATIONAL SYSTEM

Legal basis for National System

In order to strengthen the institutional arrangements for the functioning of the National system and ensuring consistent long-term-financing, continuity of its inventory experts and a proper data collection the new National system with re-defined responsibilities was designed.

By the Order No D1-1017 of Minister of Environment of 22 December 2010, the **Lithuanian Environmental Protection Agency under the Ministry of Environment was nominated as an institution responsible for GHG inventory preparation starting** from 2011. The Agency‘s responsibilities inter alia include monitoring of environmental quality, collection and storage of environmental data and information as well as assessment and forecasting of environmental quality. Aiming to ensure consistent long-term-financing, the preparation of the National GHG Inventory Report is included in the State Environment Monitoring Programme for the 2011-2016 year, which will be approved by the Government of Lithuania at the beginning of this year. The Environmental Protection Agency under the Ministry of Environment is a responsible authority for the implementation of the State Environment Monitoring Programme and coordinates all issues related to this programme.

Aiming to set up the system which ensures better data collection for the preparation of National Inventory, the amendment No 1540 of the Government Resolution No 388 of 7 April 2004 On Confirmation of Rules for the Reporting on the Implementation of the European Union Legal Acts to the European Commission and the Provision of Information Required for the Preparation of Reports to the European Environmental Protection Agency was adopted on 3 November 2010. The Government Resolution **determines responsibilities of other ministries and their subordinated institutions, as well as other institutions and the state science research institutes to provide data** which they collect and possess and are required for the inventory compilation (Table 1). In the Government Resolution different ministries (e. g. Ministry of Agriculture, Ministry of Energy, Ministry of Communication, Ministry of Economy, etc.) are assigned to collect more precise information from institutions and agencies within their jurisdiction and provide all this information to Ministry of Environment and its authorized institution - Environmental Protection Agency. The state science research institutes are authorized to perform new scientific researches, which are necessary for the improvement of data collection in the sectors were the lack of data is identified, and to provide information required for the preparation of the National Inventory Report.

On 29 of July 2010 the Order No D1-666 of the Minister of Environment was approved, which **determines the responsibilities to the State Forest Service to collect, analyse and estimate forestry data** for the reporting of information on anthropogenic GHG by sources and removals by sinks from land use, land-use change and forestry activities under Article 3, p. 3, forest management under Article 3, p. 4 and supplementary information under Article 7 of the Kyoto Protocol (KP-LULUCF). The State Forest Service prepares the National Forest Inventory of Lithuania. The National Forest Inventory is based on the method of continuous, combined, multistage with partial replacement sampling. Sampling of units is carried out systematically at random start by combining repeated inventory of permanent plots with the measurements of temporary plots, and by combining overground measurements with the measurements and assessment on satellite image maps and aerial photos. The same methods and data which they use for the National Forest Inventory will be used for GHG inventory, calculated under requirements of UNFCCC guidelines.

The Government Resolution No 683 on establishing permanent GHG inventory working group consisting of sectoral experts, mainly from State science research institutes, and determining their rules, responsibilities and financing provisions have been approved on 8 June 2011. Working group for inventory preparation is set up for unlimited time and the State’s budget financing for GHG inventory preparation is determined by this Resolution.

Minister of Environment Order No D1-538 on the approval of the personal composition of the working group for the preparation of the National GHG inventory report was approved on 1 July 2011. The institutions and experts involved in this working group are those which already have experience in GHG emissions and removals estimation (Center for Environmental Policy, Institute of Animal Science, State Forest Service, Energy Institute) as well as new institutions are involved (National Land Service, Institute of Physics). The permanent working group in close cooperation with the Climate Change Division of the Ministry of Environment and the Environmental Protection Agency would have to ensure reliability of the national system and continuity of expertise in different sectors.

Institutional Arrangement and Process for Inventory Preparation

National system for Lithuanian GHG inventory is changing over the time: until the year 2011 one of the key institutions involved in GHG inventory preparation was the Centre for Environmental Policy. It was assigned on the contract basis annually as a GHG inventory compiler. Aiming to increase institutional capacity for inventory preparation and continuity of the inventory preparation process in compliance with Guidelines for National systems under Article 5 paragraph 1 of the Kyoto Protocol (decision 19/CMP.1) starting from the year 2011, the Environmental Protection Agency under the Ministry of Environment was designated as an inventory compiler.

Earlier last year, the State Forestry Service undertook responsibility to prepare annually GHG inventory part related to LULUCF and supplementary information required under Article 7, paragraph 1 (KP-LULUCF articles 3.3 and 3.4).

The most important challenge now is experience and knowledge transfer from previous to present structure and the ability of the new National system timely produce high quality GHG inventory complying with all UNFCCC and EU requirements.

The principle diagram showing institutions responsible for the preparation of the GHG inventory in Lithuania and their interaction is shown in Fig.13-1. The entities participating in this scheme are:

- Ministry of Environment
- Environmental Protection Agency
- GHG inventory working group established by the Government Resolution No 683
- National Climate Change Committee
- Data providers
- External consultants

Detailed description of the specific functions of each entity participating in GHG inventory preparation and more explicit information on planned improvements of the National System of the preparation of GHG inventory was presented in the Plan of Improvements for Lithuania’s GHG inventory, submitted to the UNFCCC Secretariat and European Commission in January 2011 (it does not include information on Draft Government Resolution on establishing permanent GHG inventory working group) and in the updated QA/QC plan.

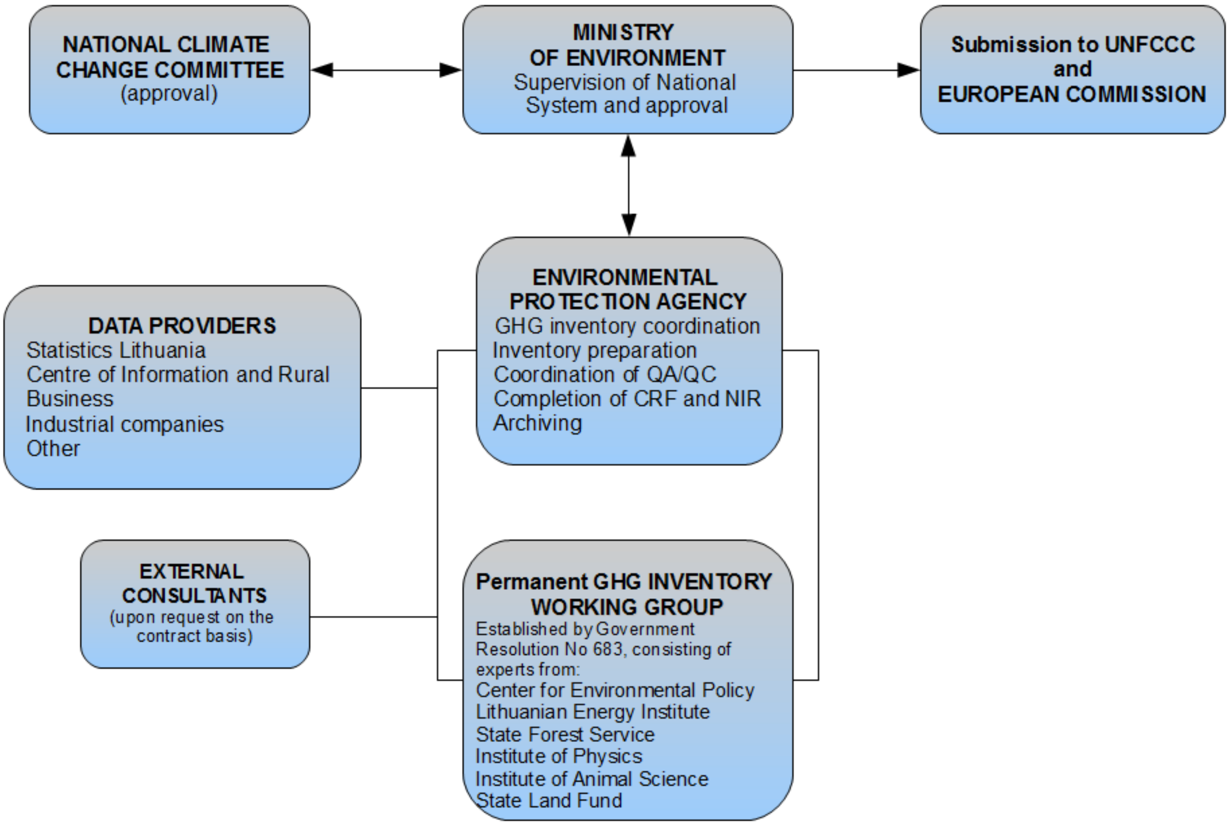


Figure 13-1. Institutional set-up for Lithuania's GHG inventory (from 2012 GHG inventory submission)

14 INFORMATION ON CHANGES IN THE NATIONAL GREENHOUSE GAS REGISTRY

General description and background information on the National GHG Registry has been included in the Lithuania's Initial Report, submitted to the UNFCCC. Lithuanian GHG Registry has been completely operational since 2005.The UNFCCC Secretariat completed the live connection between the UNFCCC International Transaction Log (ITL) and the Lithuanian Registry on the 6th of October, 2008. The whole process was synchronized between ITL, the European Union Community Independent Transaction Log (CITL) and 26 EU greenhouse gas emissions trading registries in 2008. There was a migration of registry data from GRETA (UK) to Community Registry (EC) software in October 2009, followed by the successfully performed EU ETS and Annex H of Data Exchange Standards for Registry Systems under the Kyoto Protocol (Technical specifications) tests. There were no other changes in National Registry according to 15/CMP.1 annex II.E paragraph 32 (a) to (j) during the reported year.

15 INFORMATION ON MINIMIZATION OF ADVERSE IMPACTS IN ACCORDANCE WITH ARTICLE 3, PARAGRAPH 14

Lithuania is striving under the Kyoto protocol to implement its commitments in such a way as to minimize adverse social, environmental and economic impacts on developing countries.

During the international negotiations on the post-2012 climate change regime EU and its member states ' committed to provide EUR 7.2 billion cumulatively over the period 2010 – 2012 to fast start finance, in order to promote the implementation of climate change measures in developing countries. In this context Lithuania has committed to provide 3 million EUR. Lithuania has already started the implementation its commitments and transferred part of the funds to the Energy Sector Management Assistance Program (ESMAP) under the World Bank. The program addresses the challenges posed by energy security, poverty reduction and climate change through its core functions as a think thank and knowledge clearing house, but also through operational leveraging. ESMAP assists low- and middle-income countries to promote environmentally sustainable energy solutions for poverty reduction and economic growth. ESMAP offers pre-investment activities such as analytical and advisory activities, studies, pilot projects, conferences, trainings and workshops, but not investments themselves. A priori the potential of investments are analysed, while ex post best practices are gathered, evaluations are undertaken and knowledge is transferred.

In accordance with the provisions of the Law on Financial instruments for climate change management, adopted on 7 July 2009 by the Parliament of the Republic of Lithuania, a Special Programme for Climate Change (SPCC) was established. The aim of this programme is to rise additional funding for the climate change management measures. One of the areas where the funds of the SPCC shall be used is the implementation, in the territory of the Republic of Lithuania and third countries, of measures of adaptation to climate change and mitigation of climate change effects as stipulated under legal acts of the European Union, the Convention on Climate Change, the Kyoto Protocol and other international agreements. Currently there are no funds in the SPCC, therefore no initiatives in financing climate change mitigation and adaptation to climate change measures in developing countries are being undertaken.

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ANNEX 1. Key source category analysis

Key category analysis excluding LULUCF: 1990

Key Category	GHG emissions, Gg CO2 eq.	Level assessment	Cumulative total
Stationary Combustion, liquid fuel, CO2	12,931.45	26.0%	26.0%
Stationary Combustion, gaseous fuel, CO2	9,515.67	19.2%	45.2%
Road transportation, CO2	5,247.18	10.6%	55.8%
Stationary Combustion, solid fuel, CO2	3,160.87	6.4%	62.1%
Enteric Fermentation domestic livestock, CH4	3,134.94	6.3%	68.5%
Direct Soil Emissions, N2O	2,391.15	4.8%	73.3%
Other transportation	1,971.55	4.0%	77.2%
Indirect Emissions, N2O	1,809.99	3.6%	80.9%
Cement Production, CO2	1,668.07	3.4%	84.3%
Manure Management, CH4	1,333.07	2.7%	86.9%
Ammonia Production, CO2	1,190.53	2.4%	89.3%
Nitric Acid Production, N2O	907.93	1.8%	91.2%
Manure Management, N2O	817.06	1.6%	92.8%
Waste-water Handling, CH4	774.86	1.6%	94.4%
Solid Waste Disposal on Land, CH4	752.94	1.5%	95.9%
Pasture, Range and Paddock Manure, N2O	388.87	0.8%	96.7%
Railways, CO2	349.94	0.7%	97.4%
Other industries, CO2	247.41	0.5%	97.9%
Lime Production, CO2	216.42	0.4%	98.3%
Stationary Combustion, CH4	199.14	0.4%	98.7%
Solvent and other product use	197.61	0.4%	99.1%
Fugitive Emissions from Oil and Gas Operations	150.43	0.3%	99.4%
Waste-water Handling, N2O	79.91	0.2%	99.6%
Stationary Combustion, N2O	69.96	0.1%	99.7%
Road transportation, N2O	62.30	0.1%	99.8%
Iron and steel, CO2	21.41	0.0%	99.9%
Road transportation, CH4	19.97	0.0%	99.9%
Navigation, CO2	15.45	0.0%	100.0%
Soda Ash Production and Use, CO2	4.99	0.0%	100.0%
Limestone and Dolomite Use, CO2	4.48	0.0%	100.0%
Railways, N2O	4.46	0.0%	100.0%
Waste Incineration, CO2	4.00	0.0%	100.0%
Methanol production	3.83	0.0%	100.0%
Aviation, CO2	0.70	0.0%	100.0%
Railways, CH4	0.50	0.0%	100.0%
Waste Incineration, N2O	0.17	0.0%	100.0%
Navigation, N2O	0.04	0.0%	100.0%
Navigation, CH4	0.01	0.0%	100.0%
Aviation, N2O	0.01	0.0%	100.0%
Aviation, CH4	0.00	0.0%	100.0%
Military use	0.00	0.0%	100.0%
Consumption of HFCs	0.00	0.0%	100.0%
Consumption of SF6	0.00	0.0%	100.0%

Key category analysis including LULUCF: 1990

Key Category	GHG emissions, Gg CO2 eq.	Level assessment	Cumulative total
Stationary Combustion, liquid fuel, CO2	12,931.4	23.3%	23.3%
Stationary Combustion, gaseous fuel, CO2	9,515.7	17.2%	40.5%
Road transportation, CO2	5,247.2	9.5%	49.9%
Forest Land , CO2	5,068.1	9.1%	59.1%
Stationary Combustion, solid fuel, CO2	3,160.9	5.7%	64.8%
Enteric Fermentation domestic livestock, CH4	3,134.9	5.7%	70.4%
Direct Soil Emissions, N2O	2,391.2	4.3%	74.7%
Other transportation	1,971.5	3.6%	78.3%
Indirect Emissions, N2O	1,810.0	3.3%	81.6%
Cement Production, CO2	1,668.1	3.0%	84.6%
Manure Management, CH4	1,333.1	2.4%	87.0%
Ammonia Production, CO2	1,190.5	2.1%	89.1%
Nitric Acid Production, N2O	907.9	1.6%	90.8%
Manure Management, N2O	817.1	1.5%	92.2%
Waste-water Handling, CH4	774.9	1.4%	93.6%
Solid Waste Disposal on Land, CH4	752.9	1.4%	95.0%
Pasture, Range and Paddock Manure, N2O	388.9	0.7%	95.7%
Railways, CO2	349.9	0.6%	96.3%
Other land, CO2	283.1	0.5%	96.8%
Other industries, CO2	247.4	0.4%	97.3%
Lime Production, CO2	216.4	0.4%	97.7%
Stationary Combustion, CH4	199.1	0.4%	98.0%
Solvent and other product use	197.6	0.4%	98.4%
Wetlands, CO2	175.2	0.3%	98.7%
Settlements, CO2	165.2	0.3%	99.0%
Fugitive Emissions from Oil and Gas Operations	150.4	0.3%	99.3%
Cropland, CO2	93.4	0.2%	99.4%
Waste-water Handling, N2O	79.9	0.1%	99.6%
Stationary Combustion, N2O	70.0	0.1%	99.7%
Road transportation, N2O	62.3	0.1%	99.8%
Iron and steel, CO2	21.4	0.0%	99.9%
Forest Land, N2O	20.5	0.0%	99.9%
Road transportation, CH4	20.0	0.0%	99.9%
Navigation, CO2	15.5	0.0%	100.0%
Soda Ash Production and Use, CO2	5.0	0.0%	100.0%
Limestone and Dolomite Use, CO2	4.5	0.0%	100.0%
Railways, N2O	4.5	0.0%	100.0%
Waste Incineration, CO2	4.0	0.0%	100.0%
Methanol production	3.8	0.0%	100.0%
Aviation, CO2	0.7	0.0%	100.0%
Railways, CH4	0.5	0.0%	100.0%
Waste Incineration, N2O	0.2	0.0%	100.0%
Forest Land, CH4	0.2	0.0%	100.0%
Navigation, N2O	0.0	0.0%	100.0%
Navigation, CH4	0.0	0.0%	100.0%
Aviation, N2O	0.0	0.0%	100.0%
Aviation, CH4	0.0	0.0%	100.0%

Military use	0.0	0.0%	100.0%
Consumption of HFCs	0.0	0.0%	100.0%
Consumption of SF6	0.0	0.0%	100.0%

Key category analysis excluding LULUCF: 2009

Key Category	GHG emissions, Gg CO2 eq.	Level assessment	Cumulative total
Road transportation, CO2	3,965.41	19.4%	19.4%
Stationary Combustion, gaseous fuel, CO2	3,734.40	18.3%	37.8%
Stationary Combustion, liquid fuel, CO2	2,556.65	12.5%	50.3%
Direct Soil Emissions, N2O	1,375.09	6.7%	57.0%
Enteric Fermentation domestic livestock, CH4	1,283.31	6.3%	63.3%
Ammonia Production, CO2	1,173.01	5.8%	69.1%
Indirect Emissions, N2O	925.14	4.5%	73.6%
Solid Waste Disposal on Land, CH4	891.59	4.4%	78.0%
Nitric Acid Production, N2O	731.28	3.6%	81.6%
Stationary Combustion, solid fuel, CO2	655.91	3.2%	84.8%
Manure Management, CH4	559.09	2.7%	87.5%
Waste-water Handling, CH4	475.14	2.3%	89.9%
Manure Management, N2O	319.60	1.6%	91.4%
Cement Production, CO2	284.02	1.4%	92.8%
Fugitive Emissions from Oil and Gas Operations	269.84	1.3%	94.2%
Other transportation	226.72	1.1%	95.3%
Pasture, Range and Paddock Manure, N2O	203.64	1.0%	96.3%
Railways, CO2	175.01	0.9%	97.1%
Stationary Combustion, CH4	141.13	0.7%	97.8%
Solvent and other product use	100.34	0.5%	98.3%
Consumption of HFCs	88.21	0.4%	98.7%
Waste-water Handling, N2O	75.41	0.4%	99.1%
Stationary Combustion, N2O	55.51	0.3%	99.4%
Road transportation, N2O	50.29	0.2%	99.6%
Navigation, CO2	16.49	0.1%	99.7%
Other industries, CO2	14.83	0.1%	99.8%
Road transportation, CH4	12.21	0.1%	99.8%
Military use	11.38	0.1%	99.9%
Consumption of SF6	5.00	0.0%	99.9%
Lime Production, CO2	4.25	0.0%	99.9%
Iron and steel, CO2	4.03	0.0%	100.0%
Aviation, CO2	2.56	0.0%	100.0%
Railways, N2O	2.23	0.0%	100.0%
Waste Incineration, CO2	0.64	0.0%	100.0%
Soda Ash Production and Use, CO2	0.45	0.0%	100.0%
Railways, CH4	0.25	0.0%	100.0%
Limestone and Dolomite Use, CO2	0.19	0.0%	100.0%
Waste Incineration, N2O	0.05	0.0%	100.0%
Navigation, N2O	0.04	0.0%	100.0%
Aviation, N2O	0.02	0.0%	100.0%
Navigation, CH4	0.01	0.0%	100.0%

Aviation, CH4	0.01	0.0%	100.0%
Methanol production	0.00	0.0%	100.0%

Key category analysis including LULUCF: 2009

Key Category	GHG emissions, Gg CO2 eq.	Level assessment	Cumulative total
Forest Land , CO2	4,411.96	17.3%	17.3%
Road transportation, CO2	3,965.41	15.6%	32.9%
Stationary Combustion, gaseous fuel, CO2	3,734.40	14.7%	47.6%
Stationary Combustion, liquid fuel, CO2	2,556.65	10.0%	57.6%
Direct Soil Emissions, N2O	1,375.09	5.4%	63.0%
Enteric Fermentation domestic livestock, CH4	1,283.31	5.0%	68.1%
Ammonia Production, CO2	1,173.01	4.6%	72.7%
Indirect Emissions, N2O	925.14	3.6%	76.3%
Solid Waste Disposal on Land, CH4	891.59	3.5%	79.8%
Nitric Acid Production, N2O	731.28	2.9%	82.7%
Stationary Combustion, solid fuel, CO2	655.91	2.6%	85.3%
Manure Management, CH4	559.09	2.2%	87.5%
Waste-water Handling, CH4	475.14	1.9%	89.3%
Manure Management, N2O	319.60	1.3%	90.6%
Other land, CO2	295.53	1.2%	91.7%
Cement Production, CO2	284.02	1.1%	92.9%
Fugitive Emissions from Oil and Gas Operations	269.84	1.1%	93.9%
Other transportation	226.72	0.9%	94.8%
Pasture, Range and Paddock Manure, N2O	203.64	0.8%	95.6%
Railways, CO2	175.01	0.7%	96.3%
Settlements, CO2	172.49	0.7%	97.0%
Wetlands, CO2	163.42	0.6%	97.6%
Stationary Combustion, CH4	141.13	0.6%	98.2%
Solvent and other product use	100.34	0.4%	98.6%
Consumption of HFCs	88.21	0.3%	98.9%
Waste-water Handling, N2O	75.41	0.3%	99.2%
Stationary Combustion, N2O	55.51	0.2%	99.4%
Road transportation, N2O	50.29	0.2%	99.6%
Forest Land, N2O	22.74	0.1%	99.7%
Navigation, CO2	16.49	0.1%	99.8%
Other industries, CO2	14.83	0.1%	99.8%
Road transportation, CH4	12.21	0.0%	99.9%
Military use	11.38	0.0%	99.9%
Consumption of SF6	5.00	0.0%	99.9%
Lime Production, CO2	4.25	0.0%	100.0%
Iron and steel, CO2	4.03	0.0%	100.0%
Aviation, CO2	2.56	0.0%	100.0%
Railways, N2O	2.23	0.0%	100.0%
Waste Incineration, CO2	0.64	0.0%	100.0%
Soda Ash Production and Use, CO2	0.45	0.0%	100.0%
Forest Land, CH4	0.40	0.0%	100.0%
Railways, CH4	0.25	0.0%	100.0%

Limestone and Dolomite Use, CO2	0.19	0.0%	100.0%
Waste Incineration, N2O	0.05	0.0%	100.0%
Navigation, N2O	0.04	0.0%	100.0%
Aviation, N2O	0.02	0.0%	100.0%
Navigation, CH4	0.01	0.0%	100.0%
Aviation, CH4	0.01	0.0%	100.0%
Methanol production	0.00	0.0%	100.0%
Cropland, CO2	0.00	0.0%	100.0%

Trend assessment excluding LULUCF: 1990-2009

Key Category	GHG emissions, Gg CO2 eq.		Level assessment 2009	Trend assessment		Cumulative total
	1990	2009				
Stationary Combustion, liquid fuel, CO2	12,931.45	2,556.65	12.5%	32.9%	29.0%	29.0%
Road transportation, CO2	5,247.2	3,965.41	19.4%	21.6%	19.0%	48.0%
Ammonia Production, CO2	1,190.53	1,173.01	5.8%	8.2%	7.2%	55.2%
Stationary Combustion, solid fuel, CO2	3,160.9	655.91	3.2%	7.7%	6.8%	61.9%
Other transportation	1,971.55	226.72	1.1%	7.0%	6.1%	68.1%
Solid Waste Disposal on Land, CH4	752.9	891.59	4.4%	7.0%	6.1%	74.2%
Cement Production, CO2	1,668.07	284.02	1.4%	4.8%	4.2%	78.4%
Direct Soil Emissions, N2O	2,391.15	1,375.09	6.7%	4.7%	4.1%	82.5%
Nitric Acid Production, N2O	907.93	731.28	3.6%	4.3%	3.8%	86.3%
Fugitive Emissions from Oil and Gas Operations	150.43	269.84	1.3%	2.5%	2.2%	88.5%
Indirect Emissions, N2O	1,809.99	925.14	4.5%	2.2%	1.9%	90.4%
Stationary Combustion, gaseous fuel, CO2	9,515.67	3,734.40	18.3%	2.1%	1.8%	92.2%
Waste-water Handling, CH4	774.9	475.14	2.3%	1.9%	1.6%	93.9%
Consumption of HFCs	0.00	88.21	0.4%	1.1%	0.9%	94.8%
Other industries, CO2	247.4	14.83	0.1%	1.0%	0.9%	95.7%
Lime Production, CO2	216.42	4.25	0.0%	1.0%	0.9%	96.6%
Stationary Combustion, CH4	199.14	141.13	0.7%	0.7%	0.6%	97.2%
Pasture, Range and Paddock Manure, N2O	388.87	203.64	1.0%	0.5%	0.5%	97.7%
Waste-water Handling, N2O	79.9	75.41	0.4%	0.5%	0.4%	98.1%
Railways, CO2	349.94	175.01	0.9%	0.4%	0.3%	98.5%
Stationary Combustion, N2O	69.96	55.51	0.3%	0.3%	0.3%	98.8%
Road transportation, N2O	62.30	50.29	0.2%	0.3%	0.3%	99.0%
Solvent and other product use	197.6	100.34	0.5%	0.2%	0.2%	99.2%
Manure Management, N2O	817.1	319.60	1.6%	0.2%	0.2%	99.4%
Manure Management, CH4	1,333.07	559.09	2.7%	0.1%	0.1%	99.5%
Military use	0.00	11.38	0.1%	0.1%	0.1%	99.6%
Navigation, CO2	15.45	16.49	0.1%	0.1%	0.1%	99.7%
Consumption of SF6	0.0	5.00	0.0%	0.1%	0.1%	99.8%

Iron and steel, CO2	21.41	4.03	0.0%	0.1%	0.1%	99.8%
Enteric Fermentation domestic livestock, CH4	3,134.94	1,283.31	6.3%	0.0%	0.0%	99.9%
Road transportation, CH4	19.97	12.21	0.1%	0.0%	0.0%	99.9%
Aviation, CO2	0.70	2.56	0.0%	0.0%	0.0%	99.9%
Limestone and Dolomite Use, CO2	4.48	0.19	0.0%	0.0%	0.0%	100.0%
Soda Ash Production and Use, CO2	4.99	0.45	0.0%	0.0%	0.0%	100.0%
Waste Incineration, CO2	4.0	0.64	0.0%	0.0%	0.0%	100.0%
Railways, N2O	4.5	2.23	0.0%	0.0%	0.0%	100.0%
Railways, CH4	0.5	0.25	0.0%	0.0%	0.0%	100.0%
Navigation, N2O	0.04	0.04	0.0%	0.0%	0.0%	100.0%
Aviation, N2O	0.01	0.02	0.0%	0.0%	0.0%	100.0%
Waste Incineration, N2O	0.17	0.05	0.0%	0.0%	0.0%	100.0%
Navigation, CH4	0.01	0.01	0.0%	0.0%	0.0%	100.0%
Aviation, CH4	0.00	0.01	0.0%	0.0%	0.0%	100.0%
Methanol production	3.83	0.00	0.0%	0.0%	0.0%	100.0%

