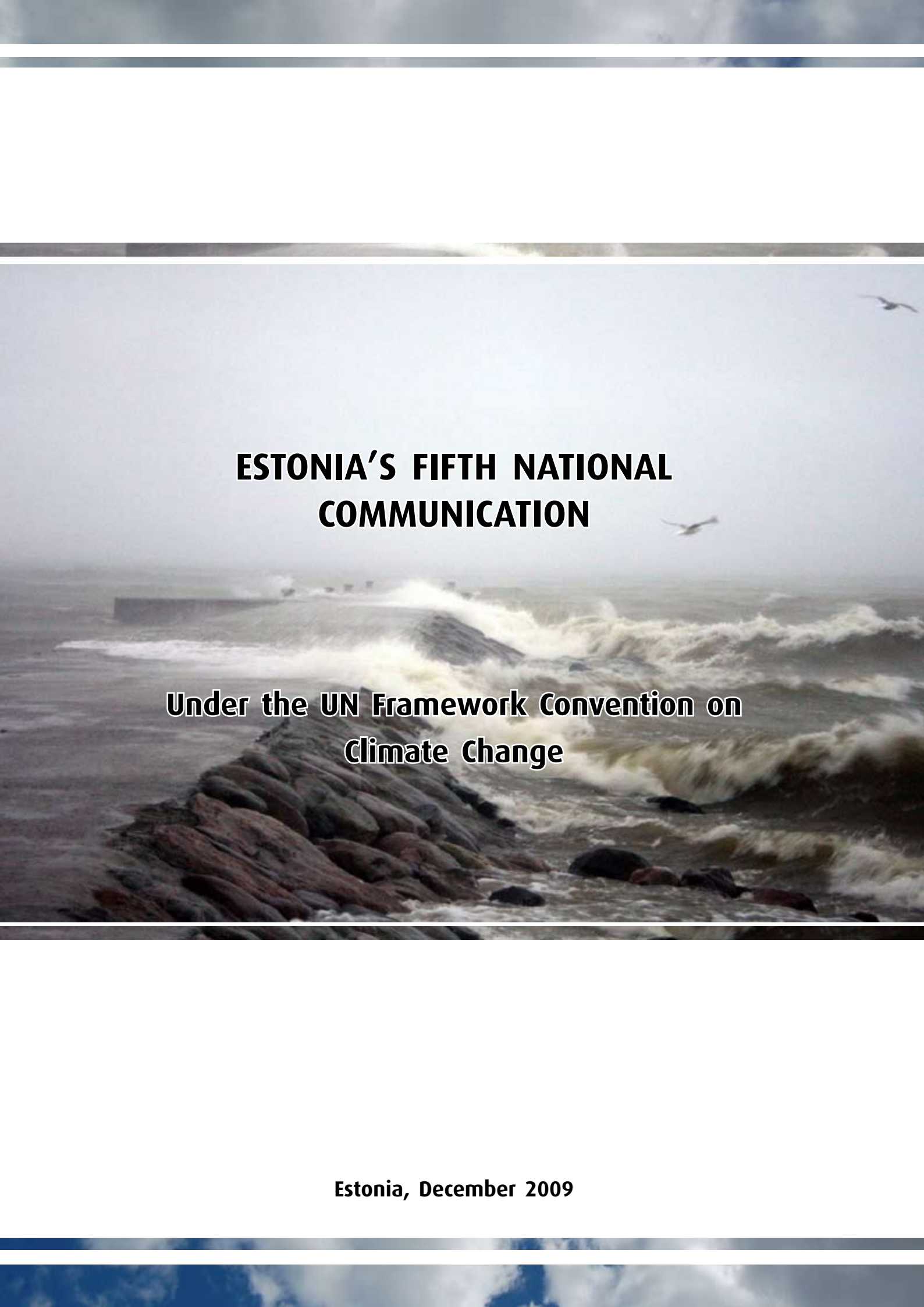

ESTONIA'S FIFTH NATIONAL COMMUNICATION

Under the UN Framework Convention on Climate Change

Estonia, December 2009

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Abbreviations

ASTRA- Developing Policies and Adaptation Strategies to Climate Change in the Baltic Sea Region