Trend assessment including LULUCF: 1990-2009

Key Category	GHG emissions, Gg CO2 eq.		Level assessment 2009	Trend assessment		Cumulative total
	1990	2009				
Stationary Combustion, liquid fuel, CO2	12,931.4	2,556.65	10.0%	28.9%	26.2%	26.2%
Forest Land , CO2	5,068.1	4,411.96	17.3%	17.8%	16.1%	42.3%
Road transportation, CO2	5,247.18	3,965.41	15.6%	13.3%	12.0%	54.4%
Stationary Combustion, solid fuel, CO2	3,160.87	655.91	2.6%	6.8%	6.2%	60.5%
Other transportation	1,971.5	226.72	0.9%	5.8%	5.3%	65.8%
Stationary Combustion, gaseous fuel, CO2	9,515.67	3,734.40	14.7%	5.4%	4.9%	70.7%
Ammonia Production, CO2	1,190.53	1,173.01	4.6%	5.4%	4.8%	75.5%
Solid Waste Disposal on Land, CH4	752.9	891.59	3.5%	4.7%	4.2%	79.7%
Cement Production, CO2	1,668.1	284.02	1.1%	4.1%	3.7%	83.5%
Nitric Acid Production, N2O	907.9	731.28	2.9%	2.7%	2.4%	85.9%
Direct Soil Emissions, N2O	2,391.15	1,375.09	5.4%	2.4%	2.1%	88.0%
Fugitive Emissions from Oil and Gas Operations	150.43	269.84	1.1%	1.7%	1.6%	89.6%
Other land, CO2	283.05	295.53	1.2%	1.4%	1.3%	90.9%
Enteric Fermentation domestic livestock, CH4	3,134.94	1,283.31	5.0%	1.3%	1.2%	92.1%
Waste-water Handling, CH4	774.86	475.14	1.9%	1.0%	0.9%	93.0%
Other industries, CO2	247.41	14.83	0.1%	0.8%	0.8%	93.8%
Settlements, CO2	165.21	172.49	0.7%	0.8%	0.7%	94.5%
Lime Production, CO2	216.42	4.25	0.0%	0.8%	0.7%	95.3%
Indirect Emissions, N2O	1,810.0	925.14	3.6%	0.8%	0.7%	96.0%
Consumption of HFCs	0.00	88.21	0.3%	0.8%	0.7%	96.7%
Wetlands, CO2	175.16	163.42	0.6%	0.7%	0.6%	97.3%
Manure Management, N2O	817.06	319.60	1.3%	0.5%	0.4%	97.7%
Manure Management, CH4	1,333.1	559.09	2.2%	0.5%	0.4%	98.2%
Stationary Combustion, CH4	199.14	141.13	0.6%	0.4%	0.4%	98.5%
Waste-water Handling, N2O	79.9	75.41	0.3%	0.3%	0.3%	98.8%
Pasture, Range and Paddock Manure, N2O	388.9	203.64	0.8%	0.2%	0.2%	99.0%
Stationary Combustion, N2O	70.0	55.51	0.2%	0.2%	0.2%	99.2%
Road transportation, N2O	62.30	50.29	0.2%	0.2%	0.2%	99.4%
Railways, CO2	349.94	175.01	0.7%	0.1%	0.1%	99.5%

Forest Land, N2O	20.46	22.74	0.1%	0.1%	0.1%	99.6%
Military use	0.00	11.38	0.0%	0.1%	0.1%	99.7%
Solvent and other product use	197.61	100.34	0.4%	0.1%	0.1%	99.8%
Navigation, CO2	15.5	16.49	0.1%	0.1%	0.1%	99.8%
Iron and steel, CO2	21.41	4.03	0.0%	0.0%	0.0%	99.9%
Consumption of SF6	0.0	5.00	0.0%	0.0%	0.0%	99.9%
Road transportation, CH4	20.0	12.21	0.0%	0.0%	0.0%	99.9%
Aviation, CO2	0.70	2.56	0.0%	0.0%	0.0%	100.0%
Limestone and Dolomite Use, CO2	4.48	0.19	0.0%	0.0%	0.0%	100.0%
Soda Ash Production and Use, CO2	4.99	0.45	0.0%	0.0%	0.0%	100.0%
Waste Incineration, CO2	4.0	0.64	0.0%	0.0%	0.0%	100.0%
Forest Land, CH4	0.17	0.40	0.0%	0.0%	0.0%	100.0%
Railways, N2O	4.46	2.23	0.0%	0.0%	0.0%	100.0%
Waste Incineration, N2O	0.17	0.05	0.0%	0.0%	0.0%	100.0%
Navigation, N2O	0.04	0.04	0.0%	0.0%	0.0%	100.0%
Railways, CH4	0.5	0.25	0.0%	0.0%	0.0%	100.0%
Aviation, N2O	0.01	0.02	0.0%	0.0%	0.0%	100.0%
Navigation, CH4	0.01	0.01	0.0%	0.0%	0.0%	100.0%
Aviation, CH4	0.00	0.01	0.0%	0.0%	0.0%	100.0%
Methanol production	3.8	0.00	0.0%	0.0%	0.0%	100.0%
Cropland, CO2	93.43	0.00	0.0%	0.0%	0.0%	100.0%

ANNEX 2. Tier I Uncertainty evaluation

1. Uncertainty evaluation excluding LULUCF

IPCC Source category	Gas	Base year (1990) emissions *	Emissions in 2009	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in 2008	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Gg CO_2 eqv	Gg CO_2 eqv	%	%	%	%	%	%	%	%	%
1A1 Energy Industries: liquid fuel	CO_2	7,786	2,288	2	5	5.4	0.61	-0.018	0.046	-0.09	0.13	0.16
1A1 Energy Industries: solid fuel	CO_2	193	29	2	5	5.4	0.01	-0.001	0.001	-0.01	0.00	0.01
1A1 Energy Industries: gaseous fuel	CO_2	5,982	2,576	2	5	5.4	0.68	0.002	0.052	0.01	0.15	0.15
1A1 Energy Industries: biomass				2	5	5.4	0.00	0.000	0.000	0.00	0.00	0.00
1A2 Manufacturing Industries	CO_2	5,954	993	3	5	5.8	0.29	-0.029	0.020	-0.15	0.09	0.17
1A3 Mobile combustion: road transport	CO_2	5,247	3,965	5	5	7.1	1.38	0.037	0.080	0.18	0.57	0.60
1A3 Mobile combustion: other transport	CO_2	2,132	414	3	5	5.8	0.12	-0.009	0.008	-0.05	0.04	0.06
1A4 Commercial/Institutional	CO_2	2,892	382	5	5	7.1	0.13	-0.016	0.008	-0.08	0.05	0.10
1A4 Residential	CO_2	2,382	595	5	5	7.1	0.21	-0.008	0.012	-0.04	0.09	0.09
1.B. Fugitive Emissions from Fuels	CO_2	1.0	9.5	5	5	7.1	0.00	0.000	0.000	0.00	0.00	0.00
1A4 Agriculture/Forestry/Fishing	CO_2	419	83	5	5	7.1	0.03	-0.002	0.002	-0.01	0.01	0.01
2A1 Cement Production	CO_2	1,668	284	2	5	5.4	0.08	-0.008	0.006	-0.04	0.02	0.04
2A2 Lime Production	CO_2	216	4	5	5	7.1	0.00	-0.002	0.000	-0.01	0.00	0.01
2A3 Limestone and dolomite use	CO_2	4	0.2	10	5	11.2	0.00	0.000	0.000	0.00	0.00	0.00
2A4 Soda ash use	CO_2	5	0.5	10	5	11.2	0.00	0.000	0.000	0.00	0.00	0.00

2A7.1Glass production	CO_2	13	5	7	5	8.6	0.00	0.000	0.000	0.00	0.00	0.00
2A7.2 Mineral wool production	CO_2	6	5	7	5	8.6	0.00	0.000	0.000	0.00	0.00	0.00
2A7.3 Bricks and tiles	CO_2	228	5	5	5	7.1	0.00	-0.002	0.000	-0.01	0.00	0.01
2B1 Ammonia production	CO_2	1,191	1,173	2	10	10.2	0.59	0.014	0.024	0.14	0.07	0.15
2.C.1.2 Cast iron production	CO_2	21	4	4	10	10.8	0.00	0.000	0.000	0.00	0.00	0.00
6C Waste incineration	CO_2	4	1	25	30	39.1	0.00	0.000	0.000	0.00	0.00	0.00
Total	CO_2	**36,345**	**12,818**				**1.80**					**0.69**
1A1, 1A2 Energy: stationary combustion	CH_4	16	12	3	50	50.1	0.03	0.000	0.000	0.01	0.00	0.01
1A3 Energy: mobile combustion	CH_4	22	13	5	50	50.2	0.03	0.000	0.000	0.00	0.00	0.00
1A4 Energy: other sectors	CH_4	183	129	5	50	50.2	0.32	0.001	0.003	0.05	0.02	0.06
1.A.5 Other	CH_4	IE,NE,NO	0									
2.B.5.5 Methanol production	CH_4	4	0	2	10	10.2	0.00	0.000	0.000	0.00	0.00	0.00
1B Fugitive Emissions	CH_4	149	260	5	15	15.8	0.20	0.004	0.005	0.06	0.04	0.07
4A Enteric Fermentation	CH_4	3,135	1,283	2	30	30.1	1.90	0.000	0.026	0.00	0.07	0.07
4B Manure Management	CH_4	1,333	559	20	25	32.0	0.88	0.000	0.011	0.01	0.32	0.32
6A Solid Waste	CH_4	753	892	30	50	58.3	2.56	0.012	0.018	0.59	0.76	0.97
6B Wastewater Handling	CH_4	775	475	30	50	58.3	1.37	0.003	0.010	0.16	0.41	0.44
Total	CH_4	**6,370**	**3,623**				**3.60**					**1.11**
1A1, 1A2, 1A4, 1A5 Energy: stationary combustion	N_2O	70	56	3	80	80.1	0.22	0.001	0.001	0.04	0.00	0.04
1A3 Energy: mobile combustion	N_2O	271	70	5	80	80.2	0.28	-0.001	0.001	-0.07	0.01	0.07
2B2 Nitric Acid Production	N_2O	908	731	2	30	30.1	1.08	0.007	0.015	0.22	0.04	0.22
4B Manure Management	N_2O	817	320	20	75	77.6	1.22	0.000	0.006	-0.02	0.18	0.18
4D1 Direct Soil Emissions	N_2O	2,391	1,375	20	100	102.0	6.91	0.008	0.028	0.80	0.79	1.12
4D2 Pasture Range and Paddock	N_2O	389	204	20	100	102.0	1.02	0.001	0.004	0.09	0.12	0.15
4D3 Indirect Soil Emissions	N_2O	1,810	925	20	100	102.0	4.65	0.004	0.019	0.37	0.53	0.65
6B Wastewater Handling	N_2O	80	75	30	50	58.3	0.22	0.001	0.002	0.04	0.06	0.08
6C Waste incineration	N_2O	0	0	25	100	103.1	0.00	0.000	0.000	0.00	0.00	0.00
Total	N_2O	**6,736**	**3,756**				**8.56**					**1.34**

2.F Consumption of halocargons and SF6			93	30	20	36.1	0.17	0.002	0.002	0.04	0.08	0.09
	Total emissions	**49,452**	**20,290**				**9.46**					**1.87**

* Base year for F-gases is 1995

2. Uncertainty evaluation including LULUCF

IPCC Source category	Gas	Base year (1990) emissions*	Emissions in 2009	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in 2008	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Gg CO_2 eqv	**Gg CO_2 eqv**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
1A1 Energy Industries: liquid fuel	CO_2	7,786	2,288	2	5	5.4	0.75	-0.012	0.051	-0.06	0.14	0.16
1A1 Energy Industries: solid fuel	CO_2	193	29	2	5	5.4	0.01	-0.001	0.001	0.00	0.00	0.00
1A1 Energy Industries: gaseous fuel	CO_2	5,982	2,576	2	5	5.4	0.84	0.009	0.057	0.04	0.16	0.17
1A1 Energy Industries: biomass		0	0	2	5	5.4	0.00	0.000	0.000	0.00	0.00	0.00
1A2 Manufacturing Industries	CO_2	5,954	993	3	5	5.8	0.35	-0.026	0.022	-0.13	0.09	0.16
1A3 Mobile combustion: road transport	CO_2	5,247	3,965	5	5	7.1	1.70	0.045	0.088	0.23	0.62	0.66
1A3 Mobile combustion: other transport	CO_2	2,132	414	3	5	5.8	0.15	-0.008	0.009	-0.04	0.04	0.06
1A4 Commercial/Institutional	CO_2	2,892	382	5	5	7.1	0.16	-0.015	0.008	-0.08	0.06	0.10
1A4 Residential	CO_2	2,382	595	5	5	7.1	0.25	-0.006	0.013	-0.03	0.09	0.10
1.B. Fugitive Emissions from Fuels	CO_2	1	10	5	5	7.1	0.00	0.000	0.000	0.00	0.00	0.00
1A4 Agriculture/Forestry/Fishing	CO_2	419	83	5	5	7.1	0.04	-0.002	0.002	-0.01	0.01	0.02
2A1 Cement Production	CO_2	1,668	284	2	5	5.4	0.09	-0.007	0.006	-0.04	0.02	0.04

2A2 Lime Production	CO_2	216	4	5	5	7.1	0.00	-0.002	0.000	-0.01	0.00	0.01
2A3 Limestone and dolomite use	CO_2	4	0	10	5	11.2	0.00	0.000	0.000	0.00	0.00	0.00
2A4 Soda ash use	CO_2	5	0	10	5	11.2	0.00	0.000	0.000	0.00	0.00	0.00
2A7.1Glass production	CO_2	13	5	7	5	8.6	0.00	0.000	0.000	0.00	0.00	0.00
2A7.2 Mineral wool production	CO_2	6	5	7	5	8.6	0.00	0.000	0.000	0.00	0.00	0.00
2A7.3 Bricks and tiles	CO_2	228	5	5	5	7.1	0.00	-0.002	0.000	-0.01	0.00	0.01
2B1 Ammonia production	CO_2	1,191	1,173	2	10	10.2	0.72	0.016	0.026	0.16	0.07	0.18
2.C.1.2 Cast iron production	CO_2	21	4	4	10	10.8	0.00	0.000	0.000	0.00	0.00	0.00
5.A.1. Forest Land remaining Forest Land	CO_2	-5,068	-4,412	2	5	5.4	-1.44	-0.057	-0.098	-0.28	-0.28	0.40
5.A.2. Land converted to Forest Land	CO_2	0	0	40	10	41.2	0.00	0.000	0.000	0.00	0.00	0.00
5.B. Cropland	CO_2	93		30	10	31.6	0.00	-0.001	0.000	-0.01	0.00	0.01
5.D. Wetlands	CO_2	175	163	80	20	82.5	0.82	0.002	0.004	0.04	0.41	0.41
5.E Settlements	CO_2	165	172	80	20	82.5	0.86	0.002	0.004	0.05	0.43	0.44
5.F Other land	CO_2	283	296	80	20	82.5	1.47	0.004	0.007	0.09	0.74	0.75
6C Waste incineration	CO_2	4	1	25	30	39.1	0.00	0.000	0.000	0.00	0.00	0.00
Total	CO_2	**31,994**	**9,037**				**3.25**					**1.28**
1A1, 1A2 Energy: stationary combustion	CH_4	16	12	3	50	50.1	0.04	0.000	0.000	0.01	0.00	0.01
1A3 Energy: mobile combustion	CH_4	22	13	5	50	50.2	0.04	0.000	0.000	0.01	0.00	0.01
1A4 Energy: other sectors	CH_4	183	129	5	50	50.2	0.39	0.001	0.003	0.07	0.02	0.07
1.A.5 Other	CH_4											
2.B.5.5 Methanol production	CH_4	4	0	2	10	10.2	0.00	0.000	0.000	0.00	0.00	0.00
1B Fugitive Emissions	CH_4	149	260	5	15	15.8	0.25	0.005	0.006	0.07	0.04	0.08
4A Enteric Fermentation	CH_4	3,135	1,283	2	30	30.1	2.33	0.003	0.028	0.09	0.08	0.12
4B Manure Management	CH_4	1,333	559	20	25	32.0	1.08	0.002	0.012	0.04	0.35	0.35
5.A.1. Forest Land remaining Forest Land		0	0	2	50	50.0	0.00	0.000	0.000	0.00	0.00	0.00
6A Solid Waste	CH_4	753	892	30	50	58.3	3.14	0.014	0.020	0.68	0.84	1.08
6B Wastewater Handling	CH_4	775	475	30	50	58.3	1.68	0.004	0.011	0.21	0.45	0.49
Total	CH_4	**6,370**	**3,624**				**4.42**					**1.25**

1A1, 1A2, 1A4 Energy: stationary combustion	N_2O	70	56	3	80	80.1	0.27	0.001	0.001	0.05	0.01	0.05
1A3 Energy: mobile combustion	N_2O	271	70	5	80	80.2	0.34	-0.001	0.002	-0.05	0.01	0.05
2B2 Nitric Acid Production	N_2O	908	731	2	30	30.1	1.33	0.009	0.016	0.26	0.05	0.27
4B Manure Management	N_2O	817	320	20	75	77.6	1.50	0.000	0.007	0.03	0.20	0.20
4D1 Direct Soil Emissions	N_2O	2,391	1,375	20	100	102.0	8.48	0.011	0.030	1.11	0.86	1.40
4D2 Pasture Range and Paddock	N_2O	389	204	20	100	102.0	1.26	0.001	0.005	0.14	0.13	0.19
4D3 Indirect Soil Emissions	N_2O	1,810	925	20	100	102.0	5.71	0.006	0.021	0.58	0.58	0.82
5.A.1. Forest Land remaining Forest Land		20	23	2	100	100.0	0.14	0.000	0.001	0.03	0.00	0.03
6B Wastewater Handling	N_2O	80	75	30	50	58.3	0.27	0.001	0.002	0.05	0.07	0.09
6C Waste incineration	N_2O	0	0	25	100	103.1	0.00	0.000	0.000	0.00	0.00	0.00
Total	N_2O	**6,757**	**3,779**				**10.51**					**1.67**
2.F Consumption of halocargons and SF6		0	93	30	20	36.1	0.20	0.002	0.002	0.04	0.09	0.10
	Total emissions	**45,121**	**16,532.7**				**11.85**					**2.45**

* Base year for F-gases is 1995

ANNEX 3. CO_2 emissions from the installations registered in the GHG Emission Allowance Registry, 2009.

	Company	Installation ID	Name of the installation	EUA Allocation	NER for 2009	Verified emissions, t CO_2	Corresponding CRF Sector (Fuel Combustion)
1	AB "Akmenės cementas"	LT-1	Katiline, cemento gamybos krosnys	985617		585206	1.AA.2.F Other
2	AB "Naujasis kalcitas"	LT-2	Kalkiu gamybos krosnys	72938	29784	6763	1.AA.2.F Other
3	UAB "Švencioneliu keramika"	LT-3	Tunelines krosnys keraminiu gaminiu gamybai	5339	3662	1759	1.AA.2.F Other
4	UAB "Taurages keramika"	LT-4	Keramines produkcijos degimo krosnys	10908		0	1.AA.2.F Other
5	UAB "Rokų keramika"	LT-6	Keramines produkcijos degimo krosnys	6076		1325	1.AA.2.F Other
6	AB "Palemono keramika"	LT-7	Katilas, keramikos deginimo krosnys	7950		976	1.AA.2.F Other
7	AB "Dvarcioniu keramika"	LT-8	Keramines produkcijos degimo krosnys	11226		4631	1.AA.2.F Other
8	AB "Alytaus keramika"	LT-10	Keramines produkcijos degimo krosnys	1563		718	1.AA.2.F Other
9	AB "Ekranas"	LT-11	Stiklo lydymo krosnys	9451		0	1.AA.2.F Other
10	UAB "Kauno stiklas"	LT-12	Stiklo lydymo krosnys	12202		14015	1.AA.2.F Other
11	AB "Panevežio stiklas"	LT-13	Stiklo lydymo krosnys	23803		19875	1.AA.2.F Other
12	AB "ORLEN Lietuva"	LT-14	Naftos perbirbimo gamykla	2035090	153339	2102763	1.AA.1.B Petroleum Refining
13	AB "Klaipedos kartonas"	LT-15	Katiline	32313		23181	1.AA 2.D Pulp, Paper and Print
14	AB "Grigiškes"	LT-16	Katiline	47234	10525	32729	1.AA 2.D Pulp, Paper and Print
15	AB "Simega"	LT-17	Katiline Nr. 1	11526		0	1.AA.4.C Agriculture/ Forestry/ Fisheries
16	AB "Achema"	LT-18	Katiline ir amoniako cecho paleidimo katiline	212558		97939	1.AA.2.C Chemicals
17	AB "Nordic Sugar Kedainiai"	LT-20	Katiline, išspaudu džiovykla	25741		29977	1.AA.2.E Food processing, Beverages and Tobacco
18	AB "Anykšciu vynas"	LT-22	Katiline	2987		1172	1.AA.2.E Food processing, Beverages and Tobacco
19	AB "Lifosa"	LT-23	Katiline	99939		0	1.AA.2.C Chemicals
20	UAB "Lino apdaila"	LT-24	Katiline	10607		4035	1.AA.2.F Other
21	AB "Danisco sugar Panevežys"	LT-25	Katiline	29860		236	1.AA.2.E Food processing, Beverages and Tobacco
22	AB Klaipedos nafta"	LT-27	Katiline	19692		25619	1.AA.1.A Public Electricity and Heat Production
23	"Ž.u.b. "Dembavos šiltnamiai"	LT-29	Katiline	4879		1160	1.AA.4.C Agriculture/ Forestry/ Fisheries
24	UAB "ARVI cukrus"	LT-30	Katiline	17153		11261	1.AA.2.E Food processing, Beverages and Tobacco
25	AB "Alita"	LT-31	Katiline, obuoliu išspaudu džiovykla	3962		1910	1.AA.2.E Food processing, Beverages and Tobacco
26	UAB "Pasodele"	LT-32	Katiline	4664		0	1.AA.4.C Agriculture/ Forestry/ Fisheries
27	AB "Klaipedos mediena"	LT-33	Katiline	24390		4463	1.AA.4.C Agriculture/ Forestry/ Fisheries
28	UAB "Matuizu plytine"	LT-35	Katiline	14912		0	1.AA.2.F Other
29	AB "Jonavos šilumos tinklai"	LT-36	Jonavos RK	28262		35090	1.AA.1.A Public Electricity and Heat Production
30	AB "Jonavos šilumos tinklai"	LT-37	Gireles RK	8533		261	1.AA.1.A Public Electricity and Heat Production
31	UAB "Mažeikiu šilumos tinklai"	LT-38	Mažeikiu katiline	43068		12497	1.AA.1.A Public Electricity and Heat Production
32	UAB "Raseiniu šilumos tinklai"	LT-39	Raseiniu kv. katiline Nr. 4	8818		1568	1.AA.1.A Public Electricity and Heat Production
33	UAB "Miesto energija"	LT-40	Ukmerges katiline Nr. 1	5942		6065	1.AA.1.A Public Electricity and Heat Production
34	UAB "Moletu šiluma"	LT-42	Moletu kv. katiline	6963	680	72	1.AA.1.A Public Electricity and Heat Production
35	UAB "Šilutes šilumos tinklai"	LT-43	Šilutes RK	18727		5581	1.AA.1.A Public Electricity and Heat Production
36	UAB "Vilniaus energija"	LT-44	Vilniaus elektrine Nr. 2 (E-2)	412234		339899	1.AA.1.A Public Electricity and Heat Production

	Company	Installation ID	Name of the installation	EUA Allocation	NER for 2009	Verified emissions, t CO_2	Corresponding CRF Sector (Fuel Combustion)
37	UAB "Vilniaus energija"	LT-45	Vilniaus elektrine Nr. 3 (E-3)	599578		412733	1.AA.1.A Public Electricity and Heat Production
38	UAB "Vilniaus energija"	LT-46	Vilniaus RK-2	18898		18543	1.AA.1.A Public Electricity and Heat Production
39	UAB "Vilniaus energija"	LT-48	Vilniaus RK-8	17944		2	1.AA.1.A Public Electricity and Heat Production
40	UAB "Širvintu šiluma"	LT-49	Širvintu katiline Nr. 3	7843		221	1.AA.1.A Public Electricity and Heat Production
41	AB "Šiauliu energija"	LT-50	Šiauliu pietine katiline	117320		100775	1.AA.1.A Public Electricity and Heat Production
42	AB "Klaipedos energija"	LT-54	Gargždu šilumos tinklu katiline Nr. 4	8467		8937	1.AA.1.A Public Electricity and Heat Production
43	AB "Klaipedos energija"	LT-55	Elektrine	92021		74765	1.AA.1.A Public Electricity and Heat Production
44	UAB "Radviliškio šiluma"	LT-56	Radviliškio miesto katiline	12329		11892	1.AA.1.A Public Electricity and Heat Production
45	UAB "Utenos šilumos tinklai"	LT-57	Utenos RK	38267		20300	1.AA.1.A Public Electricity and Heat Production
46	UAB "Taurages šilumos tinklai"	LT-58	Taurages - Beržes RK	20149		1628	1.AA.1.A Public Electricity and Heat Production
47	UAB "Šalcininku šilumos tinklai"	LT-60	Šalcininku centrine katiline	6013		5452	1.AA.1.A Public Electricity and Heat Production
48	Pravieniškiu 2-ieji pataisos namai	LT-61	Katiline	4967		3894	1.AA.1.A Public Electricity and Heat Production
49	UAB "Varenos šiluma"	LT-62	Varenos katiline	19409		1203	1.AA.1.A Public Electricity and Heat Production
50	AB "Panevežio energija"	LT-63	Panevežio RK-2	58223		21299	1.AA.1.A Public Electricity and Heat Production
51	AB "Panevežio energija"	LT-64	Rokiškio RK	31807		2047	1.AA.1.A Public Electricity and Heat Production
52	AB "Panevėžio energija"	LT-65	Panevežio RK-1	63049		38909	1.AA.1.A Public Electricity and Heat Production
53	AB "Panevežio energija"	LT-66	Pasvalio RK	7361		7793	1.AA.1.A Public Electricity and Heat Production
54	AB "Panevežio energija"	LT-67	Zarasu katiline Nr.4	8159		4056	1.AA.1.A Public Electricity and Heat Production
55	UAB "Geoterma"	LT-68	Klaipedos geotermine jegaine	44553		28628	1.AA.1.A Public Electricity and Heat Production
56	AB "Kauno energija"	LT-69	Petrašiunu elektrine	21391		5160	1.AA.1.A Public Electricity and Heat Production
57	AB "Kauno energija"	LT-70	Pergales katiline	5687		1728	1.AA.1.A Public Electricity and Heat Production
58	AB "Kauno energija"	LT-71	Šilko katiline	2966		5802	1.AA.1.A Public Electricity and Heat Production
59	AB "Kauno energija"	LT-72	Noreikiškiu RK	9976		4471	1.AA.1.A Public Electricity and Heat Production
60	AB "Kauno energija"	LT-73	Garliavos RK	7265		6944	1.AA.1.A Public Electricity and Heat Production
61	AB "Kauno energija"	LT-74	Jurbarko RK	9054		9545	1.AA.1.A Public Electricity and Heat Production
62	UAB "Ignalinos šilumos tinklai"	LT-75	Ignalinos centrine katiline Nr. 2	8320	680	1	1.AA.1.A Public Electricity and Heat Production
63	UAB "Plunges šilumos tinklai"	LT-76	Plunges katiline Nr.1	19131		530	1.AA.1.A Public Electricity and Heat Production
64	UAB "Birštono šiluma"	LT-77	Birštono RK	5014		1036	1.AA.1.A Public Electricity and Heat Production
65	UAB "Litesko" filialas "Druskininku šiluma"	LT-78	Druskininku pramones katiline	28451	361	30655	1.AA.1.A Public Electricity and Heat Production
66	UAB "Litesko" filialas "Biržu šiluma"	LT-79	Biržu Rotušes katiline	10320		2075	1.AA.1.A Public Electricity and Heat Production
67	UAB "Litesko" filialas "Vilkaviškio šiluma"	LT-80	Vilkaviškio katiline	8028		4538	1.AA.1.A Public Electricity and Heat Production
68	UAB "Litesko" filialas Telšiu šiluma"	LT-81	Luokes katiline	14835		7191	1.AA.1.A Public Electricity and Heat Production
69	UAB "Litesko" filialas "Kelmes šiluma"	LT-82	Mackeviciaus katiline	5695		679	1.AA.1.A Public Electricity and Heat Production
70	UAB "Litesko" filialas "Palangos šiluma"	LT-83	Palangos katiline	19053		8119	1.AA.1.A Public Electricity and Heat Production
71	UAB "Litesko" filialas "Marijampoles šiluma"	LT-84	Kazlu Rudos katiline	5422		1508	1.AA.1.A Public Electricity and Heat Production
72	UAB "Litesko" filialas "Marijampoles šiluma"	LT-85	Marijampoles RK	37160		22408	1.AA.1.A Public Electricity and Heat Production

	Company	Installation ID	Name of the installation	EUA Allocation	NER for 2009	Verified emissions, t CO_2	Corresponding CRF Sector (Fuel Combustion)
73	UAB "Litesko" filialas "Alytaus energija"	LT-86	Alytaus RK	95309		64093	1.AA.1.A Public Electricity and Heat Production
74	AB Lietuvos elektrine	LT-87	Lietuvos elektrine	546506		628765	1.AA.1.A Public Electricity and Heat Production
75	UAB Kauno termofikacijos elektrine	LT-88	Kauno elektrine	562251		512227	1.AA.1.A Public Electricity and Heat Production
76	UAB "Kaišiadoriu šiluma"	LT-89	Kaišiadoriu katiline	8585		4301	1.AA.1.A Public Electricity and Heat Production
77	UAB "Kretingos šilumos tinklai"	LT-90	Kretingos katiline Nr. 2	9133		0	1.AA.1.A Public Electricity and Heat Production
78	AB "Klaipedos energija"	LT-91	Klaipedos rajonine katiline	75097		50822	1.AA.1.A Public Electricity and Heat Production
79	AB "Klaipedos energija"	LT-92	Lypkiu rajonine katiline	21436		34006	1.AA.1.A Public Electricity and Heat Production
80	AB "Klaipedos energija"	LT-93	Gargždu šilumos tinklu katiline Nr. 2	2210		17	1.AA.1.A Public Electricity and Heat Production
81	AB "Pagirių šiltnamiai"	LT-94	Katiline	26327		213	1.AA.4.C Agriculture/ Forestry/ Fisheries
82	UAB "Prienų energija"	LT-95	Prienu katiline Nr.2	200		0	1.AA.1.A Public Electricity and Heat Production
83	UAB "Miesto energija"	LT-96	Termofikacine elektrine TE-1	55194		0	1.AA.1.A Public Electricity and Heat Production
84	VI Ignalinos atominė elektrinė	LT-97	Katiline, dyzeline elektros stotis	85027		4523	1.AA.1.A Public Electricity and Heat Production
85	UAB "Prienų energija"	LT-98	Traku katiline	4436		4249	1.AA.1.A Public Electricity and Heat Production
86	UAB "Prienų energija"	LT-99	Lentvario katiline	3237		2086	1.AA.1.A Public Electricity and Heat Production
87	UAB Gargždų plytų gamykla	LT-100	Katiline	3437		0	1.AA.2.F Other
88	UAB "Akmenes energija"	LT-101	Zalgirio katiline	13521		6273	1.AA.1.A Public Electricity and Heat Production
89	AB "Panevežio energija"	LT-102	Panevežio termofikacine elektrine	100300		100350	1.AA.1.A Public Electricity and Heat Production
90	UAB "Giriu bizonas"	LT-103	Kura deginantys irenginiai	67436		32894	1.AA.4.C Agriculture/ Forestry/ Fisheries
91	AB "Grigiškes" PGC Naujieji Verkiai"	LT-104	Katiline	6122		627	1.AA 2.D Pulp, Paper and Print
92	UAB "NEO GROUP"	LT-105	katiline	59231		30223	1.AA.2.C Chemicals
93	AB Panevežio energija	LT-106	Kedaniu RK	20964		121	1.AA.1.A Public Electricity and Heat Production
94	UAB "paroc"	LT-107	Akmens vatos gamybos irenginiai	70149		30172	1.AA.2.C Chemicals
95	AB "Vilniaus GKG-3"	LT-108	Katilas DE-14-25 GM	1368		407	1.AA.1.A Public Electricity and Heat Production
96	UAB "Vilniaus energija"	LT-109	Rajonine katiline Nr.7 (RK-7)	551		0	1.AA.1.A Public Electricity and Heat Production
97	AB "Vilniaus paukštynas"	LT-110	Katiline	4208		3464	1.AA.4.C Agriculture/ Forestry/ Fisheries
98	UAB"Agro Neveronys"	LT-112	katiline	34192		5239	1.AA.4.C Agriculture/ Forestry/ Fisheries
99	UAB "Orion Global pet"	LT-113	Katiline	20637		23120	1.AA.2.C Chemicals
100	UAB "Pramonės energija"	LT-114	Katilinė	-	15517	337	1.AA.1.A Public Electricity and Heat Production
Total:				**7568316**	**214548**	**5786742**	
				7782864			

ANNEX 4. Emission factors for Energy sector

CO_2 emission factors for stationary fuel combustion

Fuel	Emission factor, kg.GJ
Crude Oil	78
Orimulsion	81
Motor gasoline	72,97
Jet kerosene	72,24
Shale Oil	74
Gas/Diesel Oil	72,89
Residual Fuel Oil	81,29
Liquefied Petroleum Gases	65,42
Bitumen	80.7
Lubricants	73.3
Petroleum Coke	101
Refinery Feedstocks	73.3
Paraffin Waxes	73.3
Coking Coal	95
Lignite	95
Natural Gas	56.9
Waste Oil	73.3
Peat	102
Wood/Wood Waste	102
Charcoal	102
Biogas	41.9
Not liquefied petroleum gas, refinery gas	54,86

CH_4 emission factors for stationary fuel combustion

Fuel	Emission factor (kg/TJ)	Source / Comments
	Energy industries	
Crude Oil	3	2006 IPCC Guidelines
Orimulsion	3	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Motor gasoline	20	Revised 1996 IPCC Guidelines
Shale Oil	3	2006 IPCC Guidelines
Gas/Diesel Oil	3	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Residual Fuel Oil	3	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Liquefied Petroleum Gases	1	2006 IPCC Guidelines corresponding to CORINAIR range
Petroleum Coke	3	2006 IPCC Guidelines corresponding to CORINAIR range
Coking Coal	1	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Lignite		NO
Natural Gas	1	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Waste Oil	30	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Peat	1	2006 IPCC Guidelines
Wood/Wood Waste	30	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Charcoal		NO

Biogas	1	2006 IPCC Guidelines corresponding to CORINAIR range
Not liquefied petroleum gas, refinery gas	1	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Manufacturing industries and construction		
Crude Oil		NO
Orimulsion		NO
Shale Oil	3	2006 IPCC Guidelines corresponding to CORINAIR range
Jet kerosene	2	EF used in earlier submissions within the range of CORINAIR values
Gas/Diesel Oil	3	2006 IPCC Guidelines corresponding to CORINAIR range
Residual Fuel Oil	3	2006 IPCC Guidelines corresponding to CORINAIR range
Liquefied Petroleum Gases	1	2006 IPCC Guidelines corresponding to CORINAIR range
Petroleum Coke	3	2006 IPCC Guidelines corresponding to CORINAIR range
Coking Coal	10	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Lignite		NO
Natural Gas	5	Revised 1996 IPCC Guidelines
Waste Oil		NO
Peat	2	2006 IPCC Guidelines
Wood/Wood Waste	30	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Charcoal		NO
Biogas	1	2006 IPCC Guidelines
Commercial/Institutional		
Crude Oil		NO
Orimulsion		NO
Shale Oil	10	2006 IPCC Guidelines
Gas/Diesel Oil	10	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Residual Fuel Oil	10	2006 IPCC Guidelines
Liquefied Petroleum Gases	5	2006 IPCC Guidelines corresponding to CORINAIR range
Petroleum Coke		NO
Coking Coal	10	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Lignite	10	2006 IPCC Guidelines
Natural Gas	5	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Waste Oil		NO
Peat	10	2006 IPCC Guidelines corresponding to CORINAIR range
Wood/Wood Waste	300	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Charcoal	200	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Biogas	5	2006 IPCC Guidelines corresponding to CORINAIR range
Residential/Agriculture		
Crude Oil		NO
Orimulsion		NO
Shale Oil	3	2006 IPCC Guidelines
Gas/Diesel Oil	3	2006 IPCC Guidelines corresponding to CORINAIR range
Residual Fuel Oil	3	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Liquefied Petroleum Gases	5	2006 IPCC Guidelines
Petroleum Coke		NO

Coking Coal	300	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Lignite	300	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Natural Gas	5	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Waste Oil		NO
Peat	300	2006 IPCC Guidelines
Wood/Wood Waste	300	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Charcoal		NO
Biogas	5	2006 IPCC Guidelines

N_2O emission factors for stationary fuel combustion

Fuel	Emission factor (kg/TJ)	Source / Comments
		Energy industries
Crude Oil	0.6	2006 IPCC Guidelines
Orimulsion	0.6	2006 IPCC Guidelines
Motor gasoline	0.6	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Shale Oil	0.6	2006 IPCC Guidelines
Gas/Diesel Oil	0.6	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Residual Fuel Oil	0.6	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Liquefied Petroleum Gases	1.5	EF used in earlier submissions corresponding to CORINAIR range
Petroleum Coke	0.6	2006 IPCC Guidelines
Coking Coal	1.4	Revised 1996 IPCC Guidelines
Lignite		NO
Natural Gas	0.1	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Waste Oil	4	2006 IPCC Guidelines
Peat	4	EF used in earlier submissions corresponding to CORINAIR range
Wood/Wood Waste	4	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Charcoal		NO
Biogas	1.95	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
Not liquefied petroleum gas, refinery gas	1.5	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
		Manufacturing industries and construction
Crude Oil		NO
Orimulsion		NO
Shale Oil	0.6	2006 IPCC Guidelines
Jet kerosene	2	Revised 1996 IPCC Guidelines
Gas/Diesel Oil	0.6	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Residual Fuel Oil	0.6	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Liquefied Petroleum Gases	1.5	EF used in earlier submissions corresponding to CORINAIR range
Petroleum Coke	0.6	2006 IPCC Guidelines
Coking Coal	1.4	Revised 1996 IPCC Guidelines

Lignite		NO
Natural Gas	0.1	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Waste Oil		NO
Peat	4	EF used in earlier submissions corresponding to CORINAIR range
Wood/Wood Waste	4	EF used in earlier submissions corresponding to Revised 1996 IPCC Guidelines
Charcoal		NO
Biogas	1.95	EF used in earlier submissions corresponding to CORINAIR range
Commercial/Institutional		
Crude Oil		NO
Orimulsion		NO
Shale Oil	0.6	2006 IPCC Guidelines
Gas/Diesel Oil	0.6	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Residual Fuel Oil	0.6	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Liquefied Petroleum Gases	1.5	EF used in earlier submissions corresponding to CORINAIR range
Petroleum Coke		NO
Coking Coal	1.4	Revised 1996 IPCC Guidelines
Lignite	1.5	2006 IPCC Guidelines
Natural Gas	0.1	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Waste Oil		NO
Peat	4	EF used in earlier submissions corresponding to CORINAIR range
Wood/Wood Waste	4	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Charcoal	1	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Biogas	1.95	EF used in earlier submissions corresponding to CORINAIR range
Residential/Agriculture		
Crude Oil		NO
Orimulsion		NO
Shale Oil	0.6	2006 IPCC Guidelines
Gas/Diesel Oil	0.6	Revised 1966 IPCC Guidelines and 2006 IPCC Guidelines
Residual Fuel Oil	0.6	Revised 1966 IPCC Guidelines and 2006 IPCC Guidelines
Liquefied Petroleum Gases	1	EF used in earlier submissions corresponding to CORNIAIR range
Petroleum Coke		NO
Coking Coal	1.4	Revised 1996 IPCC Guidelines
Lignite	1.5	2006 IPCC Guidelines
Natural Gas	0.1	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Waste Oil		NO
Peat	4	EF used in earlier submissions corresponding to CORINAIR range
Wood/Wood Waste	4	Revised 1996 IPCC Guidelines and 2006 IPCC Guidelines
Charcoal		NO
Biogas	1.95	EF used in earlier submissions corresponding to CORINAIR range

CO_2 emission factors for mobile fuel combustion

Fuel	Emission factor (kg/GJ)	Source / Comments
Aviation		
Aviation gasoline	70	2006 IPCC Guidelines
Jet kerosene	72.24	2006 IPCC Guidelines
Road transportation		
Motor gasoline	72.97	EF used in earlier submissions corresponding to Revised 1996 IPCC Guidelines
Gas/Diesel oil	72.89	EF used in earlier submissions corresponding to Revised 1996 IPCC Guidelines
LPG	65.42	EF used in earlier submissions close to EU average
Biodiesel	70.8	2006 IPCC Guidelines
Bioethanol	70.8	2006 IPCC Guidelines
Railways		
Diesel oil	72.89	EF used in earlier submissions corresponding to Revised 1996 IPCC Guidelines
Navigation		
Residual Fuel Oil	81.29	EF used in earlier submissions close to 2006 IPCC Guidelines
Diesel Oil	72.89	EF used in earlier submissions close to 2006 IPCC Guidelines
Off-road vehicles		
Motor gasoline	72.97	2006 IPCC Guidelines
Diesel oil	72.89	2006 IPCC Guidelines

CH_4 emission factors for mobile fuel combustion

Fuel	Emission factor (kg/TJ)	Source / Comments
Aviation		
Aviation gasoline	20	Revised 1996 IPCC Guidelines
Jet kerosene	1.5	EF used in earlier submissions close to EU average
Road transportation		
Motor gasoline	20	Revised 1996 IPCC Guidelines
Gas/Diesel oil	3.30	EF used in earlier submissions corresponding to 2006 IPCC Guidelines
LPG	19.2	EF used in earlier submissions close to EU average
Biodiesel	10	2006 IPCC Guidelines
Bioethanol	10	2006 IPCC Guidelines
Railways		
Diesel oil	5	EF used in earlier submissions corresponding to Revised 1996 IPCC Guidelines
Navigation		
Residual Fuel Oil	3	EF used in earlier submissions
Diesel Oil	3	EF used in earlier submissions close to EU average
Off-road vehicles		
Motor gasoline	26	2006 IPCC Guidelines

Diesel oil	1.67	2006 IPCC Guidelines

N_2O emission factors for mobile fuel combustion

Fuel	Emission factor (kg/TJ)	Source / Comments
Aviation		
Aviation gasoline	2	EF used in earlier submissions close to EU average
Jet kerosene	2.2	EF used in earlier submissions close to Revised 1996 IPCC Guidelines
Road transportation		
Motor gasoline	2	EF used in earlier submissions close to EU average
Gas/Diesel oil	4	EF used in earlier submissions close to 2006 IPCC Guidelines
LPG	0.2	2006 IPCC Guidelines
Biodiesel	0.6	2006 IPCC Guidelines
Bioethanol	0.6	2006 IPCC Guidelines
Railways		
Diesel oil	3	EF used in earlier submissions close to 2006 IPCC Guidelines
Navigation		
Residual Fuel Oil	0.6	2006 IPCC Guidelines
Diesel Oil	0.6	2006 IPCC Guidelines
Off-road vehicles		
Motor gasoline	2	2006 IPCC Guidelines
Diesel oil	28.6	2006 IPCC Guidelines

ANNEX 5. General methods of Lithuanian NFI

National forest inventory is based on the method of continuous, combined, multistage sampling with partial replacement and method of GIS. Sampling of units is carried out systematically at random start by combining repeated inventory of permanent plots and by combining over ground measurements with the measurements and assessment on satellite image maps and aerial photos (Kuliešis,1999). The aim of establishment of permanent plots is to estimate reliably (by direct measurements) growing stock volume increment, mortality and cut trees, to control the dynamics of forest area in the country. Transformation of other land into forest is controlled by satellite image maps and aerial photos every 5 years. NFI sampling units were based on the division of Lithuanian territory into 5×5 km squares on 1:10 000 scale LKS-94 maps. Each 5×5 km square is subdivided into 25 squares of 1×1 km, while the latter into four squares of 500×500 m. In one of them – north-western, a tract of 250×250 m in size is allocated with 4 permanent sample plots on each side (Fig. 1).

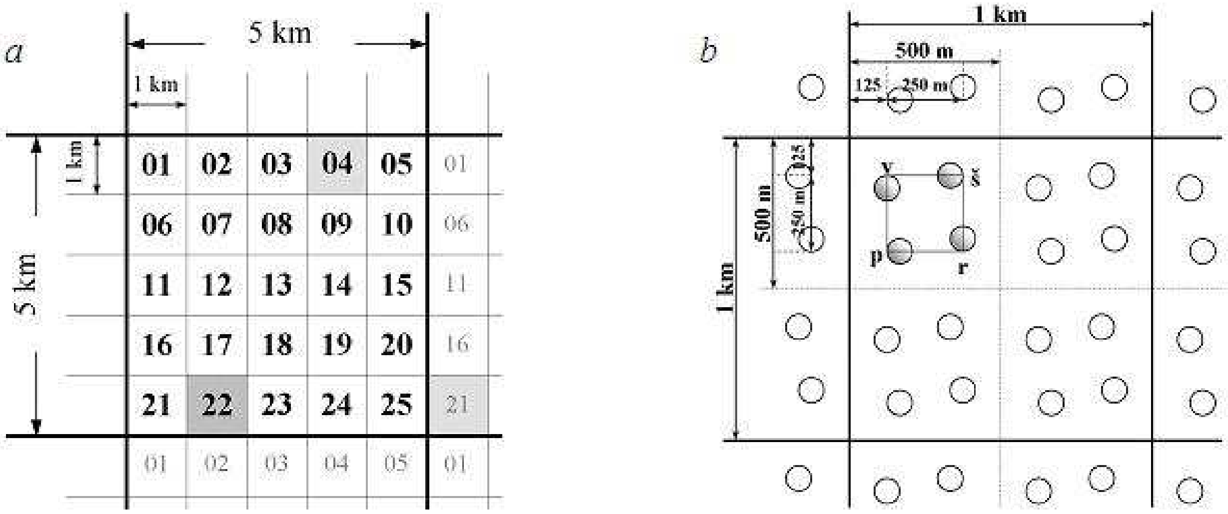

Fig. 1. Selection of permanent sample plot groups: a) distribution of groups, b) position of a tract in 1×1 km size square; N, E, S, W – position of a sample plot; permanent sample plot; – sample plot on satellite image map.

For the first stage sampling, data basis of a satellite map was used to work out LMŽ 50 000 (Kasperavičius, Kuliešis, Mozgeris, 2000). On the whole territory of Lithuania sample plots are scattered on every 250 m to assess area distribution by land categories: forest land, non-forest land.

For the second sampling stage all the plots ascribed at the first stage to forest land category are used. Every sixty-fourth plot from the first stage is chosen for continuous permanent overground measurement. Optimizing inventory design according to time consumption and object representation degree using sample units of different construction, the purposefulness of grouping the plots in four was ascertained. In order to distribute permanent plots more evenly on the whole territory as well as regularly control transformations of other land categories and forest growth there, a strictly systematic distribution pattern of permanent plots was applied.

Taking into account the number of homogeneous stands (strata), minimal growing stock volume and increment estimation accuracy, every year about 1100 plots in the forest were established and measured. Over a five-year period 5600 permanent sample plots were allocated and measured on forest land (Fig. 2.). One permanent sample plot represents an area of 400 ha. Permanent sample plots are remeasured each five-year period.

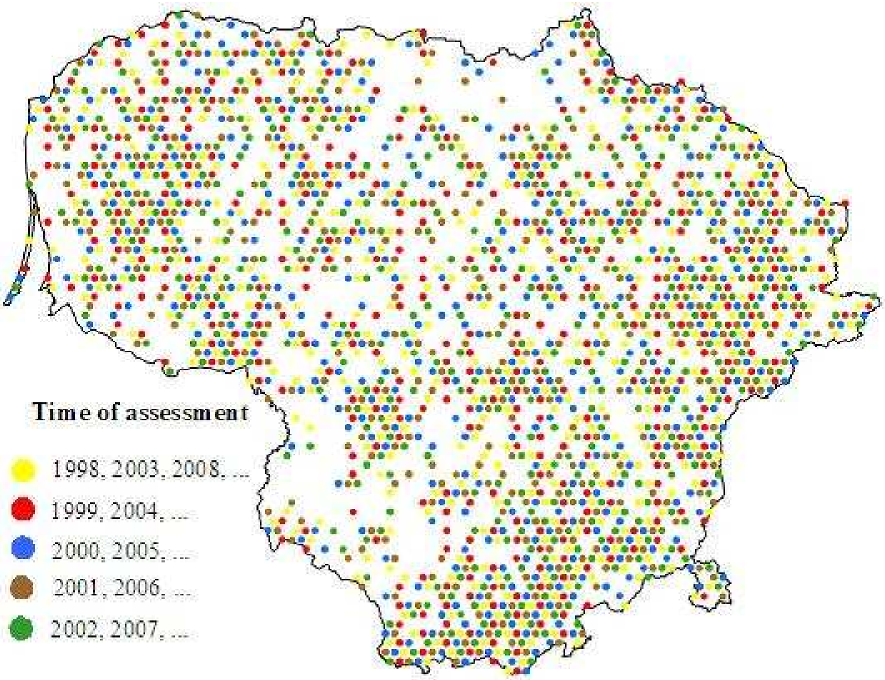

Fig.2. Scheme of NFI plots group allocation

The principal sample unit is a permanent plot of fixed radius (Fig. 3, 4). The area of the main plot in horizontal projection is 500 m² (R = 12.62 m). For plots allocated on sloping terrain, their radius is increased taking into account the level of sloping. On the main 500 m² plot all trees over 14.0 cm in diameter are measured. In the centre of the plot additional 100 m² circular plot is singled out, where all trees over 6.0 cm in diameter are measured. In the first quarter of the 100 m² plot, i.e. on 25 m² area, naturally growing saplings, shoots over 2.0 cm in diameter at 1.3 m height as well as all planted trees, independently of their dimensions, are measured and mapped. Undergrowth and underbrush are taken into account in a 3×20 m strip-like plot allocated within the main plot in the direction of movement. Strip-like plot is allocated at 1.5 m wide distances from the measurement line and 10 m to both sides from the plot centre. At the distance of 20 m from the centre on both sides of the movement direction 2 plots of angle count with transfer coefficient K = 2 are established. The data of angle count plots are used to estimate stand species composition, age and increment according to primary inventory data.

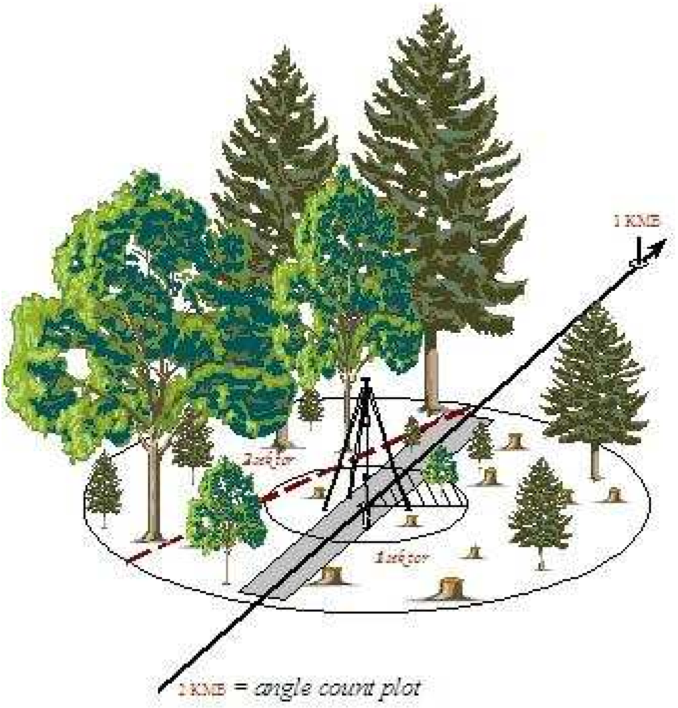

Fig. 3. Inventory of trees and stumps in a permanent sample plot

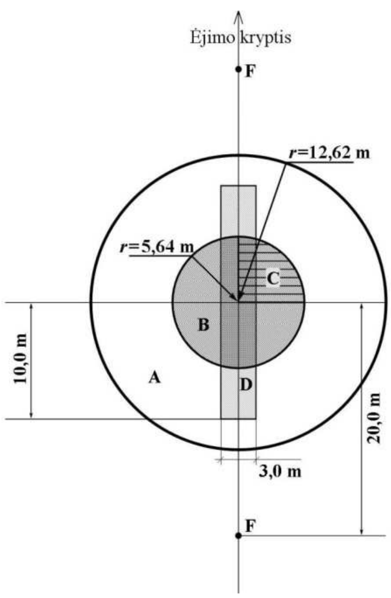

Fig. 4. Construction of the main sample plot:A,B,C - circular plots, respectively 500, 100 and 25 m² in size, D –60 m² strip-like and F – angle count plot

Seeking to integrate information obtained in NFI permanent sample plots with information received from aerial or satellite images, attempts to identify the centres of plots with not less than ±2-3 m accuracy are made (Fig.5). Deviations, ascertaining the centres of plots, occur due to insufficiently precise mapping material or magnetic meridian declination. Deviations of satellite image data basis S 1:50 000 more than ten times, while deviations due to magnetic meridian declination up to ten times exceed precision requirements for plot centre positioning. To ensure sampling objectiveness and the adequacy of plot centre positioning plan with its realization, GPS receivers are used for plot allocation, owing to which plot centre is ascertained with ±1-2 m accuracy.

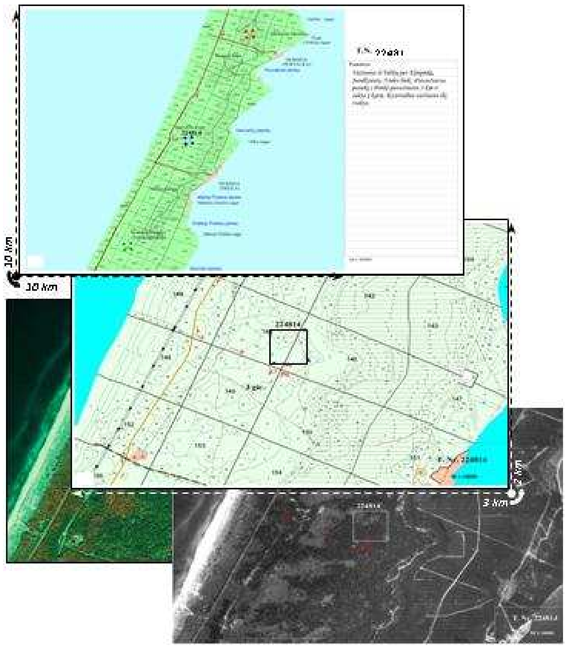

Fig.5. Identification of the NFI plots in terrain.

Sample plots occurring on the boundaries of several forest compartments or different land use categories are divided into smaller units, i.e. sectors (Fig. 6), which in our sampling design comprise primary sampling units. Singling out of sectors increases the representativeness of a sample plot. Each singled out sector is described separately, with trees being measured as in a separate sampling unit. Smaller primary sampling units, created in the process of sample plot division, are not interpreted in the sampling design as being of variable size, therefore, algorithms used in data analysis are based on ratio estimation (Kuliešis, 1994). Sectors, independently of their size, are singled out always when differs the county, natural yield region, ownership or land use category, compartment. Plots on forested land are divided into sectors, if: a) differs the origin of stands, b) site type by trophotop or hydrotop differs by one or more grades, c) coefficients of tree species composition differ by 4 or more units, d) age differences exceed 20 years, e) stocking level of the main storey differs by 0.3 or more.

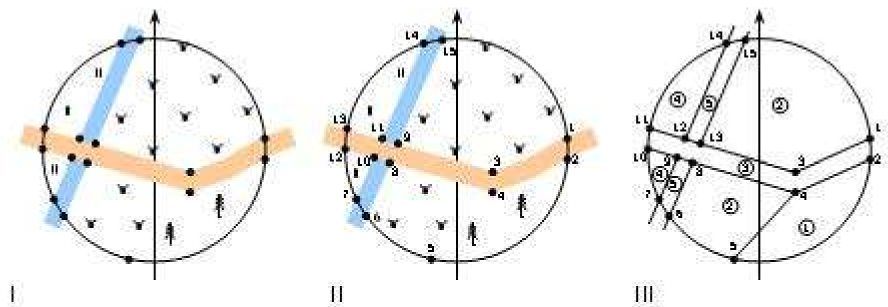

Fig. 6. Plot division into sectors: I - identification of turning points of the different polygons; II – coordination of borders and numeration of turning points of the polygons; III – formation of the borders of sectors and description of them

Within a sample plot or its sector allocated on forested (overgrown with forest, plantations, regeneration areas up to 10 years) or non-forested (cutting site, dead stand, glade, land for afforestation) land, a complete measurement of trees and stumps of predefined parameters as well as their state assessment is performed. Sample plots of various sizes and forms depending on the parameters of measured trees or stumps are allocated in the same centre. Inventory of trees of required diameter is carried out describing tree species, storey, condition, damages, their degree and location, measuring diameter at 1.3 m height, distance to the plot centre, azimuth. For stumps the least diameter on the root collar (underbark) is recorded. Based on the parameters (tree species, storey, diameter at 1.3 m height) of separate trees ascertained in a sample plot and detailed measurements of selected sample trees, using elaborated algorithms, parameters of all trees measured in the sample plot are found (the volume of each tree is estimated), assortment structure of trees and volume are ascertained (Kuliešis, 1985).