BAT- Best Available Technique

CFBC- Circulating Fluidized Bed Combustion

CHP- Combined Heat and Power

CITL- Community Independent Transaction Log

CRF- Common Reporting Format

DES- Data Exchange Standards

DH- District Heating

EC- European Commission

ECMWF - European Centre for Medium-Range Weather Forecasts;

EEIC- Estonian Environment Information Centre

EERC- Estonian Environmental Research Centre

EGM- Estonian Green Movement

ELV - End-of-Life Vehicle

EPBD- Energy Performance of Buildings

EU ETS- European Union Emission Trading Scheme

EU- European Union

EUMETNET- European Meteorological Services Network;

EUMETSAT- European Organization for the Exploitation of Meteorological Satellites;

EUSF- European Union Solidarity Fund

FADN- Farm Accountancy Data Network

FSC- Forest Stewardship Council

GDP-Gross Domestic Product

GHG- Greenhouse Gas

GLOBE- Global Learning and Observations to Benefit the Environment

GNI- Gross National Income

GRETA- Greenhouse Gas Registry for Emission Trading Arrangements

GWP- Global Warming Potential

HIRLAM – High Resolution Limited Area Model;

IPCC - Intergovernmental Panel on Climate Change

ITL- International Transaction Log

LULUCF- Land Use, Land Use Change and Forestry

MBT- Mechanical-Biological Treatment

MoE- Ministry of the Environment

NAO- National Audit Office

NFI- National Forest Inventory

NGO- Non-Governmental Organization
NIR- National Inventory Report
NORDRAD- Nordic Weather Radar Network
PEFC- Programme for the Endorsement of Forest Certification Schemes
PP- Power Plant
QA/QC- Quality Assurance/Quality Control
RDF- Refuse Derived Fuel (waste fuel)
SEI- Stockholm Environment Institute
TUT- Tallinn University of Technology
UNESCO- United Nations Educational, Scientific and Cultural Organization
UNFCCC- United Nations Framework Convention on Climate Change
UNICEF- United Nations International Children's Emergency Fund
WEEE- Waste Electric and Electronic Equipment

Foreword

I am delighted to present Estonia's Fifth National Communication under the Framework Convention on Climate Change.

The Fifth National Communication reflects the developments that have taken place in the relevant fields of activity during the reporting period. The Communication is the result of cooperation between Estonian governmental bodies and experts.

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change projects that, without further action to reduce greenhouse gas emissions, the global average surface temperature is likely to rise by a further 1.8-4.0°C in this century, and by up to 6.4°C in the worst case scenario. In order to achieve a reduction of 2°C for the average surface temperature, all developed countries will have to reduce their greenhouse gas emissions by 25–40% by 2020 compared to the 1990 baseline, by 80-95% by 2050, and to rearrange their economies during the coming decades so that global emissions are reduced by at least 50% by 2050.

The European Union has set a goal to keep the lead role in combating climate change and not let the average surface temperature rise more than 2 ºC, compared to pre-industrial times.

Over the last years, considerable efforts have been made in Europe to mitigate and adapt to the occurring climate change. At the end of 2008, the member states of the European Union agreed on the "Climate action and renewable energy package", which commits the member states to reducing their overall greenhouse gas emissions to at least 20% below the 1990 levels by 2020. The EU is also ready to scale up this reduction to 30% when other countries make comparable efforts under a new global climate change agreement. The climate and energy package sets out the contribution expected from each Member State to meet these targets and proposes a series of measures to help achieve them. It has also set itself the target of increasing the share of renewables in energy use to 20% by 2020. Estonia's share of renewable energy will have to be 25% by year 2020.

Estonia signed the UN Framework Convention on Climate Change in June 1992 and acceded to the Kyoto protocol in 1998, taking the responsibility to reduce its greenhouse gas emissions by 8% as compared to 1990.

Estonia has reduced its greenhouse gas emissions by almost 50% compared to the base year 1990. In 1990, the emissions amounted to 41,935 thousand tonnes in CO_2 equivalents and in

2007 the corresponding figure was 22,018 thousand tonnes, thus there has been a reduction of 47.5%. Estonia has implemented joint implementation projects, the EU emission trading scheme and is also active in the international emissions trading system.