Based on the data of tree distance and direction measurements in each plot, computer draws a location map of trees in the plot (Fig. 7). In the map the boundaries of sectors are marked, trees thicker than 14 cm are mapped proportionally to their diameter, keeping to the defined scale, other objects by legend signs. Maps of location of trees in a plot are used to identify the position of trees during remeasurement of plots. To estimate the parameters of individual trees in sample plots measured by over ground method, trees according to a predefined system are chosen for the measurement of their height, height to crown base, quality, damages.

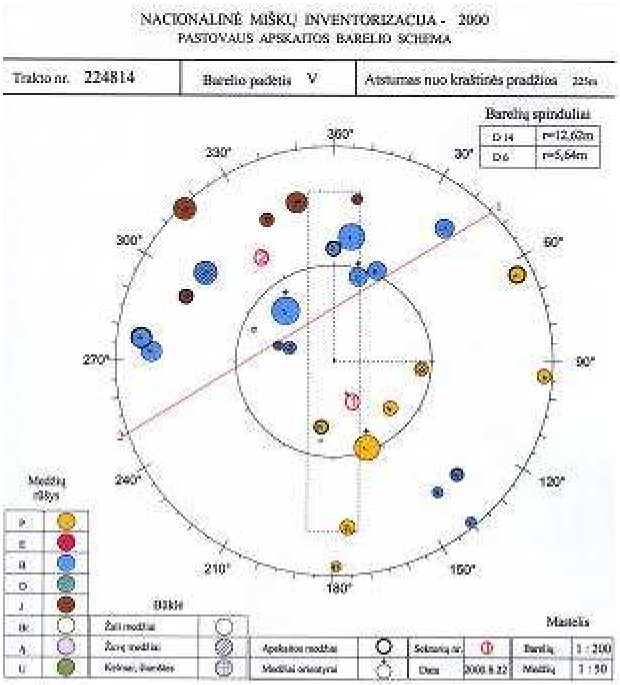

Fig.7. Plan of tree location in a permanent plot

Assessments of afforestation and deforestation are very precise in NFI system. Taking advantage of available actual orthophotographic, standwise inventory, and other material, the positions of permanent plots (about 2000 permanent plots every year) in non-forest land were checked by remote method within Lithuanian territory. Among them, additionally about 140 permanent plots select for checking by field work every year. Usually the afforestation run by natural regeneration near forest border and in abandoned grasslands (Fig. 8.).

Every permanent sample plot is assessed regularly for Afforestation, Reforestation and Deforestation area estimation. Territory outside forest land is assessed every 5 years, using remote sensing material, forest management data and if land is afforested, new permanent sample plots are established (Fig. 9.).

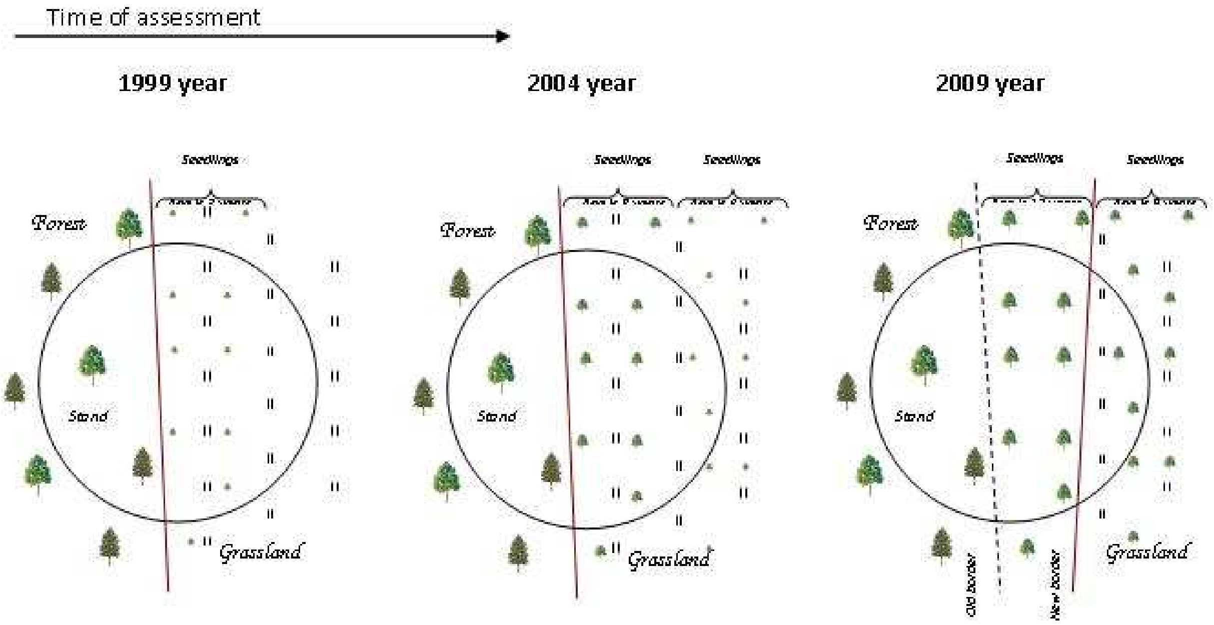

Fig. 8. Assessment of afforestation in areas bordering to forest land

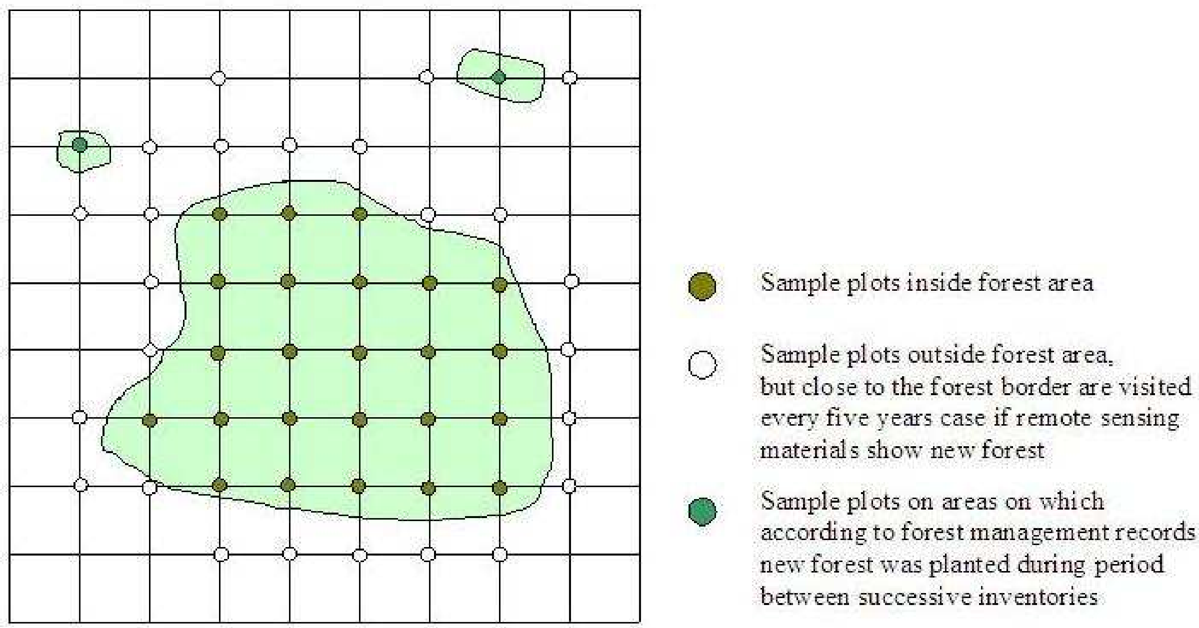

Fig. 9. Assessments of afforestation outside forest land

During NFI fieldworks, assessment of deforestation is carried out in permanent plots too. The method of sample plots division into the sectors with different characteristics, gives a possibility to define intensity of deforestation in a country. The forest land areas are strictly controlled under requirements of Lithuanian Forest Law. Changes of forest land to croplands, grasslands, settlements and other lands can be done only in exceptional cases for society needs That explains why deforestation is not frequent phenomenon in Lithuania? In most cases of deforestation forest land is changed to lands for building of roads (Fig. 10.).

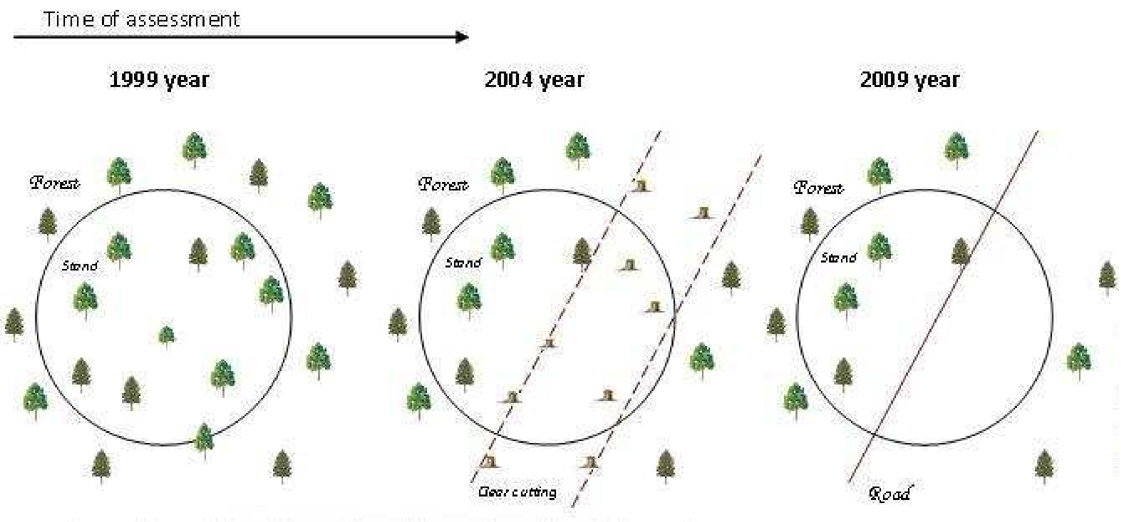

Fig. 10. Assessment of deforestation in case of road building

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ANNEX 6. Minutes of meetings

Protocol 1

Minutes of meeting

Date: 2010-10-12
Venue: Department of Statistics, Gedimino pr. 29, LT-01500 Vilnius, Lithuania
Participants:

Rima Šidlauskiene **-** Department of Energy Statistics, Statistics Lithuania
Romas Lenkaitis – Center for Environmental Policy
Simonas Valatka – Center for Environmental Policy

1. ***Data on Natural Gas Transportation***. The Statistics Lithuania has started collecting statistics on consumption of natural gas used for gas transportation in pipeline compressor stations from 2001. For the period prior to 2001 data on use of natural gas for transmission are not available.

2. ***Data on fuel consumption by off-road vehicles and machinery***. Data on fuel consumption by off-road vehicles and machinery in industry, construction, agriculture, fishery and forestry are not collected separately and provided in statistical reports but included in overall fuel consumption by separate sectors (industry, construction, agriculture). Consumption of motor gasoline and diesel oil in these sectors as shown in energy balances provided by the Statistics Lithuania actually should be assigned to consumption by off-road machinery. Therefore consumption of motor gasoline and diesel oil can be separated from other fuels and emissions caused by off-road vehicles can be calculated from these data.

3. **Data on fuel consumption for military stationary combustion**. The statistical reports are based on information provided by the fuel suppliers. No statistical data are available for military stationary combustion. Data on fuel used for military stationary combustion is included in Commercial/Institutional category.

4. **Data on fuel consumption for military mobile sources**. The statistical reports are based on information provided by the fuel suppliers. No statistical data are available for fuel consumption for military mobile sources.

5. **Data on length of natural gas transmission pipeline**. Information on length of gas pipelines is not collected by the Statistics Lithuania and may be available only from AB Lietuvos Dujos.

6. **Storage facilities for natural gas**. There are no storage facilities for natural gas in Lithuania. Lithuania uses storage facilities located in Latvia.

Minutes of meeting compiled by Simonas Valatka

Protocol 2

Minutes of meeting

Date: October 27, 2010

Venue: Ministry of Environment of the Republic of Lithuania, Jakšto g. 4/9, 01105 Vilnius

Participants:
Ingrida Kavaliauskienė, Head of the Waste Management Strategy Division, Ministry of Environment
Audrius Naktinis, Chief Specialist of the Waste Management Division, Ministry of Environment
Sandra Netikšaitė, Chief Specialist of the Pollution and Waste Management Accounting Division, Lithuanian Environmental Protection Agency
Romas Lenkaitis – Center for Environmental Policy

Discussed: Data on waste generation and disposal in Lithuania.

Concluded:

1. Information on waste generation and disposal in Lithuania are recorded from 1991 but the data collected in 1991-1998 are clearly not reliable and overestimated. At that time there were no weighing of waste at the disposal sites and the amounts of waste disposed of were estimated visually causing substantial errors. Waste collectors were interested in showing higher amounts of collected waste and used to apply higher factors for volume-to-weight conversion.

2. Reliability of information about waste disposal has increased with improved control and monitoring of reporting and recording process, and accumulated experience. It should be considered that waste disposal data collected from 1999 are consistent and could be used for evaluating methane generation in landfills.

3. There is no reason to believe that waste generation and disposal in 1991-1998 were substantially different from generation and disposal in 1999-2008, i.e. the total annual amount of waste disposed of in Lithuania should have been about or a bit more than 1 million tonnes or about 300 kg per person per year.

4. Based on comparison of variation of data on GDP and waste disposal per capita it is reasonable to assume that changes of waste generation and disposal per capita are correlated with the changes of GDP but annual changes in waste generation are approximately 10 times lower than changes of GDP.

5. Calculated waste disposal data for 1991-1998 based on assumption that annual change of per capita amount of waste disposed of in landfills makes 10%of per capita GDP change provide much more realistic information than the data collected by statistics.

6. In Lithuania both non-hazardous municipal and industrial waste are disposed in the landfills for non-hazardous waste, and the data on waste disposal cover all wastes that generate landfill gas.

Romas Lenkaitis

Secretary of the meeting

ANNEX 7. CRF SUMMARY TABLES

SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS

Inventory 1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**32,094.42**	**6,370.32**	**6,853.99**	**NA,NO**	**NA,NO**	**NA,NO**	**45,318.73**
1. Energy	**32,987.81**	**370.50**	**341.35**				**33,699.66**
A. Fuel Combustion (Sectoral Approach)	32,986.76	221.12	341.34				33,549.22
1. Energy Industries	13,960.37	8.38	26.75				13,995.50
2. Manufacturing Industries and Construction	5,954.31	7.41	11.13				5,972.85
3. Transport	7,378.77	21.97	271.39				7,672.13
4. Other Sectors	5,693.31	183.35	32.08				5,908.73
5. Other	IE,NE,NO	IE,NE,NO	IE,NE,NO				IE,NE,NO
B. Fugitive Emissions from Fuels	1.05	149.38	0.00				150.43
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	1.05	149.38	0.00				150.43
2. Industrial Processes	**3,353.32**	**3.83**	**907.93**	**NA,NO**	**NA,NO**	**NA,NO**	**4,265.08**
A. Mineral Products	2,141.38	NA,NE,NO	NA,NE,NO				2,141.38
B. Chemical Industry	1,190.53	3.83	907.93	NO	NO	NO	2,102.28
C. Metal Production	21.41	NO	NO	NO	NO	NO	21.41
D. Other Production	NE						NE
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 (2)				NA,NO	NA,NO	NA,NO	NA,NO
G. Other	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	**100.50**		**97.11**				**197.61**
4. Agriculture		**4,468.02**	**5,407.08**				**9,875.09**
A. Enteric Fermentation		3,134.94					3,134.94
B. Manure Management		1,333.07	817.06				2,150.14
C. Rice Cultivation		NO					NO
D. Agricultural Soils(3)		NA,NE	4,590.01				4,590.01
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry(1)	**-4,351.21**	**0.17**	**20.46**				**-4,330.58**
A. Forest Land	-5,068.05	0.17	20.46				-5,047.42
B. Cropland	93.43	NA,NE	NA,NE				93.43
C. Grassland	NA,NE	NA,NE	NA,NE				NA,NE
D. Wetlands	175.16	NA,NE	NA,NE				175.16
E. Settlements	165.21	NE	NE				165.21
F. Other Land	283.05	NE	NE				283.05
G. Other	NE	NE	NE				NE
6. Waste	**4.00**	**1,527.80**	**80.08**				**1,611.88**
A. Solid Waste Disposal on Land	NA	752.94					752.94
B. Waste-water Handling		774.86	79.91				854.77
C. Waste Incineration	4.00	NA,NE	0.17				4.17
D. Other	NA	NA	NA				NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Memo Items: (4)							
International Bunkers	707.14	0.42	4.57				712.13
Aviation	403.40	0.18	3.85				407.43
Marine	303.73	0.25	0.72				304.70
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**1,215.43**						**1,215.43**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	49,649.31
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	45,318.73

Inventory 2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**7,871.35**	**3,400.86**	**4,112.84**	**5.03**	**NA,NO**	**0.22**	**15,390.30**
1. Energy	**10,485.58**	**393.31**	**107.78**				**10,986.66**
A. Fuel Combustion (Sectoral Approach)	10,459.54	169.18	107.70				10,736.42
1. Energy Industries	5,202.22	3.76	12.23				5,218.21
2. Manufacturing Industries and Construction	1,010.01	2.18	3.33				1,015.52
3. Transport	3,317.26	10.79	60.81				3,388.86
4. Other Sectors	930.05	152.45	31.34				1,113.83
5. Other	IE,NE,NO	IE,NE,NO	IE,NE,NO				IE,NE,NO
B. Fugitive Emissions from Fuels	26.04	224.12	0.08				250.24
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	26.04	224.12	0.08				250.24
2. Industrial Processes	**1,432.37**	**0.34**	**1,540.24**	**5.03**	**NA,NO**	**0.22**	**2,978.20**
A. Mineral Products	358.56	NA,NE,NO	NA,NE,NO				358.56
B. Chemical Industry	1,066.34	0.34	1,540.24	NO	NO	NO	2,606.92
C. Metal Production	7.47	NO	NO	NO	NO	NO	7.47
D. Other Production	NE						NE
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 (2)				5.03	NO	0.22	5.25
G. Other	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	**95.03**		**78.51**				**173.54**
4. Agriculture		**1,713.56**	**2,287.55**				**4,001.11**
A. Enteric Fermentation		1,201.66					1,201.66
B. Manure Management		511.91	282.48				794.38
C. Rice Cultivation		NO					NO
D. Agricultural Soils(3)		NA,NE	2,005.07				2,005.07
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry(1)	**-4,143.48**	**0.41**	**21.27**				**-4,121.80**
A. Forest Land	-5,018.36	0.41	21.27				-4,996.67
B. Cropland	NA,NE	NA,NE	NA,NE				NA,NE
C. Grassland	NA,NE	NA,NE	NA,NE				NA,NE
D. Wetlands	220.64	NA,NE	NA,NE				220.64
E. Settlements	241.12	NE	NE				241.12
F. Other Land	413.12	NE	NE				413.12
G. Other	NE	NE	NE				NE
6. Waste	**1.84**	**1,293.24**	**77.49**				**1,372.58**
A. Solid Waste Disposal on Land	NA	833.76					833.76
B. Waste-water Handling		459.48	77.42				536.90
C. Waste Incineration	1.84	NA,NE	0.08				1.92
D. Other	NA	NA	NA				NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Memo Items: (4)							
International Bunkers	371.89	0.28	1.45				373.62
Aviation	77.08	0.03	0.74				77.85
Marine	294.82	0.24	0.71				295.77
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**2,643.74**						**2,643.74**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	19,512.09
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	15,390.30

Inventory 2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**10,883.26**	**3,646.88**	**5,327.66**	**16.08**	**NA,NO**	**1.38**	**19,875.26**
1. Energy	**12,468.32**	**406.07**	**129.03**				**13,003.43**
A. Fuel Combustion (Sectoral Approach)	12,450.49	160.58	128.98				12,740.06
1. Energy Industries	5,753.76	6.77	20.75				5,781.28
2. Manufacturing Industries and Construction	1,264.65	4.91	7.90				1,277.45
3. Transport	4,321.12	12.70	72.49				4,406.32
4. Other Sectors	1,099.04	136.20	27.73				1,262.97
5. Other	11.92	0.01	0.11				12.04
B. Fugitive Emissions from Fuels	17.84	245.48	0.05				263.37
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	17.84	245.48	0.05				263.37
2. Industrial Processes	**1,609.07**	**1.65**	**2,353.72**	**16.08**	**NA,NO**	**1.38**	**3,981.89**
A. Mineral Products	447.90	NA,NE,NO	NA,NE,NO				447.90
B. Chemical Industry	1,153.98	1.65	2,353.72	NO	NO	NO	3,509.34
C. Metal Production	7.19	NO	NO	NO	NO	NO	7.19
D. Other Production	NE						NE
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 [2]				16.08	NA,NO	1.38	17.46
G. Other	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	**92.72**		**69.21**				**161.92**
4. Agriculture		**1,958.76**	**2,676.75**				**4,635.51**
A. Enteric Fermentation		1,322.60					1,322.60
B. Manure Management		636.16	342.04				978.20
C. Rice Cultivation		NO					NO
D. Agricultural Soils[3]		NA,NE	2,334.71				2,334.71
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry[1]	**-3,292.54**	**0.06**	**22.30**				**-3,270.18**
A. Forest Land	-5,066.25	0.06	22.30				-5,043.89
B. Cropland	NA,NE	NA,NE	NA,NE				NA,NE
C. Grassland	NA,NE	NA,NE	NA,NE				NA,NE
D. Wetlands	375.31	NA,NE	NA,NE				375.31
E. Settlements	515.38	NE	NE				515.38
F. Other Land	883.01	NE	NE				883.01
G. Other	NE	NE	NE				NE
6. Waste	**5.69**	**1,280.34**	**76.66**				**1,362.69**
A. Solid Waste Disposal on Land	NA	827.84					827.84
B. Waste-water Handling		452.49	76.41				528.90
C. Waste Incineration	5.69	NA,NE	0.25				5.94
D. Other	NA	NA	NA				NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Memo Items: [4]							
International Bunkers	597.40	0.44	2.42				600.26
Aviation	137.71	0.07	1.31				139.09
Marine	459.69	0.37	1.10				461.17
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**3,098.10**						**3,098.10**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	23,145.44
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	19,875.26

Inventory 2009

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**9,127.74**	**3,623.68**	**3,788.39**	**88.21**	**NA,NO**	**5.00**	**16,633.03**
1. Energy	**11,336.15**	**414.15**	**125.78**				**11,876.09**
A. Fuel Combustion (Sectoral Approach)	11,326.64	153.85	125.76				11,606.24
1. Energy Industries	4,893.63	8.99	24.37				4,926.99
2. Manufacturing Industries and Construction	993.21	3.42	5.19				1,001.83
3. Transport	4,368.40	12.71	70.14				4,451.26
4. Other Sectors	1,060.13	128.72	25.94				1,214.79
5. Other	11.27	0.00	0.11				11.38
B. Fugitive Emissions from Fuels	9.51	260.30	0.03				269.84
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	9.51	260.30	0.03				269.84
2. Industrial Processes	**1,480.79**	**NA,NE,NO**	**731.28**	**88.21**	**NA,NO**	**5.00**	**2,305.28**
A. Mineral Products	303.75	NA,NE,NO	NA,NE,NO				303.75
B. Chemical Industry	1,173.01	NO	731.28	NO	NO	NO	1,904.29
C. Metal Production	4.03	NO	NO	NO	NO	NO	4.03
D. Other Production	NE						NE
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [(2)]				88.21	NA,NO	5.00	93.21
G. Other	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	**90.68**		**9.66**				**100.34**
4. Agriculture		**1,842.39**	**2,823.46**				**4,665.86**
A. Enteric Fermentation		1,283.31					1,283.31
B. Manure Management		559.09	319.60				878.69
C. Rice Cultivation		NO					NO
D. Agricultural Soils[(3)]		NA,NE	2,503.86				2,503.86
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry[(1)]	**-3,780.52**	**0.40**	**22.74**				**-3,757.38**
A. Forest Land	-4,411.96	0.40	22.74				-4,388.83
B. Cropland	NA,NE	NA,NE	NA,NE				NA,NE
C. Grassland	NA,NE	NA,NE	NA,NE				NA,NE
D. Wetlands	163.42	NA,NE	NA,NE				163.42
E. Settlements	172.49	NE	NE				172.49
F. Other Land	295.53	NE	NE				295.53
G. Other	NE	NE	NE				NE
6. Waste	**0.64**	**1,366.74**	**75.47**				**1,442.85**
A. Solid Waste Disposal on Land	NA	891.59					891.59
B. Waste-water Handling		475.14	75.41				550.56
C. Waste Incineration	0.64	NA,NE	0.05				0.70
D. Other	NA	NA	NA				NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Memo Items: [(4)]							
International Bunkers	518.28	0.38	2.02				520.68
Aviation	108.82	0.05	1.04				109.91
Marine	409.46	0.33	0.98				410.77
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**3,405.38**						**3,405.38**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	20,390.41
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	16,633.03