The Estonian Government will continue its efforts to reduce greenhouse gas emissions at the national and international level and is also contributing to the financial schemes to support the climate related activities of developing countries. Two important strategic documents for future, the National Development Plan for Energy Sector until 2020 and National Development Plan for Electricity Sector until 2018 were prepared in 2008-2009. These plans define Estonia's energy sector: to ensure a steady, efficient, environment benign energy supply with reasonable prices, while also ensuring the sustainable use of energy to decrease electrical energy production from oil shale and an increase in the proportion of other sources of energy. There are many measures taken that will impact the emissions in future.

In addition to tangible emission cuts from industry, the Government will continue investing in research and development, focusing on renewable energy and energy saving activities, keeping up with climate friendly forest management and giving a clear signal to industry that it is essential to invest in alternative technologies.

Tallinn, December 2009

Jaanus Tamkivi

Minister of the Environment

I EXECUTIVE SUMMARY

1.1. Introduction

This Fifth National Communication Under the Framework Convention on Climate Change covers the policies and activities in Estonia of the time period up to September 2009.

Estonia signed the Framework Convention on Climate Change at the United Nations Conference on Environment and Development held in Rio de Janeiro in June 1992. In 1994, Estonia ratified the UNFCCC, and in 2002, the Kyoto Protocol. Under the Protocol, Estonia is obliged to reduce during the period 2008-2012 the emissions of air polluting greenhouse gases from its territory by 8% as compared with the 1990 level. Due to the re-organization of the economic sector, this target was achieved. By 2007 the greenhouse gas emissions decrease made up 47 % compared to the 1990 level. As Estonia is a member of EU, all European legislative acts are binding to the country. It includes also acts dealing with climate change policy. In December 2008, the European Parliament adopted a set of legislative documents (the so-called EU climate and energy package) for transforming Europe gradually into a low-carbon economy and for increasing energy security. An agreement has been reached on legally binding targets by 2020: to cut greenhouse gas emissions by 20%; to establish a 20% share for renewable energy in final energy consumption; to improve energy efficiency by 20%. The package contains also an offer to reduce greenhouse gas emissions further and commit to a 30% cut in the event of a satisfactory international agreement being reached.

1.2. National circumstances relevant to greenhouse gas emissions and removals

Estonia is one of the smallest nations in Europe. In 2009, the population of Estonia was 1.34 million. In 2009, the population density was in 30.9 persons per sq km, which is one of the lowest in Europe. Urban population made up almost 69% in 2009. The biggest town in Estonia is the capital - Tallinn with more than 390 thousand inhabitants, forming approximately 30% of the total population.

Estonia is situated in the northwestern part of the flat East-European Plain, lying entirely within the drainage area of the Baltic Sea. It lies between latitudes 57°30`N and 59°49`N and 21°46`E and 28°13`E. To the west and north, it has a long coastline on the Baltic Sea which is characterized by numerous bays, peninsulas, and straits between islands. The total area of Estonia is 45,227 km^2, including 42,692 km^2 of land area. Almost half of the land area is covered by forests (ca 47%), one-third is agricultural land (cropland 28% and pastures 7%), around 2% is under settlements and the rest of the territory is covered by mires and bogs. There are about 1,450 natural and man-made lakes in Estonia (6.1 per cent of the country's territory).

Estonia belongs to the Atlantic continental region of the temperate zone. The summers are moderately warm (the mean air temperature in July is 15-17 °C) and winters are moderately cold (the mean air temperature in February is between –3.5 to –7.5 °C). Since annual precipitation exceeds evaporation approximately twofold, the climate is excessively damp. The mean annual

precipitation is about 550-650 mm, ranging from 520 mm on some islands to almost 730 mm in the uplands. The prevailing winds are south-westerly, southerly and westerly.

In 2000-2007, Estonia's economy experienced one of the highest growth rates among emerging market economies and until 2005 a low inflation. Eight years ago, Estonia's GDP per capita in Purchasing Power Standards was only 45% of EU27 average, but by December 2008 it has grown to 68.2%. In 2008, GDP at current prices was 16.1 billion euros. The structure of GDP has been quite stable during the recent years. The main contributors to GDP are real estate, renting, business activities (20.1%) and manufacturing (16%).

Estonia ranks among the first ten EU countries with the primary energy production per capita. Estonia is on the average level among the EU states with the generation of electricity per capita (7.4 MWh per capita). Oil shale, natural gas, and shale oil serve as the primary fuels for power plants.

The Estonian transport network is very well developed and consists of the infrastructure needed for road, rail, water and air traffic. The total length of Estonian road network is 58,034 kilometers. The density of the national roads is 380 km per 1,000 km^2 and the density of the entire registered road network is 1,336 km per 1,000 km^2 of the territory. The rail transport system in Estonia consists of about 1,200 kilometres of railway lines, of which 919 kilometres are currently in public use and 133 kilometres have been electrified.

Estonia's economy is highly export-oriented. Manufacture of machinery and equipment, wood industry and manufacture of food and beverages have highest share in Estonian industry. Machinery and metalworking sector makes up only 24% of manufacturing companies, it contributes 42% in total exports and 43% in total imports (2008). The most export-oriented sub-sector is machinery and mechanical appliances, which contributes 22% of total exports.

In 2007, a total of about 21.2 million tonnes of waste was generated in Estonia. The amount of annually generated municipal waste has been on the level of about 400 kg per habitant. During the recent years, the sharp decrease of landfills in Estonia can be noticed. While in 2000 there were about 170 different functioning landfills, then in 2007 the number of landfills in use was only 30. There are only 6 landfills for municipal and other non-hazardous waste in operation after July 16, 2009.

As of 2007, the total forest land area of Estonia is 2,213,000 hectares, which represents approximately half of the country. There are 1.7 hectares of forested land and 337 cubic metres of timber per capita in Estonia on average.

1.3. Greenhouse gas inventory information

Estonia's greenhouse gas (GHG) emissions in 2007 totalled 14 115.63 Gg CO_2 equivalent and without Land Use, Land Use Change and Forestry 22 018.68 Gg CO_2 equivalent. From 1990 to 2007 the emissions decreased by 47.49%. This decrease was mainly caused by the transition from planned economy to market economy and the successful implementation of the necessary reforms.

In 2007, the most important GHG in Estonia was carbon dioxide (CO_2), contributing 86.71% of the total national GHG emissions expressed in CO_2-eq, followed by methane (CH_4), 7.83%, and nitrous oxide (N_2O), 4.79%. Fluorinated gases accounted for about 0.66% of the total emissions. Energy sector accounted for 86.69% of the total GHG emissions, followed by agriculture (6.05%), industrial processes (4.09%) and waste (3.17%).

Table 1.1 shows Estonia's total emissions of the GHGs CO2, CH4 and N2O and the fluorinated gases HFCs, PFCs and SF6 from 1990 to 2007, calculated in CO2 equivalents.

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007
	CO_2 equivalent (Gg)					
CO_2 emissions including net CO_2 from LULUCF	30909.56	11049.72	14092.21	9285.94	7395.02	11187.81
CO_2 emissions excluding net CO_2 from LULUCF	37283.48	18165.83	15555.63	16847.86	16341.13	19093.24
CH_4 emissions including CH_4 from LULUCF	2731.11	1677.41	1716.89	1721.76	1733.10	1725.59
CH_4 emissions excluding CH_4 from LULUCF	2726.35	1675.95	1713.77	1721.35	1723.09	1724.31
N_2O emissions including N_2O from LULUCF	1926.67	993.80	1037.45	949.32	976.73	1056.47
N_2O emissions excluding N_2O from LULUCF	1925.60	992.92	1036.16	948.31	974.74	1055.36
HFCs	NA,NO	25.70	70.79	118.70	139.53	144.73
PFCs	NA,NO	NA,NO	NA,NO	NA,NO	0.07	0.06
SF_6	NA,NO	3.22	2.73	1.08	1.15	0.97
Total (including LULUCF)	35567.34	13749.85	16920.08	12076.80	10245.60	14115.63
Total (excluding LULUCF)	41935.43	20863.62	18379.09	19637.29	19179.71	22018.68
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1995	2000	2005	2006	2007
	CO_2 equivalent (Gg)					
1. Energy	37285.23	18154.77	15569.73	17016.16	16482.27	19087.28
2. Indutrial processes	945.59	597.46	656.65	665.21	720.39	901.17
3. Solvent and Other Product Use	NA	NA	NA	NA	NA	NA
4. Agriculture	3032.75	1467.78	1297.99	1255.28	1274.40	1333.09
5. Land-Use, Land-Use Change and Forestry	-6368.09	-7113.77	-1459.02	-7560.49	-8934.11	-7903.05
6. Waste	671.87	643.60	854.73	700.65	702.66	697.14