TABLE 8(a)RECALCULATION - RECALCULATED DATA

Inventory 1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2						CH_4						N_2O					
		Previous submission	Latest submission	Difference	Difference(1)	Impact of recalculation on total emissions excluding LULUCF (2)	Impact of recalculation on total emissions including LULUCF(3)	Previous submission	Latest submission	Difference	Difference(1)	Impact of recalculation on total emissions excluding LULUCF (2)	Impact of recalculation on total emissions including LULUCF(3)	Previous submission	Latest submission	Difference	Difference(1)	Impact of recalculation on total emissions excluding LULUCF (2)	Impact of recalculation on total emissions including LULUCF(3)
		CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)		
Total National Emissions and Removals		**21,947.73**	**32,094.42**	**10,146.69**	46.23	20.44	22.39	6,313.48	6,370.32	**56.84**	0.90	0.11	0.13	7,349.36	6,853.99	**-495.37**	-6.74	-1.00	-1.09
1. Energy		**34,078.73**	**32,987.81**	**-1,090.92**	-3.20	-2.20	-2.41	372.43	370.50	**-1.94**	-0.52	0.00	0.00	352.87	341.35	**-11.53**	-3.27	-0.02	-0.03
1.A.	Fuel Combustion Activities	34,077.69	32,986.76	-1,090.92	-3.20	-2.20	-2.41	223.05	221.12	-1.94	-0.87	0.00	0.00	352.87	341.34	-11.53	-3.27	-0.02	-0.03
1.A.1.	Energy Industries	13,856.88	13,960.37	103.50	0.75	0.21	0.23	8.61	8.38	-0.23	-2.65	0.00	0.00	27.17	26.75	-0.42	-1.55	0.00	0.00
1.A.2.	Manufacturing Industries and Construction	5,806.10	5,954.31	148.21	2.55	0.30	0.33	7.41	7.41					11.13	11.13				
1.A.3.	Transport	7,440.99	7,378.77	-62.22	-0.84	-0.13	-0.14	21.97	21.97					271.39	271.39				
1.A.4.	Other Sectors	6,973.71	5,693.31	-1,280.41	-18.36	-2.58	-2.83	185.06	183.35	-1.71	-0.92	0.00	0.00	43.19	32.08	-11.11	-25.72	-0.02	-0.02
1.A.5.	Other	IE,NE,NO	IE,NE,NO					IE,NE,NO	IE,NE,NO					IE,NE,NO	IE,NE,NO				
1.B.	Fugitive Emissions from Fuels	1.05	1.05					149.38	149.38					0.00	0.00		0.00		
1.B.1.	Solid fuel	NO	NO					NO	NO					NO	NO				
1.B.2.	Oil and Natural Gas	1.05	1.05					149.38	149.38					0.00	0.00		0.00		
2. Industrial Processes		**3,352.35**	**3,353.32**	**0.97**	**0.03**	**0.00**	**0.00**	**3.83**	**3.83**					**771.30**	**907.93**	**136.63**	**17.71**	**0.28**	**0.30**
2.A.	Mineral Products	2,141.38	2,141.38					NA,NE,NO	NA,NE,NO					NA,NE,NO	NA,NE,NO				
2.B.	Chemical Industry	1,189.56	1,190.53	0.97	0.08	0.00	0.00	3.83	3.83					771.30	907.93	136.63	17.71	0.28	0.30
2.C.	Metal Production	21.41	21.41					NO	NO					NO	NO				
2.D.	Other Production	NE	NE																
2.G.	Other	NA	NA					NA	NA					NA	NA				
3. Solvent and Other Product Use		**100.50**	**100.50**											**NA,NE**	**97.11**	**97.11**	**100.00**	**0.20**	**0.21**
4. Agriculture								**4,464.02**	**4,468.02**	**4.00**	**0.09**	**0.01**	**0.01**	**6,124.34**	**5,407.08**	**-717.26**	**-11.71**	**-1.44**	**-1.58**
4.A.	Enteric Fermentation							3,133.57	3,134.94	1.37	0.04	0.00	0.00						
4.B.	Manure Management							1,330.44	1,333.07	2.63	0.20	0.01	0.01	879.85	817.06	-62.79	-7.14	-0.13	-0.14
4.C.	Rice Cultivation							NO	NO										
4.D.	Agricultural Soils (4)							NA,NE	NA,NE					5,244.48	4,590.01	-654.47	-12.48	-1.32	-1.44
4.E.	Prescribed Burning of Savannas							NO	NO					NO	NO				
4.F.	Field Burning of Agricultural Residues							NO	NO					NO	NO				
4.G.	Other							NO	NO					NO	NO				
5. Land Use, Land-Use Change and Forestry (net) (5)		**-15,587.85**	**-4,351.21**	11,236.64	-72.09		24.79	0.80	0.17	-0.63	-78.91		0.00	20.94	20.46	-0.48	-2.31		0.00
5.A.	Forest Land	-15,953.02	-5,068.05	10,884.97	-68.23		24.02	0.80	0.17	-0.63	-78.91		0.00	20.94	20.46	-0.48	-2.31		0.00
5.B.	Cropland	93.43	93.43					NA,NE	NA,NE					NA,NE	NA,NE				
5.C.	Grassland	NA,NE	NA,NE					NA,NE	NA,NE					NA,NE	NA,NE				
5.D.	Wetlands	104.57	175.16	70.59	67.50		0.16	NA,NE	NA,NE					NA,NE	NA,NE				
5.E.	Settlements	87.56	165.21	77.64	88.67		0.17	NE	NE					NE	NE				
5.F.	Other Land	79.60	283.05	203.45	255.58		0.45	NE	NE					NE	NE				
5.G.	Other	NE	NE					NE	NE					NE	NE				

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2						CH_4						N_2O					
	Previous submission	Latest submission	Difference	Difference(1)	Impact of recalculation on total emissions excluding LULUCF (2)	Impact of recalculation on total emissions including LULUCF(3)	Previous submission	Latest submission	Difference	Difference(1)	Impact of recalculation on total emissions excluding LULUCF (2)	Impact of recalculation on total emissions including LULUCF(3)	Previous submission	Latest submission	Difference	Difference(1)	Impact of recalculation on total emissions excluding LULUCF (2)	Impact of recalculation on total emissions including LULUCF(3)
	CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)		
6. Waste	**4.00**	**4.00**					1,472.40	1,527.80	55.40	3.76	0.11	0.12	79.91	80.08	0.17	0.21	0.00	0.00
6.A. Solid Waste Disposal on Land	NA,NE	NA					697.54	752.94	55.40	7.94	0.11	0.12						
6.B. Waste-water Handling							774.86	774.86					79.91	79.91				
6.C. Waste Incineration	4.00	4.00					NE	NA,NE					NE	0.17	0.17	100.00	0.00	0.00
6.D. Other	NA	NA					NA	NA					NA	NA				
7. Other ***(as specified in Summary 1.A)***	NA	NA					NA	NA					NA	NA				
Memo Items:																		
International Bunkers	**721.24**	**707.14**	**-14.11**	**-1.96**	**-0.03**	**-0.03**	**0.28**	**0.42**	**0.14**	**50.00**	**0.00**	**0.00**	**6.24**	**4.57**	**-1.67**	**-26.79**	**0.00**	**0.00**
Multilateral Operations	**NO**	**NO**					**NO**	**NO**					**NO**	**NO**				
CO_2 Emissions from Biomass	**1,215.43**	**1,215.43**																

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs						PFCs						SF_6					
	Previous submission	Latest submission	Difference	Difference(1)	Impact of recalculation on total emissions excluding LULUCF (2)	Impact of recalculation on total emissions including LULUCF(3)	Previous submission	Latest submission	Difference	Difference(1)	Impact of recalculation on total emissions excluding LULUCF (2)	Impact of recalculation on total emissions including LULUCF(3)	Previous submission	Latest submission	Difference	Difference(1)	Impact of recalculation on total emissions excluding LULUCF (2)	Impact of recalculation on total emissions including LULUCF(3)
	CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)		
Total Actual Emissions	**NA,NO**	**NA,NO**					**NA,NO**	**NA,NO**					**NA,NO**	**NA,NO**				
2.C.3. Aluminium Production							NO	NO										
2.E. Production of Halocarbons and SF_6	NO	NO					NO	NO					NO	NO				
2.F. Consumption of Halocarbons and SF_6	NA	NA,NO					NA	NA					NA	NA				
2.G. Other	NA	NA					NA	NA					NA	NA				
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**NA,NO**	**NA,NO**					**NA,NO**	**NA,NO**					**NA,NO**	**NA,NO**				

	Previous submission	Latest submission	Difference	Difference(1)
	CO_2 equivalent (Gg)			(%)
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	35,610.57	45,318.73	9,708.16	27.26
Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	51,176.68	49,649.31	-1,527.37	-2.98

Inventory 2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2						CH_4						N_2O					
		Previous submission	Latest submission	Difference	Difference[1]	Impact of recalculation on total emissions excluding LULUCF [2]	Impact of recalculation on total emissions including LULUCF[3]	Previous submission	Latest submission	Difference	Difference[1]	Impact of recalculation on total emissions excluding LULUCF [2]	Impact of recalculation on total emissions including LULUCF[3]	Previous submission	Latest submission	Difference	Difference[1]	Impact of recalculation on total emissions excluding LULUCF [2]	Impact of recalculation on total emissions including LULUCF[3]
		CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)		
Total National Emissions and Removals		**-1,748.98**	**7,871.35**	**9,620.33**	-550.05	49.30	62.51	3,279.22	3,400.86	**121.65**	3.71	0.62	0.79	4,283.36	4,112.84	**-170.52**	-3.98	-0.87	-1.11
1. Energy		**10,664.17**	**10,485.58**	**-178.59**	-1.67	-0.92	-1.16	393.85	393.31	**-0.54**	-0.14	0.00	0.00	109.19	107.78	**-1.41**	-1.29	-0.01	-0.01
1.A.	Fuel Combustion Activities	10,638.13	10,459.54	-178.59	-1.68	-0.92	-1.16	169.73	169.18	-0.54	-0.32	0.00	0.00	109.11	107.70	-1.41	-1.29	-0.01	-0.01
1.A.1.	Energy Industries	5,239.69	5,202.22	-37.46	-0.72	-0.19	-0.24	3.89	3.76	-0.13	-3.45	0.00	0.00	12.47	12.23	-0.25	-1.99	0.00	0.00
1.A.2.	Manufacturing Industries and Construction	991.43	1,010.01	18.58	1.87	0.10	0.12	2.18	2.18					3.33	3.33				
1.A.3.	Transport	3,341.43	3,317.26	-24.17	-0.72	-0.12	-0.16	10.79	10.79					60.81	60.81				
1.A.4.	Other Sectors	1,065.59	930.05	-135.54	-12.72	-0.69	-0.88	152.86	152.45	-0.41	-0.27	0.00	0.00	32.50	31.34	-1.16	-3.58	-0.01	-0.01
1.A.5.	Other	IE,NE,NO	IE,NE,NO					IE,NE,NO	IE,NE,NO					IE,NE,NO	IE,NE,NO				
1.B.	Fugitive Emissions from Fuels	26.04	26.04					224.12	224.12					0.08	0.08	0.00	0.00		
1.B.1.	Solid fuel	NO	NO					NO	NO					NO	NO				
1.B.2.	Oil and Natural Gas	26.04	26.04					224.12	224.12					0.08	0.08	0.00	0.00		
2. Industrial Processes		**1,433.14**	**1,432.37**	**-0.77**	**-0.05**	**0.00**	**-0.01**	**0.34**	**0.34**					**1,308.46**	**1,540.24**	**231.78**	**17.71**	**1.19**	**1.51**
2.A.	Mineral Products	358.56	358.56					NA,NE,NO	NA,NE,NO					NA,NE,NO	NA,NE,NO				
2.B.	Chemical Industry	1,067.12	1,066.34	-0.77	-0.07	0.00	-0.01	0.34	0.34					1,308.46	1,540.24	231.78	17.71	1.19	1.51
2.C.	Metal Production	7.47	7.47					NO	NO					NO	NO				
2.D.	Other Production	NE	NE																
2.G.	Other	NA	NA					NA	NA					NA	NA				
3. Solvent and Other Product Use		**95.03**	**95.03**											**NA,NE**	**78.51**	**78.51**	**100.00**	**0.40**	**0.51**
4. Agriculture								**1,650.30**	**1,713.56**	**63.27**	**3.83**	**0.32**	**0.41**	**2,766.44**	**2,287.55**	**-478.90**	**-17.31**	**-2.45**	**-3.11**
4.A.	Enteric Fermentation							1,167.61	1,201.66	34.05	2.92	0.17	0.22						
4.B.	Manure Management							482.69	511.91	29.22	6.05	0.15	0.19	305.02	282.48	-22.54	-7.39	-0.12	-0.15
4.C.	Rice Cultivation							NO	NO										
4.D.	Agricultural Soils [4]							NA,NE	NA,NE					2,461.43	2,005.07	-456.36	-18.54	-2.34	-2.97
4.E.	Prescribed Burning of Savannas							NO	NO					NO	NO				
4.F.	Field Burning of Agricultural Residues							NO	NO					NO	NO				
4.G.	Other							NO	NO					NO	NO				
5. Land Use, Land-Use Change and Forestry (net) [5]		**-13,943.17**	**-4,143.48**	9,799.69	-70.28		63.67	2.04	0.41	-1.63	-79.86		-0.01	21.85	21.27	-0.58	-2.66		0.00
5.A.	Forest Land	-14,218.92	-5,018.36	9,200.57	-64.71		59.78	2.04	0.41	-1.63	-79.86		-0.01	21.85	21.27	-0.58	-2.66		0.00
5.B.	Cropland	NA,NE	NA,NE					NA,NE	NA,NE					NA,NE	NA,NE				
5.C.	Grassland	NA,NE	NA,NE					NA,NE	NA,NE					NA,NE	NA,NE				
5.D.	Wetlands	103.88	220.64	116.76	112.40		0.76	NA,NE	NA,NE					NA,NE	NA,NE				
5.E.	Settlements	90.03	241.12	151.09	167.83		0.98	NE	NE					NE	NE				
5.F.	Other Land	81.84	413.12	331.28	404.77		2.15	NE	NE					NE	NE				
5.G.	Other	NE	NE					NE	NE					NE	NE				

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2						CH_4						N_2O					
	Previous submission	Latest submission	Difference	Difference(1)	Impact of recalculation on total emissions excluding LULUCF (2)	Impact of recalculation on total emissions including LULUCF(3)	Previous submission	Latest submission	Difference	Difference(1)	Impact of recalculation on total emissions excluding LULUCF (2)	Impact of recalculation on total emissions including LULUCF(3)	Previous submission	Latest submission	Difference	Difference(1)	Impact of recalculation on total emissions excluding LULUCF (2)	Impact of recalculation on total emissions including LULUCF(3)
	CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)		
6. Waste	**1.84**	**1.84**					1,232.69	1,293.24	60.55	4.91	0.31	0.39	77.42	77.49	0.08	0.10	0.00	0.00
6.A. Solid Waste Disposal on Land	NA,NE	NA					773.21	833.76	60.55	7.83	0.31	0.39						
6.B. Waste-water Handling							459.48	459.48					77.42	77.42				
6.C. Waste Incineration	1.84	1.84					NE	NA,NE					NE	0.08	0.08	100.00	0.00	0.00
6.D. Other	NA	NA					NA	NA					NA	NA				
7. Other *(as specified in Summary 1.A)*	NA	NA					NA	NA					NA	NA				
Memo Items:																		
International Bunkers	**374.59**	**371.89**	**-2.70**	**-0.72**	**-0.01**	**-0.02**	**0.20**	**0.28**	**0.07**	**35.40**	**0.00**	**0.00**	**4.06**	**1.45**	**-2.61**	**-64.37**	**-0.01**	**-0.02**
Multilateral Operations	**NO**	**NO**					**NO**	**NO**					**NO**	**NO**				
CO_2 Emissions from Biomass	**2,643.74**	**2,643.74**																

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs						PFCs						SF_6					
	Previous submission	Latest submission	Difference	Difference(1)	Impact of recalculation on total emissions excluding LULUCF (2)	Impact of recalculation on total emissions including LULUCF(3)	Previous submission	Latest submission	Difference	Difference(1)	Impact of recalculation on total emissions excluding LULUCF (2)	Impact of recalculation on total emissions including LULUCF(3)	Previous submission	Latest submission	Difference	Difference(1)	Impact of recalculation on total emissions excluding LULUCF (2)	Impact of recalculation on total emissions including LULUCF(3)
	CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)		
Total Actual Emissions	**3.41**	**5.03**	**1.62**	**47.45**	**0.01**	**0.01**	**NA,NO**	**NA,NO**					**0.22**	**0.22**				
2.C.3. Aluminium Production							NO	NO										
2.E. Production of Halocarbons and SF_6	NO	NO					NO	NO					NO	NO				
2.F. Consumption of Halocarbons and SF_6	3.41	5.03	1.62	47.45	0.01	0.01	NO	NO					0.22	0.22				
2.G. Other	NA	NA					NA	NA					NA	NA				
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**20.88**	**20.88**					**NO**	**NO**					**IE,NE,NO**	**IE,NE,NO**				

	Previous submission	Latest submission	Difference	Difference(1)
	CO_2 equivalent (Gg)			(%)
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	5,817.22	15,390.30	9,573.07	164.56
Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	19,736.50	19,512.09	-224.41	-1.14

Inventory 2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2						CH_4						N_2O					
		Previous submission	Latest submission	Difference	Difference[1]	Impact of recalculation on total emissions excluding LULUCF [2]	Impact of recalculation on total emissions including LULUCF[3]	Previous submission	Latest submission	Difference	Difference[1]	Impact of recalculation on total emissions excluding LULUCF [2]	Impact of recalculation on total emissions including LULUCF[3]	Previous submission	Latest submission	Difference	Difference[1]	Impact of recalculation on total emissions excluding LULUCF [2]	Impact of recalculation on total emissions including LULUCF[3]
		CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)		
Total National Emissions and Removals		**530.14**	**10,883.26**	**10,353.11**	1,952.90	44.73	52.09	3,476.37	3,646.88	**170.50**	4.90	0.74	0.86	5,374.84	5,327.66	**-47.17**	-0.88	-0.20	-0.24
1. Energy		**12,755.61**	**12,468.32**	**-287.28**	-2.25	-1.24	-1.45	406.36	406.07	**-0.29**	-0.07	0.00	0.00	130.41	129.03	**-1.38**	-1.05	-0.01	-0.01
1.A.	Fuel Combustion Activities	12,737.77	12,450.49	-287.28	-2.26	-1.24	-1.45	160.87	160.58	-0.29	-0.18	0.00	0.00	130.36	128.98	-1.38	-1.06	-0.01	-0.01
1.A.1.	Energy Industries	5,885.86	5,753.76	-132.10	-2.24	-0.57	-0.66	6.89	6.77	-0.12	-1.77	0.00	0.00	20.98	20.75	-0.23	-1.08	0.00	0.00
1.A.2.	Manufacturing Industries and Construction	1,259.02	1,264.65	5.63	0.45	0.02	0.03	4.91	4.91					7.90	7.90				
1.A.3.	Transport	4,357.32	4,321.12	-36.20	-0.83	-0.16	-0.18	12.70	12.70	0.00	0.00	0.00	0.00	72.61	72.49	-0.12	-0.17	0.00	0.00
1.A.4.	Other Sectors	1,223.77	1,099.04	-124.74	-10.19	-0.54	-0.63	136.37	136.20	-0.17	-0.12	0.00	0.00	28.76	27.73	-1.03	-3.57	0.00	-0.01
1.A.5.	Other	11.80	11.92	0.12	1.03	0.00	0.00	0.01	0.01					0.11	0.11				
1.B.	Fugitive Emissions from Fuels	17.84	17.84					245.48	245.48					0.05	0.05		0.00		
1.B.1.	Solid fuel	NO	NO					NO	NO					NO	NO				
1.B.2.	Oil and Natural Gas	17.84	17.84					245.48	245.48					0.05	0.05		0.00		
2. Industrial Processes		**1,609.35**	**1,609.07**	**-0.29**	**-0.02**	**0.00**	**0.00**	**1.65**	**1.65**					**1,999.50**	**2,353.72**	**354.22**	**17.72**	**1.53**	**1.78**
2.A.	Mineral Products	448.00	447.90	-0.11	-0.02	0.00	0.00	NA,NE,NO	NA,NE,NO					NA,NE,NO	NA,NE,NO				
2.B.	Chemical Industry	1,154.16	1,153.98	-0.18	-0.02	0.00	0.00	1.65	1.65					1,999.50	2,353.72	354.22	17.72	1.53	1.78
2.C.	Metal Production	7.19	7.19					NO	NO					NO	NO				
2.D.	Other Production	NE	NE																
2.G.	Other	NA	NA					NA	NA					NA	NA				
3. Solvent and Other Product Use		**92.72**	**92.72**											**NA,NE**	**69.21**	**69.21**	**100.00**	**0.30**	**0.35**
4. Agriculture								**1,841.33**	**1,958.76**	**117.43**	**6.38**	**0.51**	**0.59**	**3,146.47**	**2,676.75**	**-469.72**	**-14.93**	**-2.03**	**-2.36**
4.A.	Enteric Fermentation							1,252.63	1,322.60	69.97	5.59	0.30	0.35						
4.B.	Manure Management							588.70	636.16	47.46	8.06	0.21	0.24	363.95	342.04	-21.91	-6.02	-0.09	-0.11
4.C.	Rice Cultivation							NO	NO										
4.D.	Agricultural Soils [4]							NA,NE	NA,NE					2,782.52	2,334.71	-447.81	-16.09	-1.93	-2.25
4.E.	Prescribed Burning of Savannas							NO	NO					NO	NO				
4.F.	Field Burning of Agricultural Residues							NO	NO					NO	NO				
4.G.	Other							NO	NO					NO	NO				
5. Land Use, Land-Use Change and Forestry (net) [5]		**-13,933.23**	**-3,292.54**	10,640.68	-76.37		53.54	0.32	0.06	-0.26	-80.30		0.00	22.05	22.30	0.24	1.10		0.00
5.A.	Forest Land	-14,030.77	-5,066.25	8,964.52	-63.89		45.10	0.32	0.06	-0.26	-80.30		0.00	22.05	22.30	0.24	1.10		0.00
5.B.	Cropland	NA,NE	NA,NE					NA,NE	NA,NE					NA,NE	NA,NE				
5.C.	Grassland	NA,NE	NA,NE					NA,NE	NA,NE					NA,NE	NA,NE				
5.D.	Wetlands	62.46	375.31	312.85	500.88		1.57	NA,NE	NA,NE					NA,NE	NA,NE				
5.E.	Settlements	18.37	515.38	497.00	2,704.85		2.50	NE	NE					NE	NE				
5.F.	Other Land	16.70	883.01	866.31	5,186.21		4.36	NE	NE					NE	NE				
5.G.	Other	NE	NE					NE	NE					NE	NE				

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2						CH_4						N_2O					
	Previous submission	Latest submission	Difference	Difference[(1)]	Impact of recalculation on total emissions excluding LULUCF [(2)]	Impact of recalculation on total emissions including LULUCF[(3)]	Previous submission	Latest submission	Difference	Difference[(1)]	Impact of recalculation on total emissions excluding LULUCF [(2)]	Impact of recalculation on total emissions including LULUCF[(3)]	Previous submission	Latest submission	Difference	Difference[(1)]	Impact of recalculation on total emissions excluding LULUCF [(2)]	Impact of recalculation on total emissions including LULUCF[(3)]
	CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)		
6. Waste	**5.69**	**5.69**					1,226.71	1,280.34	53.62	4.37	0.23	0.27	76.41	76.66	0.25	0.33	0.00	0.00
6.A. Solid Waste Disposal on Land	NA,NE	NA					774.22	827.84	53.62	6.93	0.23	0.27						
6.B. Waste-water Handling							452.49	452.49					76.41	76.41				
6.C. Waste Incineration	5.69	5.69					NE	NA,NE					NE	0.25	0.25	100.00	0.00	0.00
6.D. Other	NA	NA					NA	NA					NA	NA				
7. Other *(as specified in Summary 1.A)*	NA	NA					NA	NA					NA	NA				
Memo Items:																		
International Bunkers	**602.21**	**597.40**	**-4.81**	**-0.80**	**-0.02**	**-0.02**	**0.31**	**0.44**	**0.13**	**41.33**	**0.00**	**0.00**	**6.41**	**2.42**	**-4.00**	**-62.32**	**-0.02**	**-0.02**
Multilateral Operations	**NO**	**NO**					**NO**	**NO**					**NO**	**NO**				
CO_2 Emissions from Biomass	**3,098.10**	**3,098.10**																

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs						PFCs						SF_6					
	Previous submission	Latest submission	Difference	Difference[(1)]	Impact of recalculation on total emissions excluding LULUCF [(2)]	Impact of recalculation on total emissions including LULUCF[(3)]	Previous submission	Latest submission	Difference	Difference[(1)]	Impact of recalculation on total emissions excluding LULUCF [(2)]	Impact of recalculation on total emissions including LULUCF[(3)]	Previous submission	Latest submission	Difference	Difference[(1)]	Impact of recalculation on total emissions excluding LULUCF [(2)]	Impact of recalculation on total emissions including LULUCF[(3)]
	CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)		
Total Actual Emissions	**12.97**	**16.08**	**3.11**	**23.95**	**0.01**	**0.02**	**NA,NO**	**NA,NO**					**1.38**	**1.38**				
2.C.3. Aluminium Production							NO	NO										
2.E. Production of Halocarbons and SF_6	NO	NO					NO	NO					NO	NO				
2.F. Consumption of Halocarbons and SF_6	12.97	16.08	3.11	23.95	0.01	0.02	NA,NO	NA,NO					1.38	1.38				
2.G. Other	NA	NA					NA	NA					NA	NA				
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**93.18**	**93.18**					**NO**	**NO**					**IE,NE,NO**	**IE,NE,NO**				

	Previous submission	Latest submission	Difference	Difference[(1)]
	CO_2 equivalent (Gg)			(%)
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	9,395.71	19,875.26	10,479.55	111.54
Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	23,306.55	23,145.44	-161.11	-0.69

Inventory 2008

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2						CH_4						N_2O					
		Previous submission	Latest submission	Difference	Difference[(1)]	Impact of recalculation on total emissions excluding LULUCF [(2)]	Impact of recalculation on total emissions including LULUCF[(3)]	Previous submission	Latest submission	Difference	Difference[(1)]	Impact of recalculation on total emissions excluding LULUCF [(2)]	Impact of recalculation on total emissions including LULUCF[(3)]	Previous submission	Latest submission	Difference	Difference[(1)]	Impact of recalculation on total emissions excluding LULUCF [(2)]	Impact of recalculation on total emissions including LULUCF[(3)]
		CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)		
Total National Emissions and Removals		**1,624.23**	**11,051.08**	**9,426.86**	580.39	38.27	45.60	3,622.87	3,729.91	**107.04**	2.95	0.43	0.52	5,725.05	5,794.66	**69.61**	1.22	0.28	0.34
1. Energy		**12,813.43**	**12,499.07**	**-314.36**	-2.45	-1.28	-1.52	409.60	411.07	**1.48**	0.36	0.01	0.01	143.96	142.86	**-1.10**	-0.76	0.00	-0.01
1.A.	Fuel Combustion Activities	12,802.88	12,488.51	-314.36	-2.46	-1.28	-1.52	159.17	158.94	-0.23	-0.15	0.00	0.00	143.93	142.83	-1.10	-0.76	0.00	-0.01
1.A.1.	Energy Industries	4,970.89	4,870.13	-100.76	-2.03	-0.41	-0.49	8.01	8.01					22.59	22.59				
1.A.2.	Manufacturing Industries and Construction	1,271.87	1,231.92	-39.96	-3.14	-0.16	-0.19	4.57	4.49	-0.08	-1.68	0.00	0.00	7.26	7.23	-0.02	-0.31	0.00	0.00
1.A.3.	Transport	5,331.22	5,283.85	-47.37	-0.89	-0.19	-0.23	15.05	15.05	0.00	0.00			87.17	87.14	-0.04	-0.04	0.00	0.00
1.A.4.	Other Sectors	1,216.74	1,090.34	-126.40	-10.39	-0.51	-0.61	131.53	131.37	-0.16	-0.12	0.00	0.00	26.79	25.75	-1.04	-3.89	0.00	-0.01
1.A.5.	Other	12.16	12.28	0.13	1.03	0.00	0.00	0.01	0.01					0.12	0.12				
1.B.	Fugitive Emissions from Fuels	10.55	10.55	0.00	0.03	0.00	0.00	250.43	252.14	1.71	0.68	0.01	0.01	0.03	0.03				
1.B.1.	Solid fuel	NO	NO					NO	NO					NO	NO				
1.B.2.	Oil and Natural Gas	10.55	10.55	0.00	0.03	0.00	0.00	250.43	252.14	1.71	0.68	0.01	0.01	0.03	0.03				
2. Industrial Processes		**2,432.26**	**2,441.21**	**8.95**	**0.37**	**0.04**	**0.04**	**2.32**	**2.32**					**2,408.05**	**2,834.62**	**426.57**	**17.71**	**1.73**	**2.06**
2.A.	Mineral Products	520.56	520.27	-0.29	-0.06	0.00	0.00	NA,NE,NO	NA,NE,NO					NA,NE,NO	NA,NE,NO				
2.B.	Chemical Industry	1,906.70	1,915.94	9.24	0.48	0.04	0.04	2.32	2.32					2,408.05	2,834.62	426.57	17.71	1.73	2.06
2.C.	Metal Production	5.00	5.00					NO	NO					NO	NO				
2.D.	Other Production	NE	NE																
2.G.	Other	NA	NA					NA	NA					NA	NA				
3. Solvent and Other Product Use		**91.19**	**91.19**											**NA,NE**	**4.34**	**4.34**	**100.00**	**0.02**	**0.02**
4. Agriculture								**1,936.93**	**1,941.29**	**4.35**	**0.22**	**0.02**	**0.02**	**3,075.03**	**2,714.52**	**-360.51**	**-11.72**	**-1.46**	**-1.74**
4.A.	Enteric Fermentation							1,361.18	1,362.84	1.66	0.12	0.01	0.01						
4.B.	Manure Management							575.76	578.45	2.69	0.47	0.01	0.01	322.83	337.98	15.16	4.70	0.06	0.07
4.C.	Rice Cultivation							NO	NO										
4.D.	Agricultural Soils [(4)]							NA,NE	NA,NE					2,752.20	2,376.54	-375.67	-13.65	-1.53	-1.82
4.E.	Prescribed Burning of Savannas							NO	NO					NO	NO				
4.F.	Field Burning of Agricultural Residues							NO	NO					NO	NO				
4.G.	Other							NO	NO					NO	NO				
5. Land Use, Land-Use Change and Forestry (net) [(5)]		**-13,713.26**	**-3,980.99**	9,732.26	-70.97		47.08	0.73	0.14	-0.59	-80.55		0.00	22.34	22.61	0.26	1.18		0.00
5.A.	Forest Land	-14,080.85	-4,439.15	9,641.70	-68.47		46.64	0.73	0.14	-0.59	-80.55		0.00	22.34	22.61	0.26	1.18		0.00
5.B.	Cropland	NA,NE	NA,NE					NA,NE	NA,NE					NA,NE	NA,NE				
5.C.	Grassland	NA,NE	NA,NE					NA,NE	NA,NE					NA,NE	NA,NE				
5.D.	Wetlands	105.91	130.85	24.95	23.55		0.12	NA,NE	NA,NE					NA,NE	NA,NE				
5.E.	Settlements	137.07	120.63	-16.44	-12.00		-0.08	NE	NE					NE	NE				
5.F.	Other Land	124.61	206.68	82.07	65.86		0.40	NE	NE					NE	NE				
5.G.	Other	NE	NE					NE	NE					NE	NE				

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2						CH_4						N_2O					
	Previous submission	Latest submission	Difference	Difference[1]	Impact of recalculation on total emissions excluding LULUCF [2]	Impact of recalculation on total emissions including LULUCF[3]	Previous submission	Latest submission	Difference	Difference[1]	Impact of recalculation on total emissions excluding LULUCF [2]	Impact of recalculation on total emissions including LULUCF[3]	Previous submission	Latest submission	Difference	Difference[1]	Impact of recalculation on total emissions excluding LULUCF [2]	Impact of recalculation on total emissions including LULUCF[3]
	CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)		
6. Waste	**0.61**	**0.61**					1,273.29	1,375.09	101.79	7.99	0.41	0.49	75.66	75.71	0.05	0.07	0.00	0.00
6.A. Solid Waste Disposal on Land	NA,NE	NA					785.37	887.16	101.79	12.96	0.41	0.49						
6.B. Waste-water Handling							487.93	487.93					75.66	75.66				
6.C. Waste Incineration	0.61	0.61					NE	NA,NE					NE	0.05	0.05	100.00	0.00	0.00
6.D. Other	NA	NA					NA	NA					NA	NA				
7. Other *(as specified in Summary 1.A)*	NA	NA					NA	NA					NA	NA				
Memo Items:																		
International Bunkers	**522.87**	**514.93**	**-7.94**	**-1.52**	**-0.03**	**-0.04**	**0.24**	**0.33**	**0.10**	**41.76**	**0.00**	**0.00**	**4.94**	**2.86**	**-2.08**	**-42.12**	**-0.01**	**-0.01**
Multilateral Operations	**NO**	**NO**					**NO**	**NO**					**NO**	**NO**				
CO_2 Emissions from Biomass	**3,344.24**	**3,344.34**	**0.10**	**0.00**	**0.00**	**0.00**												

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs						PFCs						SF_6					
	Previous submission	Latest submission	Difference	Difference[1]	Impact of recalculation on total emissions excluding LULUCF [2]	Impact of recalculation on total emissions including LULUCF[3]	Previous submission	Latest submission	Difference	Difference[1]	Impact of recalculation on total emissions excluding LULUCF [2]	Impact of recalculation on total emissions including LULUCF[3]	Previous submission	Latest submission	Difference	Difference[1]	Impact of recalculation on total emissions excluding LULUCF [2]	Impact of recalculation on total emissions including LULUCF[3]
	CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)			CO_2 equivalent (Gg)			(%)		
Total Actual Emissions	**25.23**	**90.43**	**65.20**	**258.40**	**0.26**	**0.32**	**NA,NO**	**NA,NO**					**0.03**	**6.24**	**6.21**	**24,761.90**	**0.03**	**0.03**
2.C.3. Aluminium Production							NO	NO										
2.E. Production of Halocarbons and SF_6	NO	NO					NO	NO					NO	NO				
2.F. Consumption of Halocarbons and SF_6	25.23	90.43	65.20	258.40	0.26	0.32	NA,NO	NA,NO					0.03	6.24	6.21	24,761.90	0.03	0.03
2.G. Other	NA	NA					NA	NA					NA	NA				
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**155.76**	**155.76**					**NO**	**NO**					**0.03**	**0.03**				

	Previous submission	Latest submission	Difference	Difference[1]
	CO_2 equivalent (Gg)			(%)
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	10,997.40	20,672.31	9,674.91	87.97
Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	24,687.58	24,630.55	-57.03	-0.23

TABLE 8(b)RECALCULATION - EXPLANATORY INFORMATION

Inventory 1990

Specify the sector and source/sink category[1] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO CHANGES IN: Methods [2]	Emission factors [2]	Activity data [2]	Addition/removal/ reallocation of source/sink categories	Other changes in data (e.g. statistical or editorial changes, correction of errors)
	Sectors/Totals	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.			
	Sectors/Totals	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.			
	Sectors/Totals	CH4		Corrected emission factor for International bunkers			
	Sectors/Totals	N2O		Corrected emission factor for International bunkers			
1	Energy	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.		Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1	Energy	CH4		Corrected emission factor for International bunkers		Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1	Energy	N2O		Corrected emission factor for International bunkers		Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA	Fuel Combustion - Sectoral Approach	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.		Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA	Fuel Combustion - Sectoral Approach	CH4				Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA	Fuel Combustion - Sectoral Approach	N2O				Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA.1	Energy Industries	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.		Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA.1	Energy Industries	CH4				Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA.1	Energy Industries	N2O				Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA.2	Manufacturing Industries and Construction	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.			
1.AA.3	Transport	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.			
1.AA.4	Other Sectors	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.		Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA.4	Other Sectors	CH4				Emissions from use of Gasoline and Diesel Oil realocated to Transport off-road mashinery	
1.AA.4	Other Sectors	N2O				Emissions from use of Gasoline and Diesel Oil realocated to Transport off-road mashinery	

1.C1	International Bunkers	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.			
1.C1	International Bunkers	CH4		Corrected emission factors for international bunkers			
1.C1	International Bunkers	N2O		Corrected emission factors for international bunkers			
2	Industrial Processes	CO2					
2	Industrial Processes	N2O					
2.A	Mineral Products	Recovery/CH4					
2.A	Mineral Products	Recovery/N2O					
2.B	Chemical Industry	CO2					
2.B	Chemical Industry	N2O					
2.B.1	Ammonia Production	CO2			Recalculated with updated AD provided by company		
2.B.2	Nitric Acid Production	N2O		Plant specific factor was used			
2.D	Other Production	Recovery/CO2					
2.F	Consumption of Halocarbons and SF6	HFCs					
2.F	Consumption of Halocarbons and SF6	HFC-134a					
3	Solvent and Other Product Use	N2O					
3.D.1	Use of N2O for Anaesthesia	N2O					Emissions calculated for the first time
4	Agriculture	CH4					
4	Agriculture	N2O			Data on histosol area corrected		
4.A	Enteric Fermentation	CH4					
	4.A Enteric Fermentation \ Other livestock (please specify) \ Other non-specified	CH4					Reported for the first time
4.B	Manure Management	CH4					
4.B	Manure Management	N2O			Recalculated using updated data on animal herd structure and protein consumption		
	4.B Manure Management \ Other livestock (please specify) \ Other non-specified	CH4					
	4.B Manure Management \ Liquid system	N2O					
	4.B Manure Management \ Solid storage and dry lot	N2O					
	4.B Manure Management \ Other AWMS	N2O					
4.D	Agricultural Soils	N2O			Data on histosol area corrected		
4.D.1.2	Animal Manure Applied to Soils	N2O					
4.D.3.1	Atmospheric Deposition	N2O					
5	LULUCF	CO2	Method 2 applied		Activity data corrected and updated		
5	LULUCF	CH4	Method 2 applied		Activity data corrected and updated		
5	LULUCF	N2O	Method 2 applied		Activity data corrected and updated		
5.A	Forest Land	CO2	Method 2 applied		Activity data corrected and updated		
5.A	Forest Land	CH4	Method 2 applied		Activity data corrected and updated		
5.A	Forest Land	N2O	Method 2 applied		Activity data corrected and updated		
5.D	Wetlands	CO2			Activity data corrected and updated		
5.E	Settlements	CO2			Activity data corrected and updated		
5.F	Other Land	CO2			Activity data corrected and updated		
6	Waste	CH4			Disposal of non-municipal waste added to calculations		
6	Waste	N2O			Disposal of non-municipal waste added to calculations		
6.A	Solid Waste Disposal on Land	CO2					
6.A	Solid Waste Disposal on Land	CH4			Disposal of non-municipal waste added to calculations		
6.C	Waste Incineration	CH4					
6.C	Waste Incineration	N2O					Emission estimates provided for the first time

Inventory 2000

Specify the sector and source/sink category[1] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO				
			CHANGES IN:			Addition/removal/ reallocation of source/sink categories	Other changes in data (e.g. statistical or editorial changes, correction of errors)
			Methods [2]	Emission factors [2]	Activity data [2]		
	Sectors/Totals	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.			
	Sectors/Totals	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.			
	Sectors/Totals	CH4		Corrected emission factor for International bunkers			
	Sectors/Totals	N2O		Corrected emission factor for International bunkers			
	Sectors/Totals	HFCs			AD disaggregated between industrial and commercial refrigeration		Emission from metered dose inhalers added
	Sectors/Totals	HFC-23					
	Sectors/Totals	HFC-41					
	Sectors/Totals	HFC-43-10 mee					
	Sectors/Totals	HFC-134					
	Sectors/Totals	HFC-134a			AD disaggregated between industrial and commercial refrigeration		Emission from metered dose inhalers added
	Sectors/Totals	HFC-152a					
	Sectors/Totals	HFC-143					
	Sectors/Totals	HFC-227ea					
	Sectors/Totals	HFC-236fa					
	Sectors/Totals	HFC-245ca					
	Sectors/Totals	Unspecified mix of HFCs					
1	Energy	CO2				Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1	Energy	CH4		Corrected emission factor for International bunkers		Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1	Energy	N2O		Corrected emission factor for International bunkers		Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA	Fuel Combustion - Sectoral Approach	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.		Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA	Fuel Combustion - Sectoral Approach	CH4				Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA	Fuel Combustion - Sectoral Approach	N2O				Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	

1.AA.1	Energy Industries	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.		Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA.1	Energy Industries	CH4				Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA.1	Energy Industries	N2O				Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA.2	Manufacturing Industries and Construction	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.			Change due to round off ot the data
1.AA.3	Transport	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.			
1.AA.4	Other Sectors	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.		Emissions from use of Motor Gasoline and Diesel Oil realocated to Transport off-road mashinery	
1.AA.4	Other Sectors	CH4				Emissions from use of Motor Gasoline and Diesel Oil realocated to Transport off-road mashinery	
1.AA.4	Other Sectors	N2O				Emissions from use of Motor Gasoline and Diesel Oil realocated to Transport off-road mashinery	
1.C1	International Bunkers	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.			
1.C1	International Bunkers	CH4		Corrected emission factors for international bunkers			
1.C1	International Bunkers	N2O		Corrected emission factors for international bunkers			
2	Industrial Processes	CO2					
2	Industrial Processes	N2O					
2	Industrial Processes	HFCs			AD disaggregated between industrial and commercial refrigeration		Emission from metered dose inhalers added
2	Industrial Processes	HFC-23					
2	Industrial Processes	HFC-41					
2	Industrial Processes	HFC-43-10 mee					
2	Industrial Processes	HFC-134					
2	Industrial Processes	HFC-134a			AD disaggregated between industrial and commercial refrigeration		
2	Industrial Processes	HFC-152a					
2	Industrial Processes	HFC-143					
2	Industrial Processes	HFC-227ea					
2	Industrial Processes	HFC-236fa					
2	Industrial Processes	HFC-245ca					
2	Industrial Processes	Unspecified mix of HFCs					
2.A	Mineral Products	Recovery/CH4					
2.A	Mineral Products	Recovery/N2O					
2.B	Chemical Industry	CO2					

Inventory 2005

Specify the sector and source/sink category[(1)] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO				
			CHANGES IN:			Addition/removal/ reallocation of source/sink categories	Other changes in data (e.g. statistical or editorial changes, correction of errors)
			Methods [(2)]	Emission factors [(2)]	Activity data [(2)]		
	Sectors/Totals	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.			
	Sectors/Totals	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.			
	Sectors/Totals	CH4		Corrected emission factor for International bunkers			
	Sectors/Totals	N2O		Corrected emission factor for International bunkers			
	Sectors/Totals	HFCs			AD disaggregated between industrial and commercial refrigeration		Emission from metered dose inhalers added
	Sectors/Totals	HFC-23					
	Sectors/Totals	HFC-41					
	Sectors/Totals	HFC-43-10 mee					
	Sectors/Totals	HFC-134					
	Sectors/Totals	HFC-134a			AD disaggregated between industrial and commercial refrigeration		Emission from metered dose inhalers added
	Sectors/Totals	HFC-152a					
	Sectors/Totals	HFC-143					
	Sectors/Totals	HFC-227ea					
	Sectors/Totals	HFC-236fa					
	Sectors/Totals	HFC-245ca					
	Sectors/Totals	Unspecified mix of HFCs					
1	Energy	CO2			Change of statistical data.	Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1	Energy	CH4		Corrected emission factor for International bunkers	Change of statistical data.	Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1	Energy	N2O		Corrected emission factor for International bunkers	Change of statistical data.	Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA	Fuel Combustion - Sectoral Approach	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.		Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA	Fuel Combustion - Sectoral Approach	CH4				Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	

1.AA	Fuel Combustion - Sectoral Approach	N2O				Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA.1	Energy Industries	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.		Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA.1	Energy Industries	CH4				Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA.1	Energy Industries	N2O				Emissions from motor gasoline and diesel oil were reallocated to table 1.AA.3.E. Other Transportation. Off road vehicles and other machinery.	
1.AA.2	Manufacturing Industries and Construction	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.			Change due to round off ot the data
1.AA.3	Transport	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.	Change of statistical data.		
1.AA.3	Transport	CH4			Change of statistical data.		
1.AA.3	Transport	N2O			Change of statistical data.		
1.AA.4	Other Sectors	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.		Emissions from use of Motor Gasoline and Diesel Oil realocated to Transport off-road mashinery	
1.AA.4	Other Sectors	CH4				Emissions from use of Motor Gasoline and Diesel Oil realocated to Transport off-road mashinery	
1.AA.4	Other Sectors	N2O				Emissions from use of Motor Gasoline and Diesel Oil realocated to Transport off-road mashinery	
1.AA.5	Other (Not elsewhere specified)	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.			
1.C1	International Bunkers	CO2		CO2 emission factors for Motor gasoline, Jet kerosen, Gas/Diesel Oil, Residual Fuel Oil, LPG and Non liquified petroleum gas were updated based on country specific data.			
1.C1	International Bunkers	CH4		Corrected emission factors for international bunkers			
1.C1	International Bunkers	N2O		Corrected emission factors for international bunkers			
2	Industrial Processes	CO2					
2	Industrial Processes	N2O					
2	Industrial Processes	HFCs			AD disaggregated between industrial and commercial refrigeration		Emission from metered dose inhalers added
2	Industrial Processes	HFC-23					
2	Industrial Processes	HFC-41					
2	Industrial Processes	HFC-43-10 mee					
2	Industrial Processes	HFC-134					
2	Industrial Processes	HFC-134a			AD disaggregated between industrial and commercial refrigeration		
2	Industrial Processes	HFC-152a					
2	Industrial Processes	HFC-143					
2	Industrial Processes	HFC-227ea					
2	Industrial Processes	HFC-236fa					
2	Industrial Processes	HFC-245ca					
2	Industrial Processes	Unspecified mix of HFCs					

TABLE 10 EMISSION TRENDS: CO_2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**32,987.81**	**35,143.77**	**19,685.87**	**15,727.12**	**14,848.08**	**13,769.97**	**14,236.15**	**13,757.39**	**14,495.22**	**12,083.71**
A. Fuel Combustion (Sectoral Approach)	32,986.76	35,141.05	19,680.73	15,721.18	14,840.52	13,759.62	14,223.35	13,739.91	14,472.86	12,064.59
1. Energy Industries	13,960.37	15,071.56	8,877.37	7,499.15	7,472.85	6,576.73	7,273.84	6,701.35	7,555.18	6,122.16
2. Manufacturing Industries and Construction	5,954.31	6,072.71	2,879.29	1,845.96	1,872.34	1,564.28	1,436.10	1,428.92	1,411.80	1,080.37
3. Transport	7,378.77	7,538.44	5,079.36	3,985.94	3,269.25	3,787.68	3,823.90	4,161.13	4,296.62	3,758.41
4. Other Sectors	5,693.31	6,458.33	2,844.71	2,390.12	2,226.10	1,830.93	1,689.51	1,448.52	1,209.26	1,103.65
5. Other	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO
B. Fugitive Emissions from Fuels	1.05	2.73	5.13	5.94	7.55	10.35	12.80	17.48	22.37	19.13
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	1.05	2.73	5.13	5.94	7.55	10.35	12.80	17.48	22.37	19.13
2. Industrial Processes	**3,353.32**	**3,334.96**	**1,790.04**	**836.98**	**1,068.55**	**1,354.60**	**1,584.03**	**1,425.19**	**1,552.79**	**1,446.24**
A. Mineral Products	2,141.38	2,021.21	1,082.16	500.29	483.13	423.89	405.40	441.31	509.00	419.16
B. Chemical Industry	1,190.53	1,296.58	699.37	330.48	579.64	925.12	1,173.17	977.91	1,037.24	1,020.08
C. Metal Production	21.41	17.17	8.50	6.21	5.79	5.59	5.45	5.96	6.56	7.00
D. Other Production	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	100.50	100.59	100.48	100.00	99.31	98.55	97.80	97.09	96.38	95.70
4. Agriculture										
A. Enteric Fermentation										
B. Manure Management										
C. Rice Cultivation										
D. Agricultural Soils										
E. Prescribed Burning of Savannas										
F. Field Burning of Agricultural Residues										
G. Other										
5. Land Use, Land-Use Change and Forestry[(2)]	**-4,351.21**	**-4,691.27**	**-4,699.55**	**-4,722.95**	**-4,722.67**	**-4,734.77**	**-4,746.61**	**-4,765.92**	**-4,154.25**	**-4,150.14**
A. Forest Land	-5,068.05	-5,108.94	-5,104.62	-5,106.00	-5,105.07	-5,104.15	-5,103.22	-5,102.29	-5,024.89	-5,021.05
B. Cropland	93.43	80.08	66.73	53.39	40.04	26.69	13.35	NA,NE	NA,NE	NA,NE
C. Grassland	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
D. Wetlands	175.16	121.99	122.13	112.85	124.95	124.67	124.65	117.17	217.26	217.10
E. Settlements	165.21	79.46	79.68	79.90	80.13	80.35	80.57	80.79	240.81	240.96
F. Other Land	283.05	136.14	136.52	136.90	137.28	137.66	138.04	138.42	412.58	412.85
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**4.00**	**4.33**	**1.34**	**3.71**	**1.13**	**4.08**	**1.38**	**1.37**	**1.44**	**0.62**
A. Solid Waste Disposal on Land	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Waste-water Handling										
C. Waste Incineration	4.00	4.33	1.34	3.71	1.13	4.08	1.38	1.37	1.44	0.62
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CO_2 emissions including net CO_2 from LULUCF	**32,094.42**	**33,892.37**	**16,878.17**	**11,944.87**	**11,294.40**	**10,492.43**	**11,172.75**	**10,515.11**	**11,991.59**	**9,476.14**
Total CO_2 emissions excluding net CO_2 from LULUCF	**36,445.63**	**38,583.65**	**21,577.72**	**16,667.81**	**16,017.07**	**15,227.20**	**15,919.36**	**15,281.03**	**16,145.84**	**13,626.28**
Memo Items:										
International Bunkers	**707.14**	**984.48**	**1,130.12**	**627.45**	**605.44**	**574.03**	**521.16**	**288.95**	**245.82**	**311.48**
Aviation	403.40	483.48	200.20	113.97	120.12	123.19	101.60	95.45	86.23	80.08
Marine	303.73	500.99	929.92	513.47	485.32	450.84	419.56	193.50	159.59	231.40
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	1,215.43	1,215.43	1,216.35	1,816.11	1,877.72	1,969.72	2,158.12	2,208.81	2,435.15	2,524.19

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**10,485.58**	**11,153.05**	**11,220.05**	**11,188.77**	**11,805.65**	**12,468.32**	**12,611.35**	**12,795.19**	**12,499.07**	**11,336.15**
A. Fuel Combustion (Sectoral Approach)	10,459.54	11,114.28	11,184.36	11,157.32	11,780.80	12,450.49	12,596.38	12,782.48	12,488.51	11,326.64
1. Energy Industries	5,202.22	5,671.77	5,470.75	5,331.87	5,501.86	5,753.76	5,303.28	4,820.98	4,870.13	4,893.63
2. Manufacturing Industries and Construction	1,010.01	985.40	1,066.29	1,076.73	1,170.47	1,264.65	1,463.32	1,433.57	1,231.92	993.21
3. Transport	3,317.26	3,557.64	3,679.18	3,724.81	4,059.99	4,321.12	4,579.45	5,330.25	5,283.85	4,368.40
4. Other Sectors	930.05	899.47	968.14	1,020.45	1,039.09	1,099.04	1,238.77	1,182.29	1,090.34	1,060.13
5. Other	IE,NE,NO	IE,NE,NO	IE,NE,NO	3.47	9.39	11.92	11.56	15.39	12.28	11.27
B. Fugitive Emissions from Fuels	26.04	38.77	35.69	31.45	24.85	17.84	14.96	12.71	10.55	9.51
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	26.04	38.77	35.69	31.45	24.85	17.84	14.96	12.71	10.55	9.51
2. Industrial Processes	**1,432.37**	**1,500.22**	**1,554.30**	**1,302.57**	**1,511.03**	**1,609.07**	**1,839.77**	**2,934.10**	**2,441.21**	**1,480.79**
A. Mineral Products	358.56	361.85	356.96	366.28	430.23	447.90	598.72	599.11	520.27	303.75
B. Chemical Industry	1,066.34	1,130.57	1,190.14	929.02	1,073.75	1,153.98	1,234.19	2,328.45	1,915.94	1,173.01
C. Metal Production	7.47	7.80	7.20	7.27	7.05	7.19	6.87	6.54	5.00	4.03
D. Other Production	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	95.03	94.54	94.21	93.80	93.30	92.72	92.17	91.67	91.19	90.68
4. Agriculture										
A. Enteric Fermentation										
B. Manure Management										
C. Rice Cultivation										
D. Agricultural Soils										
E. Prescribed Burning of Savannas										
F. Field Burning of Agricultural Residues										
G. Other										
5. Land Use, Land-Use Change and Forestry[(2)]	**-4,143.48**	**-4,337.78**	**-4,542.46**	**-3,694.11**	**-3,819.99**	**-3,292.54**	**-3,456.14**	**-3,982.88**	**-3,980.99**	**-3,780.52**
A. Forest Land	-5,018.36	-5,213.52	-5,233.52	-5,123.93	-5,136.58	-5,066.25	-4,372.66	-4,440.81	-4,439.15	-4,411.96
B. Cropland	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
C. Grassland	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
D. Wetlands	220.64	220.98	175.88	307.29	288.52	375.31	217.36	131.14	130.85	163.42
E. Settlements	241.12	241.31	189.87	413.71	378.90	515.38	257.68	120.44	120.63	172.49
F. Other Land	413.12	413.45	325.31	708.82	649.17	883.01	441.49	206.35	206.68	295.53
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**1.84**	**2.44**	**2.24**	**6.02**	**3.09**	**5.69**	**5.23**	**0.73**	**0.61**	**0.64**
A. Solid Waste Disposal on Land	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Waste-water Handling										
C. Waste Incineration	1.84	2.44	2.24	6.02	3.09	5.69	5.23	0.73	0.61	0.64
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CO_2 emissions including net CO_2 from LULUCF	**7,871.35**	**8,412.46**	**8,328.33**	**8,897.05**	**9,593.07**	**10,883.26**	**11,092.37**	**11,838.82**	**11,051.08**	**9,127.74**
Total CO_2 emissions excluding net CO_2 from LULUCF	**12,014.83**	**12,750.24**	**12,870.79**	**12,591.16**	**13,413.06**	**14,175.80**	**14,548.51**	**15,821.70**	**15,032.08**	**12,908.26**
Memo Items:										
International Bunkers	**371.89**	**414.88**	**434.32**	**443.23**	**467.78**	**597.40**	**597.08**	**579.22**	**514.93**	**518.28**
Aviation	77.08	97.72	82.90	92.72	105.24	137.71	156.51	196.05	227.08	108.82
Marine	294.82	317.16	351.42	350.51	362.54	459.69	440.57	383.16	287.85	409.46
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	2,643.74	2,790.62	2,949.89	3,050.62	3,138.45	3,098.10	3,199.02	3,198.30	3,344.34	3,405.38

TABLE 10 EMISSION TRENDS: CH_4

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	17.64	18.42	13.46	14.97	15.05	15.64	16.69	17.30	18.38	18.51
A. Fuel Combustion (Sectoral Approach)	10.53	10.95	6.04	7.22	6.97	7.00	7.78	7.87	8.09	8.31
1. Energy Industries	0.40	0.46	0.28	0.25	0.24	0.21	0.23	0.21	0.26	0.19
2. Manufacturing Industries and Construction	0.35	0.37	0.20	0.12	0.13	0.11	0.11	0.12	0.13	0.10
3. Transport	1.05	1.15	0.71	0.57	0.47	0.62	0.68	0.69	0.69	0.59
4. Other Sectors	8.73	8.98	4.85	6.28	6.12	6.06	6.77	6.84	7.01	7.43
5. Other	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO
B. Fugitive Emissions from Fuels	7.11	7.47	7.42	7.75	8.08	8.64	8.91	9.43	10.29	10.20
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	7.11	7.47	7.42	7.75	8.08	8.64	8.91	9.43	10.29	10.20
2. Industrial Processes	**0.18**	**0.20**	**0.11**	**0.01**	**0.06**	**0.08**	**0.04**	**0.05**	**0.02**	**NA,NE,NO**
A. Mineral Products	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
B. Chemical Industry	0.18	0.20	0.11	0.01	0.06	0.08	0.04	0.05	0.02	NO
C. Metal Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use										
4. Agriculture	**212.76**	**199.24**	**145.99**	**123.56**	**110.39**	**106.02**	**104.51**	**104.64**	**98.71**	**90.96**
A. Enteric Fermentation	149.28	140.97	106.84	89.45	76.89	72.84	73.51	72.47	67.90	64.35
B. Manure Management	63.48	58.27	39.15	34.11	33.51	33.18	31.00	32.17	30.80	26.61
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	**0.01**	**0.00**	**0.06**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.00**	**0.02**
A. Forest Land	0.01	0.00	0.06	0.02	0.02	0.02	0.02	0.02	0.00	0.02
B. Cropland	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
C. Grassland	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
D. Wetlands	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**72.75**	**68.92**	**62.44**	**61.95**	**60.34**	**59.87**	**60.33**	**62.08**	**63.50**	**58.92**
A. Solid Waste Disposal on Land	35.85	36.71	37.45	38.00	38.38	38.66	38.90	39.12	39.34	39.55
B. Waste-water Handling	36.90	32.21	24.99	23.96	21.96	21.21	21.43	22.96	24.16	19.37
C. Waste Incineration	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CH_4 emissions including CH_4 from LULUCF	**303.35**	**286.78**	**222.06**	**200.51**	**185.87**	**181.63**	**181.59**	**184.09**	**180.61**	**168.41**
Total CH_4 emissions excluding CH_4 from LULUCF	**303.34**	**286.77**	**222.00**	**200.49**	**185.85**	**181.61**	**181.57**	**184.07**	**180.61**	**168.39**
Memo Items:										
International Bunkers	0.02	0.03	0.04	0.02	0.02	0.02	0.02	0.01	0.01	0.01
Aviation	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Marine	0.01	0.02	0.04	0.02	0.02	0.02	0.02	0.01	0.01	0.01
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	18.73	19.48	19.21	19.11	18.79	19.34	19.62	19.29	19.57	19.72
A. Fuel Combustion (Sectoral Approach)	8.06	8.02	7.86	7.80	7.63	7.65	7.85	7.56	7.57	7.33
1. Energy Industries	0.18	0.23	0.26	0.27	0.32	0.32	0.34	0.34	0.38	0.43
2. Manufacturing Industries and Construction	0.10	0.12	0.18	0.22	0.23	0.23	0.24	0.24	0.21	0.16
3. Transport	0.51	0.52	0.54	0.56	0.58	0.60	0.64	0.74	0.72	0.61
4. Other Sectors	7.26	7.14	6.87	6.75	6.50	6.49	6.63	6.25	6.26	6.13
5. Other	IE,NE,NO	IE,NE,NO	IE,NE,NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	10.67	11.46	11.35	11.31	11.16	11.69	11.77	11.72	12.01	12.40
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	10.67	11.46	11.35	11.31	11.16	11.69	11.77	11.72	12.01	12.40
2. Industrial Processes	**0.02**	**0.06**	**0.06**	**0.08**	**0.09**	**0.08**	**0.10**	**0.10**	**0.11**	**NA,NE,NO**
A. Mineral Products	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
B. Chemical Industry	0.02	0.06	0.06	0.08	0.09	0.08	0.10	0.10	0.11	NO
C. Metal Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use										
4. Agriculture	**81.60**	**86.16**	**89.51**	**92.61**	**91.82**	**93.27**	**96.36**	**92.04**	**92.44**	**87.73**
A. Enteric Fermentation	57.22	58.95	60.99	63.50	62.48	62.98	65.35	64.28	64.90	61.11
B. Manure Management	24.38	27.21	28.52	29.11	29.35	30.29	31.01	27.75	27.55	26.62
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	**0.02**	**0.01**	**0.04**	**0.03**	**0.02**	**0.00**	**0.07**	**0.00**	**0.01**	**0.02**
A. Forest Land	0.02	0.01	0.04	0.03	0.02	0.00	0.07	0.00	0.01	0.02
B. Cropland	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
C. Grassland	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
D. Wetlands	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**61.58**	**62.08**	**58.90**	**61.62**	**62.30**	**60.97**	**61.98**	**63.17**	**65.48**	**65.08**
A. Solid Waste Disposal on Land	39.70	40.01	40.09	40.35	39.64	39.42	39.40	39.49	42.25	42.46
B. Waste-water Handling	21.88	22.06	18.81	21.27	22.67	21.55	22.57	23.68	23.23	22.63
C. Waste Incineration	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CH_4 emissions including CH_4 from LULUCF	**161.95**	**167.79**	**167.72**	**173.45**	**173.02**	**173.66**	**178.13**	**174.60**	**177.61**	**172.56**
Total CH_4 emissions excluding CH_4 from LULUCF	**161.93**	**167.78**	**167.68**	**173.42**	**173.00**	**173.66**	**178.06**	**174.60**	**177.61**	**172.54**
Memo Items:										
International Bunkers	0.01	0.10	0.07	0.05	0.10	0.02	0.02	0.02	0.02	0.02
Aviation	0.00	0.08	0.06	0.04	0.09	0.00	0.00	0.00	0.00	0.00
Marine	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.02
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