Table 1.1 Greenhouse gas emissions in Estonia, 1990-2007
Source: Estonia's Greenhouse Gas Inventory 1990-2007

Energy sector is the main source of GHG emissions in Estonia. In 2007, the energy sector contributed 86.69% of the total emissions, totalling 19.09 Tg CO_2-eq. Most of the energy sector emissions, 97.3%, originated from fuel combustion and only 2.7% were contributed by fugitive emissions. Compared to the base year 1990, the emissions decreased by 48.8% (including: energy industries -51%; manufacturing industries -51%; transport -23% and other sectors -70%).

GHG emissions from industrial processes contributed 4.09% of the total GHG emissions in Estonia, totalling 901.17 Gg CO_2-eq. The most important GHG emissions from industrial processes in 2007 were the CO_2 emissions from the cement, ammonia and lime production with 2.7%, 0.57% and 0.16% respectively, and HFC emissions from refrigeration and air conditioning equipment and foam blowing which account for 0.49% and 0.15% of the total GHG emissions, respectively.

In 2007 the agriculture sector contributed 6.05% of the total emissions, totalling 1333.09 Gg CO_2-eq. Emissions from the enteric fermentation of livestock and direct emissions from agricultural soils contributed the main share of the total emissions from the agricultural sector.

In 2007 the LULUCF sector acted as a CO_2 sink, totalling 7903.05 Gg CO_2-eq. The LULUCF sector in Estonia has been a net sink during the whole reporting period 1990–2007 as the removals in the sector exceed the emissions. The main sink of CO_2 in Estonia is forest land.

In 2007 the waste sector contributed 3.17% of the total emissions, totalling 697 Gg CO_2-eq. CH_4 emissions from landfilled solid waste and CH_4 and N_2O emissions from composting processes were the most significant emissions of the waste sector in Estonia in 2007.

National system for preparing the GHG inventory

The single national entity with the overall responsibility for the Estonian GHG inventory is the Ministry of the Environment (MoE). The inventory is produced in collaboration between MoE, Estonian Environment Information Centre (EEIC), Tallinn University of Technology (TUT) and Estonian Environmental Research Centre (EERC).

MoE is responsible for coordinating the overall inventory preparation process; approving the inventory before its official submission to the UNFCCC and concluding the formal agreements with inventory compilers (TUT and EERC). The Climate and Ozone Bureau in EEIC is responsible for compiling the inventory according to the parts submitted by the inventory compilers and reporting the inventory to the UNFCCC; coordinating the quality assurance and quality control (QA/QC) plan and preparing the UNFCCC inventory reviews.

The National System is designed and operated to ensure the transparency, comparability, completeness, accuracy and timeliness of GHG emission inventories. The methodologies, activity data collection and the choice of emission factors are consistent with the guidance in the Revised 1996 IPCC Guidelines and the IPCC good practice guidance reports.

The objective of Estonia's GHG inventory is to comply with the requirements, principles and elements of the UNFCCC, Kyoto Protocol, IPCC guidelines and the European Union GHG monitoring mechanism. The general QA/QC procedures applied to all categories follow the IPCC Good Practice Guidance.