TABLE 10 EMISSION TRENDS: N_2O

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**1.10**	**0.97**	**0.68**	**0.61**	**0.56**	**0.54**	**0.45**	**0.46**	**0.46**	**0.39**
A. Fuel Combustion (Sectoral Approach)	1.10	0.97	0.68	0.61	0.56	0.54	0.45	0.46	0.46	0.39
1. Energy Industries	0.09	0.10	0.06	0.06	0.05	0.04	0.05	0.05	0.06	0.04
2. Manufacturing Industries and Construction	0.04	0.04	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01
3. Transport	0.88	0.73	0.53	0.44	0.40	0.39	0.30	0.30	0.29	0.24
4. Other Sectors	0.10	0.11	0.07	0.09	0.09	0.09	0.09	0.09	0.10	0.10
5. Other	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Industrial Processes	**2.93**	**3.07**	**2.24**	**2.36**	**1.84**	**2.05**	**2.82**	**3.11**	**4.02**	**4.23**
A. Mineral Products	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
B. Chemical Industry	2.93	3.07	2.24	2.36	1.84	2.05	2.82	3.11	4.02	4.23
C. Metal Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	0.31	0.31	0.30	0.30	0.29	0.28	0.28	0.27	0.27	0.26
4. Agriculture	**17.44**	**15.73**	**9.61**	**7.82**	**6.45**	**6.29**	**7.71**	**7.79**	**7.53**	**7.46**
A. Enteric Fermentation										
B. Manure Management	2.64	2.49	1.79	1.48	1.26	1.19	1.18	1.15	1.06	1.02
C. Rice Cultivation										
D. Agricultural Soils	14.81	13.25	7.82	6.34	5.19	5.10	6.53	6.64	6.47	6.45
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**
A. Forest Land	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
B. Cropland	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
C. Grassland	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
D. Wetlands	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**0.26**	**0.26**	**0.26**	**0.26**	**0.26**	**0.26**	**0.25**	**0.25**	**0.25**	**0.25**
A. Solid Waste Disposal on Land										
B. Waste-water Handling	0.26	0.26	0.26	0.26	0.26	0.26	0.25	0.25	0.25	0.25
C. Waste Incineration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total N_2O emissions including N_2O from LULUCF	**22.11**	**20.41**	**13.16**	**11.41**	**9.47**	**9.49**	**11.58**	**11.95**	**12.60**	**12.67**
Total N_2O emissions excluding N_2O from LULUCF	**22.04**	**20.34**	**13.10**	**11.34**	**9.40**	**9.42**	**11.51**	**11.88**	**12.53**	**12.60**
Memo Items:										
International Bunkers	**0.01**	**0.02**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**	**0.00**
Aviation	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Marine	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**0.35**	**0.36**	**0.38**	**0.38**	**0.40**	**0.42**	**0.43**	**0.45**	**0.46**	**0.41**
A. Fuel Combustion (Sectoral Approach)	0.35	0.36	0.38	0.38	0.40	0.42	0.43	0.45	0.46	0.41
1. Energy Industries	0.04	0.05	0.06	0.06	0.07	0.07	0.07	0.06	0.07	0.08
2. Manufacturing Industries and Construction	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.02	0.02
3. Transport	0.20	0.20	0.20	0.20	0.22	0.23	0.24	0.28	0.28	0.23
4. Other Sectors	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.08	0.08	0.08
5. Other	IE,NE,NO	IE,NE,NO	IE,NE,NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Industrial Processes	**4.97**	**5.48**	**5.93**	**6.11**	**6.69**	**7.59**	**7.62**	**9.79**	**9.14**	**2.36**
A. Mineral Products	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
B. Chemical Industry	4.97	5.48	5.93	6.11	6.69	7.59	7.62	9.79	9.14	2.36
C. Metal Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	0.25	0.25	0.24	0.24	0.23	0.22	0.13	0.10	0.01	0.03
4. Agriculture	**7.38**	**7.73**	**8.25**	**8.66**	**8.67**	**8.63**	**10.10**	**9.08**	**8.76**	**9.11**
A. Enteric Fermentation										
B. Manure Management	0.91	0.96	1.01	1.07	1.07	1.10	1.16	1.10	1.09	1.03
C. Rice Cultivation										
D. Agricultural Soils	6.47	6.77	7.23	7.59	7.61	7.53	8.94	7.98	7.67	8.08
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**
A. Forest Land	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
B. Cropland	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
C. Grassland	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
D. Wetlands	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.24**	**0.24**	**0.24**
A. Solid Waste Disposal on Land										
B. Waste-water Handling	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.24	0.24	0.24
C. Waste Incineration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total N_2O emissions including N_2O from LULUCF	**13.27**	**14.14**	**15.11**	**15.70**	**16.31**	**17.19**	**18.59**	**19.73**	**18.69**	**12.22**
Total N_2O emissions excluding N_2O from LULUCF	**13.20**	**14.07**	**15.04**	**15.63**	**16.24**	**17.11**	**18.52**	**19.66**	**18.62**	**12.15**
Memo Items:										
International Bunkers	**0.00**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
Marine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

TABLE 10 EMISSION TRENDS: SUMMARY

GREENHOUSE GAS EMISSIONS	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
CO_2 emissions including net CO_2 from LULUCF	32,094.42	33,892.37	16,878.17	11,944.87	11,294.40	10,492.43	11,172.75	10,515.11	11,991.59	9,476.14
CO_2 emissions excluding net CO_2 from LULUCF	36,445.63	38,583.65	21,577.72	16,667.81	16,017.07	15,227.20	15,919.36	15,281.03	16,145.84	13,626.28
CH_4 emissions including CH_4 from LULUCF	6,370.32	6,022.33	4,663.17	4,210.81	3,903.32	3,814.26	3,813.42	3,865.88	3,792.84	3,536.62
CH_4 emissions excluding CH_4 from LULUCF	6,370.15	6,022.25	4,661.95	4,210.36	3,902.88	3,813.82	3,812.97	3,865.43	3,792.77	3,536.19
N_2O emissions including N_2O from LULUCF	6,853.99	6,326.65	4,080.23	3,537.14	2,934.71	2,942.17	3,588.68	3,703.89	3,906.43	3,926.70
N_2O emissions excluding N_2O from LULUCF	6,833.54	6,306.15	4,059.57	3,516.50	2,914.03	2,921.44	3,567.90	3,683.06	3,885.49	3,905.57
HFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	2.39	2.73	3.14	3.65	4.27
PFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
SF_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.05	0.05	0.08	0.11	0.17
Total (including LULUCF)	**45,318.73**	**46,241.35**	**25,621.58**	**19,692.81**	**18,132.43**	**17,251.29**	**18,577.63**	**18,088.10**	**19,694.61**	**16,943.90**
Total (excluding LULUCF)	**49,649.31**	**50,912.04**	**30,299.24**	**24,394.68**	**22,833.98**	**21,964.88**	**23,303.01**	**22,832.74**	**23,827.85**	**21,072.48**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
1. Energy	33,699.66	35,831.49	20,178.86	16,230.12	15,337.45	14,266.63	14,727.73	14,262.05	15,025.08	12,594.07
2. Industrial Processes	4,265.08	4,291.94	2,488.01	1,568.65	1,640.78	1,994.52	2,460.51	2,393.20	2,802.82	2,762.35
3. Solvent and Other Product Use	197.61	195.83	193.87	191.53	188.98	186.36	183.75	181.17	178.61	176.07
4. Agriculture	9,875.09	9,060.76	6,045.60	5,019.32	4,318.58	4,176.51	4,583.67	4,612.59	4,408.27	4,224.24
5. Land Use, Land-Use Change and Forestry[5]	-4,330.58	-4,670.69	-4,677.67	-4,701.87	-4,701.55	-4,713.59	-4,725.39	-4,744.64	-4,133.24	-4,128.58
6. Waste	1,611.88	1,532.02	1,392.90	1,385.07	1,348.19	1,340.87	1,347.35	1,383.72	1,413.07	1,315.76
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)[5]	**45,318.73**	**46,241.35**	**25,621.58**	**19,692.81**	**18,132.43**	**17,251.29**	**18,577.63**	**18,088.10**	**19,694.61**	**16,943.90**

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
CO_2 emissions including net CO_2 from LULUCF	7,871.35	8,412.46	8,328.33	8,897.05	9,593.07	10,883.26	11,092.37	11,838.82	11,051.08	9,127.74
CO_2 emissions excluding net CO_2 from LULUCF	12,014.83	12,750.24	12,870.79	12,591.16	13,413.06	14,175.80	14,548.51	15,821.70	15,032.08	12,908.26
CH_4 emissions including CH_4 from LULUCF	3,400.86	3,523.56	3,522.16	3,642.42	3,633.35	3,646.88	3,740.69	3,666.56	3,729.91	3,623.68
CH_4 emissions excluding CH_4 from LULUCF	3,400.45	3,523.42	3,521.26	3,641.87	3,633.04	3,646.81	3,739.18	3,666.51	3,729.77	3,623.28
N_2O emissions including N_2O from LULUCF	4,112.84	4,383.87	4,683.11	4,867.28	5,055.05	5,327.66	5,762.82	6,116.20	5,794.66	3,788.39
N_2O emissions excluding N_2O from LULUCF	4,091.57	4,362.48	4,661.53	4,845.48	5,033.04	5,305.37	5,740.22	6,093.68	5,772.05	3,765.65
HFCs	5.03	5.95	7.30	9.43	12.05	16.08	47.37	62.99	90.43	88.21
PFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
SF_6	0.22	0.30	0.40	1.93	0.86	1.38	0.99	0.84	6.24	5.00
Total (including LULUCF)	**15,390.30**	**16,326.14**	**16,541.30**	**17,418.11**	**18,294.38**	**19,875.26**	**20,644.24**	**21,685.41**	**20,672.31**	**16,633.03**
Total (excluding LULUCF)	**19,512.09**	**20,642.39**	**21,061.27**	**21,089.87**	**22,092.04**	**23,145.44**	**24,076.27**	**25,645.71**	**24,630.55**	**20,390.41**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
1. Energy	10,986.66	11,674.91	11,739.80	11,706.47	12,323.51	13,003.43	13,155.27	13,339.58	13,053.00	11,876.09
2. Industrial Processes	2,978.20	3,206.68	3,400.41	3,208.91	3,598.53	3,981.89	4,251.75	6,034.35	5,374.81	2,305.28
3. Solvent and Other Product Use	173.54	171.18	168.99	166.73	164.36	161.92	131.36	121.75	95.53	100.34
4. Agriculture	4,001.11	4,206.27	4,435.71	4,630.53	4,617.38	4,635.51	5,154.78	4,746.72	4,655.81	4,665.86
5. Land Use, Land-Use Change and Forestry[5]	-4,121.80	-4,316.25	-4,519.98	-3,671.76	-3,797.66	-3,270.18	-3,432.03	-3,960.30	-3,958.24	-3,757.38
6. Waste	1,372.58	1,383.34	1,316.36	1,377.23	1,388.25	1,362.69	1,383.10	1,403.30	1,451.41	1,442.85
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)[5]	**15,390.30**	**16,326.14**	**16,541.30**	**17,418.11**	**18,294.38**	**19,875.26**	**20,644.24**	**21,685.41**	**20,672.31**	**16,633.03**

ANNEX 8 Improvements in response to recommendations provided in the 2010 Lithuania's individual review report

ERT recommendations	Lithuania's response	Where in the NIR
Crosscutting issues		
17. In the 2009 review report, it is stated that Lithuania explained to the ERT that its Ministry of Environment (MoE) was shortly to be restructured and that the national system and its long-term funding and stability might be influenced by this. In the NIR of the 2010 submission, however, no changes to the national system that reflects changes in its structure or in funding possibilities have been reported. The description of the national system in the NIR is the same as that in the 2009 submission. The ERT recommends that Lithuania report on any changes in its national system in the NIR and specify in more detail how the long-term stability of the national system is being assured. Lithuania provided information on the updates to the national system in response to the list of potential problems and further questions from the ERT on 8 November 2010.	Changes in national system for GHG inventory preparation are reported the NIR.	Chapter 13
19. The section on the national system in the NIR is the same as that in the previous annual submission, apart from two additional paragraphs on QA. Those paragraphs refer to the fact that, owing to limited resources, no additional QA activities are planned for the time being that go beyond, including the comments of the ERT, in the inventory improvement plan, and that the inventory improvement plan forms part of the Party's overall QA/QC plan. In response to a request made by the ERT, Lithuania provided its QA/QC plan during the review week, which lists its QC procedures and the planned improvements by sector as a follow-up to previous reviews. The ERT commends Lithuania on the progress made and recommends that the Party further improve the QA/QC plan by outlining the timeline for implementing the planned improvements and by listing potential (financial and other) problems that might hinder their timely implementation of QA/QC activities.	QA/QC plan is updated, timeline for implementing the planned improvements is clearly outlined in the plan and potential problems that might hinder timely implementation of QA/QC activities are listed.	-
20. Lithuania did not report any information in the CRF tables relating to KP-LULUCF activities, as required under Article 7, paragraph 1, of the Kyoto Protocol, in its original submission of 14 April 2010. In response to the list of potential problems and further questions raised by the ERT, Lithuania resubmitted its NIR and the KP-LULUCF CRF tables on 9 November 2010 which included no numeric values except for predefined information included in the accounting table. The ERT considered that reporting with no numeric information implies that Lithuania's national system cannot identify the area of land subject to KP-LULUCF activities. The ERT noted that Lithuania's current KPLULUCF reporting does not meet the requirements of paragraph 20 of the annex to decision 16/CMP.1, which require national systems to ensure that areas of land subject to KP-LULUCF activities are identifiable, and that information about these areas is provided in the national inventories in accordance with Article 7 of the Kyoto Protocol. Lithuania's current reporting on KP-LULUCF does not meet these requirements. Therefore, the ERT strongly recommends that Lithuania urgently put in place the	Lithuania put a lot of efforts to improve KP-LULUCF reporting during 2010 and 2011. All necessary arrangements for the national system to ensure that areas of land subject to KP-LULUCF activities are identifiable were implemented.	Chapter 11

arrangements and capacity necessary to identify areas of land subject to KP-LULUCF activities and report corresponding emissions and removals from KP-LULUCF activities in accordance with these requirements defined in the annex to decision 15/CMP.1.		
21. In the 2009 review report, concerns were raised that the overall effectiveness and reliability of the inventory preparation process might be hampered by the fact that the consultants responsible for the preparation of the inventory are contracted by MoE on an annual basis only. Reiterating these concerns, the present ERT encourages Lithuania to investigate options for ensuring the continuity of its inventory experts for long-term and maintain and enhance the arrangements necessary to perform the general and specific functions of its national system as required in the annex to decision 19/CMP.1.	Continuity of the experts is ensured by the recently approved Government Resolution No 683 on the establishment of permanent GHG inventory working group and determining their rules, responsibilities and financing provisions. Working group for inventory preparation is set up for unlimited time and the State's budget financing for GHG inventory preparation is determined by this Resolution.	Chapter 13
32. The NIR does not include explicit information on how the results of the Lithuanian key category analysis are used as a driving factor for the preparation of the inventory and how Lithuania prioritize the development and improvement of the inventory based on its results. The ERT recommends that Lithuania provide such information on how it uses its key category analysis for setting priorities in the NIR of its next annual submission.	Information on how Lithuania prioritize improvement of the inventory is provided in the QA/QC plan.	-
33. Lithuania performed a tier 1 uncertainty analysis for the emission level in 2008 and for the trend in emissions between 1990 and 2008 for all categories except the solvent and other product use sector. The uncertainty estimates are generally in line with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF and, as an improvement to the calculations in the previous year's annual submission, do include the LULUCF sector. The underlying assumptions for the estimates for each sub)category are given in the NIR. For the agriculture sector, however, some assumptions used for the uncertainty assessment are still unclear. The ERT recommends that Lithuania improve transparency of its reporting by providing corresponding background information, in its NIR, such as relevant assumptions used for uncertainty assessment for each category.	This recommendation is included to the GHG inventory improvement plan and will be addressed in the NIR 2012.	-
37. In the 2009 review report, it was noted that the transparency of Lithuania's NIR could be improved, with respect to the information on institutional arrangements and QA/QC activities implemented, and the justification of recalculations. In the sectoral chapters of the NIR, more explanations of trend variations, rationale for selecting country specific EFs, AD and methods, as well as referencing of source material and expert judgement, could be provided. The ERT recommends that Lithuania improve the transparency of its inventory by expanding the NIR in relation to these issues indicated above and recommends that the Party follow the annotated outline of the NIR, especially for all elements of the supplementary information required under Article 7, paragraph 1, and the guidance contained therein, that can be found on the UNFCCC website.[5]	Transparency of the NIR is improved in this submission. Supplementary information required under Article 7, paragraph 1 is reported following the annotated outline of the NIR. Further improvement of the transparency is included to the GHG inventory improvement plan and will be presented in the NIR 2012.	Through the NIR
38. The NIR indicates that Lithuania has a centralized archiving system, which includes the archiving of disaggregated EFs and AD, and documentation on how these factors and data have been generated and aggregated for the preparation of the inventory. The archived information also includes internal documentation on QA/QC procedures, external and internal reviews, and documentation on annual key categories and key category identification and planned inventory improvements. This information is stored at MoE on computer systems, together with some of the paper files stored there as well.	During 2011 particular attention was given to archiving of documentation of the methods, data and data sources, spreadsheets etc. Further enhancement of the archiving is planned for 2012 as well.	-

As indicated in the 2009 review report, Lithuania was unable to provide from the central archive all of the reference material that was requested by the ERT during the review. The ERT reiterates last year's recommendation that Lithuania ensure that all documents referenced in the NIR or used to develop EFs and emission estimates are archived at MoE. The information archived should also include the QA/QC procedures implemented, the key category analysis and planned inventory improvements.		
42. The ERT identifies the following cross-cutting issues for improvement, namely that the Party: (a) Ensure sufficient capacity to estimate emissions/removals reported as "NE" and to collect the AD, process information and EFs needed to use the appropriate estimation methods for key categories (see para. 12 above); (b) Put in place the necessary arrangements for the national system to ensure that areas of land subject to KP-LULUCF activities are identifiable; (c) Report on changes in the national system in the NIR and specify in more detail how the long-term stability of the national system is being assured; (d) Further improve the QA/QC plan by outlining the timeline for its implementation of QC procedures and QA activities, and by listing problems (financial and other) that might hinder its timely implementation; (e) Explain in the NIR how the key category analysis is used as a driving factor for prioritizing improvements to the inventory; (f) Include more precise justifications for recalculations in the NIR and in CRF table 8(b); (g) Improve the transparency of the NIR by more closely following the annotated outline of the NIR, and the guidance contained therein; (h) Include in the NIR more detailed information on trends, the sources of country-specific EFs, methods (including those from the 2006 IPCC Guidelines), AD and other input data, and the justification for their selection; (i) Improve the consistency between the CRF tables and the NIR, and within the NIR itself. (j) Report the information on minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol and/or changes to that in all its annual submissions consistently in the coming years.	The following improvements were introduced in this NIR: (a) Most of "NE" (for which IPCC methodology is available) are eliminated. For some key categories (nitric acid production) higher Tier was applied in this NIR. "NE" reported emission sources in LULUCF sector are planned to be reported properly in the 2012 submission under the recently improved National system for GHG inventory preparation. (b) National system arrangements to ensure that areas of land subject to KP-LULUCF activities are identifiable were put in place (MoE Order on the collection of data related to LULUCF and the submission of information); (c) Changes in the national system are reported in NIR; (d) QA/QC plan updated and improved; (e) Explanation on how the key category analysis is used as a driving factor for prioritizing improvements to the inventory will be included in the next NIR; (f) Justifications for recalculations in the NIR and in CRF table 8(b) are provided, more explicit justifications are planned to be provided in the next NIR; (g) Transparency of the NIR is improved by more closely following the annotated outline of the NIR; (h) This NIR contains more detailed information on the sources of country-specific EFs, methods, AD and other input data. Further improvements will follow in the NIR 2012 submission; (i) Consistency between the CRF tables and the NIR was improved; (j) Information on minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol was provided.	Through the NIR
Energy		
48. Emissions from solid fuel consumption in manufacture of solid fuels and other energy industries are reported as "IE" without any indication of where they are included. During the review week, the Party clarified that solid fuel consumption for peat briquettes production is reported not in manufacture of solid fuels and other energy industries but in public electricity and heat production. The ERT recommends that	Further analysis revealed, that peat briquettes are produced from peat, but neither peat nor peat briquettes are used as energy source in production process. Hence, solid fuel consumption in manufacture of solid fuel was reported as "NO", not "IE" in the CRF.	-

Lithuania relocate these emissions estimates to the subcategory manufacture of solid fuels and other energy industries.		
49. The ERT commends Lithuania for providing information on improvement activities and explanations for the recalculations undertaken for the energy sector in the NIR. However, the explanations on recalculations are not transparent as defined in the UNFCCC reporting guidelines, that is to facilitate replication of the recalculations. In order to improve the transparency and completeness of the NIR with regard to the energy sector, the ERT reiterates the recommendation from the previous review report that Lithuania include in its NIR detailed descriptions of the EFs and estimation methods used, explanations for the notation keys used, an analysis of the emission trends, detailed explanations for recalculations, and information on improvement activities and planned improvements, in accordance with the UNFCCC reporting guidelines.	More descriptions on EFs, estimation methods used, explanations on recalculations and planned improvements were added.	Chapter 3.3.2
50. In the NIR it is not clearly indicated which net calorific values (NCVs) Lithuania uses to convert fuel consumption in natural units into energy units. In CRF Table 1.A(b) the Party reports fuel export/import/production values in TJ. The ERT recommends that the Party provide, in an annex to the NIR of its next annual submission, a clear explanation and the NCVs that were applied.	The table with NCVs applied (for year 2009) was added.	Table 3-2a
51. The ERT commends the Party for its efforts to improve transparency and explain the differences between the reference approach and the sectoral approach. However, the Party is still reporting significant differences (reference approach is 13.8 per cent higher than sectoral approach in 2008) between the emission estimates calculated using the two approaches that are not clearly explained in the NIR. Some explanations for the difference between the emission estimates due to natural gas consumption were provided in the NIR. The Party noted that only 33 per cent of the natural gas used for non-energy purposes was excluded from the estimation of CO_2 emissions in the reference approach. The ERT noted that Lithuania does not use consistent EFs for all fuels between the sectoral approach and the reference approach. In order to improve transparency and enable comparison of the two approaches, the ERT recommends that Lithuania exclude feedstocks and all non-energy fuel use from the calculations in the reference approach and apply the corresponding CO_2 EFs as used in the sectoral approach. In addition, the ERT reiterates the recommendation that the Party include, in an annex to the NIR: explanations for any observed differences between the estimates calculated using the two approaches; and an overview of the national energy balance.	Consistent EFs for all fuels between the sectoral approach and the reference approach were used in this submission. More information on Lithuania's energy balance is added, for transparency reasons Energy balance 1990-2009 data (LT Energy balance 1990-2009.xls) is attached to the submission. More explanations for the difference between the emission estimates in sectoral and reference approach will be provided in the NIR 2012.	Chapter 3.3.2
52. Some differences between International Energy Agency (IEA) data and CRF data were found in the previous review stages, such as IEA data on coal mines for 2008 are 13 per cent higher than those of the CRF. However, the NIR does not provide any explanation on such differences. The ERT reiterates the previous review report recommendation that Lithuania include explanations for any differences between the data from Statistics Lithuania and those from the IEA	Explanation on differences between IEA and CRF data on coal mines is provided.	Chapter 3.8
53. Information on bunker fuels was available from Statistics Lithuania for the complete time series for marine activities and for the period 2001–2008 for aviation activities. For 1990 to 2000, it was assumed that aviation gasoline was consumed domestically, while	Tiers used for Lithuania's estimates on bunker fuels emission were checked and corrected in the CRF (Tier 1 is used for the estimation of emission from fuels used as	-

jet type fuels (gasoline and kerosene) were consumed as bunker fuels. Lithuania stated in its NIR using the tier 2 approach from the Revised 1996 IPCC Guidelines with country specific EFs to estimate emissions from international and domestic marine and aviation activities. The ERT noted that using just country-specific EFs is not a tier 2 approach of the Revised 1996 IPCC Guidelines, which entails using landing/take off (LTO) data as AD. The ERT recommends that Lithuania check the tiers in the Revised 1996 IPCC Guidelines and the IPCC good practice guidance and provide detailed description on the method applied in the NIR of its next annual submission.	bunker fuels).	
54. The ERT noted that there is still time-series inconsistency in the AD on international bunker fuels such as fuel used for aviation. The ERT reiterates the recommendation from the previous review report that the Party's energy experts from the Lithuanian Energy Institute and Statistics Lithuania work together to address the time-series inconsistency of the AD on aviation fuels so as to ensure a consistent set of AD for the Party's emission estimates. The agreed approach should be described in annex 2 to the NIR as recommended in the UNFCCC reporting guidelines.	This issue was not addressed in this NIR. By 2012 year submission Statistics Department possibilities to address the time-series inconsistency of the AD on aviation fuels will be investigated and reported accordingly in the next NIR.	-
56. During the review week, Lithuania provided the ERT with information on the country's coke use in the period 1996–2008, stating that there was zero non-energy consumption of coke in Lithuania for most years of that period. In the meantime, Lithuania reports the CO2 emissions from blast furnaces, which were calculated using data on coke consumption. It seems that there has been some double counting of the emissions from coke use in the energy and industrial processes sectors. The ERT recommends that Lithuania provide additional information in its NIR on the approach it has taken in relation to estimating emissions from the consumption of feedstocks and non-energy use of fuels, in particular from coke use, in order to increase transparency and avoid the possibility of double counting or underestimating these GHG emissions. In this context the ERT encourages Lithuania to develop a carbon balance for coke. The ERT also recommends that Lithuania report emissions from the consumption of feedstocks and non-energy use of fuels under the industrial processes sector, as recommended in the IPCC good practice guidance.	Information on the approach taken in relation to estimating emissions from the consumption of feedstocks and non-energy use of fuels is provided in the NIR. Emission from the consumption of feedstocks and non-energy use of fuels is reported under the industrial processes sector: coke used for cast iron production was subtracted from energy production in other non-specified category and added to cast iron production category (already done in 2010 submission), emission from ammonia production with the natural gas used as feedstock is reported under industrial processes as well.	Chapters 3.2.4, 4.4.1
57. Lithuania stated that emissions from stationary combustion are estimated using the IPCC tier 2 methodology along with country-specific EFs. However, these EFs are based on studies conducted for Denmark, Germany and Slovakia, and not for Lithuania, which would be better called "regional EFs". Given that CO2 emissions from stationary combustion of gaseous, liquid and solid fuels have all been identified as key categories, and in order to ensure accuracy, the ERT reiterates the recommendation from the previous review report that Lithuania conduct a study to develop country-specific EFs which accurately reflect the carbon content and other physical properties of the fossil fuel consumed in the country, rather than rely on EFs derived from data for other Parties. As stated in paragraph 53 above, the ERT noted that using just a non-default EF is not the tier 2 approach of the Revised 1996 IPCC Guidelines, which entails using technology–based AD. The ERT recommends that Lithuania check the tiers in the Revised 1996 IPCC Guidelines and the IPCC good practice guidance and, provide detailed description on the method applied in the NIR of its next annual submission.	According to the EU assistance project "Capacity building implementing the Kyoto protocol requirements in Lithuania" study on EF's in energy sector was conducted in 2008. The results of the study in Annex 4 concluded that country-specific EFs for fuel combustion should be left unchanged (study is available at http://www.am.lt/VI/index.php#a/7941). Additionally, country specific CO_2 EFs were developed for 2011 submission, based on research data from the Lithuanian oil refinery JSC "Orlen Lietuva".	Chapter 3.3.2
58. Reporting of the energy sector in the NIR is not fully transparent. An energy balance	Detailed energy consumption data for the entire time	Chapter 3.2.1

is not provided in the NIR nor are there detailed energy consumption data for the entire time series (1990–2008). Lithuania states in its NIR, that "some categories defined in the CRF do not exactly match the categories of energy commodities and economic sectors identified in the national statistics. Therefore the final figures for fuel consumption and respective emissions have had to be calculated by grouping data selected from the energy balance, using one's best judgment". However it is not clear how exactly the mentioned data grouping was done. Therefore, the ERT could not assess whether AD have been properly included in the calculations. The ERT recommends that Lithuania provide relevant information on the national energy balance and information on how fuel consumption data are included in the calculations in the next annual submission.	series (1990–2009) is attached to the NIR (LT Energy balance 1990-2009. xls). More descriptions on how fuel consumption data are included in the calculations were added in the NIR.	
59. Explanatory information on AD for this category was not provided in the NIR. The ERT recommends that the Party provide a transparent description of AD such as how AD are collected in the NIR of its next annual submission.	Explanatory information on how AD to calculate road transportation emissions is provided in the NIR.	Chapter 3.3.2.1
60. Despite the recommendation made in the previous review report, Lithuania did not provide a justification for the use of default EFs from the 2006 IPCC Guidelines for estimating fugitive emissions from natural gas transmission in its 2010 annual submission. A comparison with the emission estimates calculated using the approach recommended in the IPCC good practice guidance was not provided in the NIR. The ERT recommends that Lithuania calculate emission estimates for this category using appropriate AD and EFs from the IPCC good practice guidance and compare these estimates with those calculated using EFs from the 2006 IPCC Guidelines. Furthermore, Lithuania uses the EFs for transmission only and does not include storage of natural gas. For this activity, a separate EF is provided in the 2006 IPCC Guidelines. Emissions from storage are also included in this category in the methodology given in the IPCC good practice guidance. The ERT recommends that Lithuania estimate emissions of CO_2 and CH_4 from natural gas storage using a country specific EF if available or the default EFs from the IPCC good practice guidance for natural gas transmission and storage (shown in table 2.16 of the IPCC good practice guidance). In response to the list of potential problems and further questions raised by the ERT, Lithuania provided revised estimates of emissions from transmission as suggested by the ERT using the default EF of the IPCC good practice guidance, and a satisfactory explanation on why storage of natural gas does not occur in Lithuania. The ERT accepted the revised estimates and the explanation. The overall impact of this revision for natural gas transmission in 2008 is an increase of 52.03 Gg CO_2 eq or 0.4 per cent of emissions from the energy sector. The ERT recommends that Lithuania continue to report these estimates for its future annual submissions and transparently document the explanatory information on the methodology, EFs and AD used for the calculations.	Emissions of CO_2 and CH_4 from natural gas transmission using default EF of the IPCC good practice guidance are included in the submission.	Chapter 3.8
61. Emissions from other leakage of natural gas were reported as "NE". During the review week, Lithuania informed the ERT that "natural gas leakage from industrial and residential consumption could be established based on EFs provided in the guidelines". The ERT recommended that the Party estimate these emissions using country-specific EFs if available or the default EFs for gas consumption in the former Union of Soviet Socialist Republics (USSR) and Central and Eastern European countries from the Revised 1996 IPCC Guidelines. In response to the list of potential problems and further	Emissions from natural gas distribution were calculated by using emission factors provided in the IPCC Good Practice Guidelines (2000) and based on pipeline length. As noted in the IPCC Good Practice Guidelines (p. 2.84), "fugitive emissions from gas transmission and distribution systems do not correlate well with throughput, and are better related to lengths of pipeline".	Chapter 3.8

questions raised by the ERT, after the review week, Lithuania submitted estimates for this category, which were calculated using the default EF from the Revised 1996 IPCC Guidelines, and the ERT accepted the revised estimates. The overall impact of this revision for other leakage from natural gas in 2008 is an increase of 11.48 Gg CO2 eq or 0.1 per cent of emissions from the energy sector. The ERT recommends that Lithuania include these estimates in its future annual submissions and transparently document the background information on the methodology, EFs and AD used for the estimates.	It should be assumed that emissions from natural gas distribution cover emissions at residential and commercial sectors and in industrial plants and power stations. Therefore these emissions were not calculated separately and marked with notation key "IE".	
62. In response to a question raised by the ERT during the review week, Lithuania informed the ERT that the category road transportation excludes fuels used by off-road vehicles and machinery and that the corresponding emissions are accounted for under categories where off-road vehicles and machinery are operated. However, it was difficult for the ERT to assess the completeness of the emission estimates and no information was provided on which EFs and methodology were used by the Party to estimate these emissions. It seems that emissions from off-road mobile combustion were accounted as emissions from stationary combustion. The ERT considered these emissions to have been underestimated, particularly in the case of CH4 and N2O emissions, and recommended that the Party select appropriate AD and include the estimates, calculated using the EFs for mobile combustion, under the corresponding separate subcategory. In response to the list of potential problems and further questions raised by the ERT, after the review week, Lithuania submitted revised emission estimates for this category, and the ERT accepted the revised estimates. The overall impact of this revision for other transportation in 2008 is an increase of 280.08 Gg CO2 eq, equivalent to 2.1 per cent of emissions from the energy sector. The ERT recommends that Lithuania continue to report these estimates in its future annual submissions and transparently document the background information on the methodology, EFs and AD used for the revised estimates.	Emissions from off-road vehicles are reported in this submission.	Chapter 3.2.1
63. During the review week, Lithuania informed the ERT that NATO fighter jets are stationed in Lithuania but their fuel consumption is not taken into account in the corresponding emission estimates. However, "multilateral operations" are defined as "multilateral operations pursuant to the Charter of the United Nations".6 In response to the list of potential problems and further questions raised by the ERT, after the review week, Lithuania provided the following explanation with regard to this issue: "Data on fuel consumption by mobile military sources are provided separately by Statistics Lithuania from 2003. According to information provided by Statistics Lithuania, the data include fuel consumption by both national and NATO aviation stationed in Lithuania. Therefore emissions caused by fuel consumption by military aviation are included in 1.A.5.b – other (military mobile combustion)". The ERT considered this explanation adequate, but noted that it is different from the explanation provided during the review week. The ERT recommends that Lithuania provide a clear explanation in the NIR of its next annual submission on this issue.	Explanation on how emissions from military aviation are allocated in CRF is included in the NIR.	Chapter 3.2.1
Industrial processes		
65. The CRF tables include emission estimates for most categories in the industrial processes and solvent and other product use sectors, as recommended in the Revised 1996 IPCC Guidelines. Some categories have been reported as "NE", namely HFC emissions from consumption of halocarbons and SF_6 for subcategories other than	CO_2 emissions from asphalt roofing and from road paving with asphalt, CH_4 and N_2O emissions from glass production, CO_2 emissions from food and drink are not estimated (reported "NE") due to no IPCC methodology	Chapters 5 and 4.7

refrigeration and air-conditioning equipment, and SF_6 emissions from consumption of halocarbons and SF_6 for subcategories other than electrical equipment. The ERT recommends that Lithuania clarify if reported as "NE" is correct for the following categories: CO_2 emissions from asphalt roofing and from road paving with asphalt, CH_4 and N_2O emissions from glass production, CO_2 emissions from food and drink and N_2O emissions from other under solvent and other product use. There are no estimations provided for any emissions from consumption of halocarbons and SF_6 for the years 1990–1994, which are reported as "NO" and not applicable ("NA"). The ERT recommends that Lithuania check if such activities occurred in the country and, if the activities do occur, provide estimates of those emissions and report them in its next annual submission, however, noting that for some of these categories there are no methodologies available in the 1996 Revised IPCC Guidelines and/or the IPCC good practice guidance.	is available to calculate these emissions. For this submission, N_2O emissions from N_2O use in anesthesia was calculated for the first time. It is planned to reassess F-gases emissions for the years 1990–1994. If the analysis will show, that emissions occurred during this period, emissions will be calculated using extrapolation for the next submission (NIR 2012).	
67. The ERT noted that no category-specific QA/QC activities have been reported in the NIR for the industrial processes sector. The ERT encourages that Lithuania include results of category-specific QA/QC activities accomplished during the preparation of the inventory in the category descriptions of the NIR in its future annual submissions. The ERT also recommends that Lithuania verify production and EF data provided by the industry using, for instance, data from the European Union emissions trading scheme.	Clinker production data reported in GHG inventory was verified with the data provided in company's report to EU ETS. The results show, that data on clinker production to EU ETS matches the data on clinker production data used for GHG inventory. As regards emission data, it slightly (less than 1 %) differs from emission data calculated in GHG inventory. It was decided to use company's emission data provided to EU ETS (which is checked by independent verifiers) in GHG inventory for this submission (2005-2009). Further verification of production and EFs data provided by the industry in EU ETS reports and data used in GHG inventory is planned for the next submission.	Chapter 4.3.1.2
68. Lithuania has applied the tier 2 methodology from the IPCC good practice guidance and plant-specific production data (yearly data on the calcium oxide (CaO) and magnesium oxide (MgO) content of cement) and EFs to estimate CO_2 emissions from cement production. Fluctuation in the CaO and MgO content of cement and the use of average values have been sufficiently described in the NIR. The data on generation of cement kiln dust (CKD) were provided for the period 2005–2008, while an average value (1.3 per cent) was used for the other years of the time series. According to the cement producer, only 5 per cent of the CKD is calcinated. The ERT recommends that Lithuania verify the reported 5 per cent calcinated fraction and provide an explanation for the difference between its plant-specific CKD correction factor (1.00065 per cent) and the default value from the IPCC good practice guidance (2 per cent).	This recommendation is included to the GHG inventory improvement plan and will be addressed in the NIR 2012.	-
69. CO_2 emissions from ammonia production were estimated using data on the consumption and carbon content of natural gas, without providing the carbon content of natural gas. The methodology used was described insufficiently in the NIR, and no reasons for the fluctuations in the carbon content of natural gas (or in the EFs) were reported. The ERT recommends that Lithuania improve its description of the methodology used in its next NIR. The ERT noted that the carbon content of natural gas fluctuated over the time series; therefore, it also recommends that Lithuania verify and	Data on carbon content of natural gas used for ammonia production is provided in the NIR. The reasons of fluctuations of carbon content in natural gas are explained.	Chapter 4.4.1.2 Table 4-9

explain the wide range of carbon contents (0.40–0.52 kg C/m^3) and report on this in its next annual submission.		
70. N_2O emissions from nitric acid production were calculated using plant-specific production data and a default EF (7 kg N_2O/t nitric acid). The EF used is in line with the information contained in the IPCC good practice guidance (table 3.8). The ERT welcomes the new information provided by Lithuania about production processes, which verified the default EF used; as well as the information that a plant was a single high–pressure and another was a dual (medium/high)-pressure scheme plant and that no destruction methods were used to minimize N_2O emissions. The ERT also welcomes Lithuania's intention to improve the EFs used for the calculation of emissions from nitric acid production using measured data for its next annual submission. According to the IPCC good practice guidance, if this category is key, collection of emissions and destruction data are recommended, and also appropriate QA/QC procedures are recommended. The ERT recommends that Lithuania include these new data, provide background data used for calculations and improve the descriptions of trends in the NIR of its next annual submission.	Emission from nitric acid production was recalculated using plant specific emission factors for all time series.	Chapter 4.4.2
73. The ERT also recommends that Lithuania calculate and report estimates of HFC, PFC and SF_6 emissions (actual and potential) from consumption of halocarbons for mobile air-conditioning, domestic and transport refrigeration, and solvent and semiconductor manufacture. If the corresponding activities do not occur in the country, the notation keys used ought to be changed to "NO". For those subcategories for which corresponding activities occur in Lithuania, the ERT strongly recommends that the Party collect AD and estimate the emissions using the IPCC good practice guidance. The ERT further recommends that Lithuania clarify the description in the NIR of which subcategories are covered under the category refrigeration and air-conditioning equipment.	HFCs emissions (actual) from consumption of halocarbons for mobile air-conditioning, domestic refrigeration, and "other use of HFCs" were estimated in this submission. Emission from semiconductor manufacture is not occurring in Lithuania and reported "NO". Recommendation to estimate emission from transport refrigeration is included to the GHG inventory improvement plan and will be addressed in the NIR 2012.	Chapter 4.6
74. The rates of refrigerant consumption and leakage, including SF_6 from electrical equipment, were not transparently presented in the NIR, because the same leakage rates for installation, refilling of equipment and operation were applied to all applications. The ERT reiterates the recommendation made in the previous review report that Lithuania re-evaluate the leakage rates on the basis of type of application and account for emissions of F-gases remaining in products at decommissioning. The ERT also recommends that Lithuania investigate whether all sources of SF_6 emissions from electrical equipment are covered in the inventory and include emission estimates and a description of the estimation methodology used in its next annual submission.	This recommendation is included to the GHG inventory improvement plan and will be addressed in the NIR 2012.	-
Agriculture		
76. The CRF tables include emission estimates for all gases and all major categories of emissions in the agriculture sector, as recommended in the Revised 1996 IPCC Guidelines. Emissions from the agriculture sector have been reported for all years of the inventory time series and for all geographical locations. Lithuania has used the notation key "NE" to report emissions for the subcategory other livestock under the categories enteric fermentation and manure management. Since Lithuania has rabbits and an increasing number of fur animals, the ERT encourages it to assess the availability of national data to allow for the calculation of corresponding emissions, and to estimate	CH4 and N2O emissions from fur-bearing animals (foxes, polar foxes, minks), nutria's and rabbits under the enteric fermentation and manure management categories were reported.	Chapter 6.2.1

these emissions and report the data in its future annual submissions.		
77. Rice cultivation, prescribed burning of savannas and field burning of agricultural residues were reported as "NO". During the review week, national experts provided the reference which supports the fact that such activities do not occur in Lithuania. In order to improve transparency, the ERT recommends that Lithuania include this reference in the NIR of its next annual submission.	References explaining that such activities do not occur in Lithuania were added.	Chapters 6.1, 6.7
79. The information on AD, the detailed characterization of Lithuania's animals, the calculated EFs and the emission trends are not sufficiently complete and transparent in the NIR: disaggregated population data on non-dairy cattle were not provided; the formula used for the calculation of the gross energy intake for dairy and non-dairy cattle under two years old and the background parameters for the calculation of the gross energy intake for non-dairy cattle over two years old and for the cows used for producing meat were not documented. The ERT reiterates the recommendations made in the previous review report that Lithuania include in the NIR the disaggregated population data on non-dairy cattle used in the calculation of relevant emission estimates for the entire time series, detailed information about the production characteristics of the cattle used to calculate the gross energy intake, as well as detailed information on country-specific parameters, in its next annual submission.	Disaggregated population data on non-dairy cattle, the formula used for the calculation of the gross energy intake is provided in the NIR.	Table 6-4a Chapters 6.2.2, 6.2.2.2
80. The NIR contains undocumented assumptions and expert judgements as well as references whose relevance to the inventory data is not described (e.g. assumptions on uncertainty data, the relevance of terms Ekoagross and UAB Agrochemas). The ERT recommends that Lithuania provide information on all assumptions applied (such as climate conditions) and expert judgements, and the relevant references in the NIR. In addition, the ERT recommends that Lithuania provide relevant information in the documentation boxes of the CRF tables in its next annual submission.	Information on climate conditions, relevant references are provided in the NIR. Documentation boxes of the CRF tables are filled to the extent possible.	Chapter 6.1
86. The ERT commends the recalculation implemented by changing the MCFs relevant to dairy cattle, non-dairy cattle, swine and liquid/slurry and pit storage considering the revised values presented in table 4.10 of the IPCC good practice guidance. However, the ERT reiterates the recommendation made in the previous review report that the CH_4 EFs calculated for manure management for each subcategory of non-dairy cattle be presented in table 6.12 of the NIR.	CH_4 EF for manure management was calculated on aggregated level for non-dairy cattle, therefore it can't be presented for each subcategory.	-
87. For 2007 onwards, the Party has begun to use updated data on the allocation of manure to different animal waste management systems (AWMS). In order that the allocation of manure to AWMS reflects the changes which have taken place within agricultural activities since 1990, the ERT recommends that Lithuania update the values used for the 1990–2006 period or, if necessary, apply estimated values using extrapolation for that period.	The values of allocated manure to different animal waste management systems were recalculated using extrapolation for 1990-2006 period.	Table 6-17, Chapter 6.3.1.3
88. The data on MCFs and on the fraction of manure handled using the AWMS presented in the NIR are not consistent with the additional information in CRF table 4.B(a). The ERT recommends that Lithuania correct the data and information in CRF table 4.B(a) by making them consistent with the relevant figures from the NIR or with the appropriate notation keys.	The data and information in CRF table 4.B(a) is made consistent with relevant figures in the NIR 2011.	-
89. Lithuania used a national value for the volatile solid excretion rate for 2008, while for the period 1990–2007 a constant default value (from the Revised 1996 IPCC	In order to ensure time-series consistency, recalculations of the data series of volatile solid excretion rates for the	Chapter 6.3.1.3

Guidelines) was used. In order to ensure time-series consistency, the ERT recommends that the Party undertake recalculations of the data series of volatile solid excretion rates for the 1990–2007 period, using national data based on the approach applied to the estimation for 2008.	1990-2007 period using national data were performed for NIR 2011 submission.	
93. Lithuania used a tier 1a approach to calculate estimates of these emissions. The N_2O IEFs for synthetic and organic fertilizers reported in the CRF tables (0.011 kg N_2O-N/kg N and 0.01 kg N_2O-N/kg N, respectively) are lower than the default value given in the IPCC good practice guidance (0.0125 kg N_2O-N/kg N for both fertilizers) and these values do not correspond with the EFs presented in the NIR. The ERT reiterates the recommendation of the previous review report that Lithuania either report in the relevant CRF table the adjusted values for N input from fertilizers, calculated following equation 4.22 from the IPCC good practice guidance, or provide an explanation for the difference in the IEF in the NIR and the documentation box of the relevant CRF table.	Adjusted values for N input from fertilizers were reported in the relevant CRF table in this NIR submission.	-
95. No information has been provided on the types of crop considered in the calculation of emissions from N-fixing crops and from crop residue. The ERT reiterates the recommendation made in the previous review report that Lithuania report in its NIR the types of crop covered in its inventory and, if possible, report the production data by crop type in CRF table 4.F.	Information on types of crop considered in the calculation of emissions from N-fixing crops and from crop residue is provided.	Tables 6-26a and 6-27a Chapter 6.4.1.2
96. The ERT commends the Party's implementation of a recommendation made in the previous review report by changing the data on the area of organic soils cultivated, initially obtained as a percentage of the total area of cultivated agricultural land, to year-specific data for 2007 and 2008. However, the ERT noted that in the NIR the relevance of the term "Ekoagross" in relation to the annual data on the area of organic soils cultivated is not described, and the time series is inconsistent, with the recalculation not being undertaken also for the 1990–2006 period. During the review week, Lithuania provided explanation on the relevance of the term "Ekoagross". The ERT recommends that, as part of the next annual submission, Lithuania provide in the NIR the relevance of the term "Ekoagross" in relation to the annual data on the area of organic soils cultivated areas, considering also the relevant definitions provided in the IPCC good practice guidance. Additionally, the ERT recommends that the Party undertake recalculations for the period 1990–2006 of the data series on the area of organic cultivated soils in a similar manner as for those undertaken for the 2007–2008 period.	The emissions from histosols were recalculated using reliable activity data in NIR 2011. "Ekoagros" data on the area of organic soils is not longer used.	Chapter 6.4.1.4
97. In the NIR, the Party does not describe the relevance of "UAB Agrochema" as one of the data providers of the amount of synthetic N fertilizer applied to soils, nor information on the consistency between the values for the amount of N fertilizer applied to soils as provided by UAB Agrochema and by the International Fertilizer Industry Association (IFIA). The ERT recommends that the Party include in its NIR, as part of the next annual submission, a description of the relevance of "UAB Agrochema" as well as information on the consistency of the data provided by UAB Agrochema and by IFIA.	The description of the relevance of "UAB Agrochema" as well as information on the consistency of the data provided by UAB Agrochema and by IFIA is included in the NIR.	Chapter 6.4.1.2
98. The necessary elements pertaining to the calculation of FracGRAZ used in the calculation of estimates of emissions from animal manure applied to soils are not reported in the NIR. The ERT recommends that Lithuania improve the transparency of the NIR by reporting all the elements pertaining to the calculation of FracGRAZ, as part of its next annual submission.	Elements pertaining to the calculation of FracGRAZ are provided.	Table 6-26 Chapter 6.4.1.2

LULUCF		
103, 104, 119-122 paragraphs	Lithuania is striving to develop consistent time series for all land categories in the LULUCF sector. Under the recently approved Governmental Resolution setting up the permanent Commission for national GHG inventory preparation, the representative of the State Land Fund was involved to the Commission work. The State Land Fund is an institution responsible for the data on land use collection, monitoring, analysis and maintaining the State's land use database. Currently the available data is being assessed, analyzed and we expect that the data on land categories of the LULUCF sector such as cropland, grassland etc. will be provided in NIR 2012.	-
105, 109, 118 paragraphs	Data on land categories in LULUCF sector is under harmonization as a result of cooperation between the State Land Fund and the State Forest Service experts, as to ensure consistent time series and land representation. We expect that the results of the analysis for area data harmonization will be provided in NIR 2012 submission.	-
106, 117 paragraphs	Inconsistencies between the forest area and other data in NIR and CRF were corrected for NIR 2011 submission. According to Lithuanian legislation, land-use changes and minimum forest areas are identified at the 0,1 ha scale, which is also consistent with datasets used for the GHG estimation.	-
107, 108 paragraphs	Explanations on methodological changes and newer datasets resulted in the recalculations performed between 2010 and 2011 were provided in NIR 2011.	Chapter 7
113 paragraph	EFs used for forest fires were reviewed and emissions were recalculated.	Chapter 7.2.2.7
114-116 paragraphs	Time series of emissions/removals from LULUCF were recalculated using Method 2 (stock change method) in NIR 2011, thus recommendations listed in paragraphs 114-116 are not longer relevant for Method 2 estimates.	Chapter 7.2.3
Waste		
127. N2O emissions from waste incineration are reported as "NE". The ERT encourages Lithuania to use other reliable means of developing N2O EFs in accordance with the IPCC good practice guidance and estimate N2O emissions.	N_2O emissions from waste incineration were calculated.	Chapter 8.5.2
128. The methodology and assumptions used in the uncertainty analysis for each category in the waste sector were not explained in the NIR. The ERT recommends that Lithuania provide these explanations in its next annual submission. Also, the ERT encourages Lithuania to elaborate sector-specific QA/QC procedures and provide information on them in the NIR of its next annual submission.	This recommendation is included to the GHG inventory improvement plan and will be addressed in the NIR 2012.	-
129. In response to a recommendation made in the previous review report, Lithuania	Explanation with regard to the selection of the methane	Chapter 8.2.2.3

justified its use of the first order decay method from the 2006 IPCC Guidelines. However, the rationale for the selection of the methane generation rate constant (the value reported in the NIR is the same as the value for the wet climate condition under the boreal and temperate climate zone provided in the 2006 IPCC Guidelines) has not been explained. The ERT reiterates the recommendation made in the previous review report that Lithuania provide explanations with regard to the rationale for the selection of the methane generation rate constant in its next annual submission.	generation rate constant is included.	
131. The ERT noted that the estimates of CH_4 emissions from wastewater handling were recalculated for 2002 to 2007 and that the estimate for 2007 decreased by 11.9 per cent compared with the 2009 submission. The reason for the recalculation is that CH_4 recovery had not been taken into account before for estimating actual CH_4 emissions. The ERT recommends that Lithuania provide this explanation in CRF table 8(b) in its next annual submission. Furthermore, the ERT recommends that Lithuania provide the amount of recovered CH_4 from wastewater handling and a detailed explanation of the methodology used for the estimation of CH_4 emissions and their recovery to improve transparency.	The amount of recovered CH_4 from wastewater handling and explanation of the methodology used for the estimation of CH_4 emissions is added.	Chapter 8.3.2
132. Lithuania estimated CH_4 emissions from wastewater handling based on the equation 5.6 from the IPCC good practice guidance. According to the decision tree in the IPCC good practice guidance (figure 5.2), the recommended equation for Lithuania to use to estimate these emissions is not the check method of equation 5.6 from the IPCC good practice guidance, but the IPCC method with default or country-specific parameters, because this category is a key category for Lithuania. The ERT recommends that Lithuania update the estimation equation used for its next annual submission, as Lithuania agreed to do during the review week.	This recommendation is included to the GHG inventory improvement plan and will be addressed in the NIR 2012.	-
133. AD for this category are collected by the Lithuanian Environmental Protection Department from 1991, and 1990 data are estimated by regression analysis, however, no explanation for this regression analysis is provided in the NIR. Furthermore, information about AD trends from 1990 to 2008 is not provided in the NIR. The ERT recommends that Lithuania improve transparency by providing a more detailed description of the regression analysis for AD in 1990 and AD trends from 1990 to 2008 with reference to the change in population and economic growth, in its next annual submission.	Explanation is included in the NIR, that AD for year 1990 was evaluated by linear extrapolation of 1991-1993 data. Detailed description of the AD trends from 1990 to 2009 with reference to the change in population and economic growth will be provided in the next annual submission.	Chapter 8.3.1
134. Lithuania recalculated the estimates of CO_2 emissions from waste incineration for 2004 to 2007, which resulted in a 52.8 per cent decrease in the estimate for 2007 compared with the 2009 submission. No rationale for this recalculation is provided in the NIR or in the CRF tables. The ERT strongly recommends that Lithuania provide the reason for the recalculation, a description of the changed method, and the result of recalculation in the NIR and in CRF table 8(b).	The reason for the recalculation in waste incineration sector performed in 2009 submission is provided.	Chapter 8.5.1
135. The CO_2 emissions from incineration of hazardous waste fluctuate a great deal in Lithuania. In response to a question of the ERT during the review week, the Party explained that there is no dedicated waste incineration facility in Lithuania at present and that hazardous waste is incinerated on random bases. The ERT recommends that Lithuania include this information in its next annual submission.	More information on waste incineration conditions in Lithuania is added.	Chapter 8.5.1
Information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol (KP-LULUCF)		

Paragraphs 184-194, which concluded that Lithuania's 2010 KP-LULUCF annual submission does not meet the requirements of Article 7, paragraph 1, of the Kyoto Protocol.	Lithuania put a lot of efforts to improve KP-LULUCF reporting during 2010. All necessary arrangements for the national system to ensure that areas of land subject to KP-LULUCF activities are identifiable were implemented. In NIR 2011 land areas under the Convention and KP-LULUCF were reported consistently and requirement not to double count land areas subject to KP-LULUCF activities has been implemented.	Chapter 11