1.4. Policies and measures

The main state institutions dealing with GHG policies in Estonia are:

- Ministry of the Environment who is responsible for carrying out the national environmental policy;
- The State Chancellery's main mission is to support the Government and the Prime Minister in policy drafting and implementation.
- The Ministry of Economic Affairs and Communications (MoEAC) is responsible for energy related issues, including energy efficiency and conservation, also for the use of renewable sources in the energy sector;
- The Ministry of Agriculture advises the Government in the field of agriculture and rural life;
- The Ministry of Finance responsibilities include matters important for environmental management like taxation, use of state budget funds.

During the short period elapsed since Estonia regained its independence, great progress has been made in developing the legislation. Estonian legal acts were amended in the process of integration with the European Union. All requirements and provisions of the new EU climate and energy package have been taken into account upon preparing the latest national strategy documents in Estonia described in the following sections.

The main strategic document in the scope of environment protection in Estonia is Estonian National Strategy on Sustainable Development – Sustainable Estonia 21, the most general national strategy document, which is aimed at developing the Estonian state and society in the time frame until the year 2030, integrating the economic factors with the principles of sustainable development. The strategy document was approved by the Parliament (Riigikogu) in 2005.

More specific long-term objectives related to environmental development are formulated in the National Environmental Strategy until 2030 that was endorsed by the Parliament in February 2007. Based on this document, the Government of Estonia approved the Environmental Action Plan for 2007–2013, prepared by the Ministry of the Environment.

The National Long-term Development Plan for the Fuel and Energy Sector Until 2015 that was approved by the Government of the Republic in December 2004. On the basis of this document, a new National Energy Efficiency Programme for 2007–2013 (which takes into account objective set by Directive 2006/32/EC) has been prepared. It is estimated in the Programme that a total of 1.5 billion EEK (96.0 MEUR) is needed during the period of up to 2013 for investments.

For promoting the use of biomass and bio-energy, the Government has approved (in January 2007), the Development Plan 2007−2013 for Enhancing the Use of Biomass and Bioenergy. The objective of the plan is to create favourable conditions for the development of domestic biomass and bio-energy production. Additionally, preparations have been started for compiling a national renewable energy action plan. This is a requirement for all EU member states according to Directive 2009/28/EC.

The main goal of the National Programme of Greenhouse Gas Emission Reduction for 2003–2012 is to ensure compliance with the targets set by the UNFCCC and the Kyoto Protocol. The long-term objective of the National Programme is to reduce greenhouse gas emissions by 21% by 2010 as compared with the 1999 emission level.

There have been several fiscal measures introduced in Estonia to support sustainable energy consumption and reduce the emissions of GHGs. Excise duties on fuels and pollution charges could be mentioned. The current tax rates are stipulated in the Alcohol, Tobacco, Fuel and Electricity Excise Duty Act. The Environmental Charges Act (enforced in 2006) obliges the owners of combustion equipment to pay pollution charges for several pollutants emitted into air (e.g. sulphur dioxide, nitrogen oxides, etc.). At present, the CO_2 charge has to be paid by all enterprises producing heat, excluding the ones firing biomass, peat or waste.

The National Development Plan for Energy Sector until 2020 was passed by the Parliament in June 2009. The most general measurable target of the plan is the gradual reduction of primary energy use (total primary energy supply) which in 2007 was 124.44 PJ. For several measures, target level indicators have been set. As to other targets related to emissions, it has been established that the losses in electricity and district heating networks must have a declining trend from the current level – in 2007 the average losses had been 11.1% and 10.6% respectively. The amount of state expenditures on the activities planned will be approximately 32 billion kroons (2045 MEUR) until 2020.

The transposition of provisions of Directive 2002/91/EC into Estonia's legislation was completed by January 1, 2009. The main provisions were introduced to make relevant amendments in the Building Act and in the Energy Efficiency of Equipment Act. The objective of these amendments was to introduce the energy auditing and labelling of buildings, to improve the energy performance of new and existing buildings, and to provide the users of buildings with an easier access to information about the building's energy consumption and energy saving measures.

The Transport Development Plan for 2006–2013 sets measures aimed at making transport more environment-friendly. To increase the proportion of public transport users, the Government has set a goal to increase the number of lanes on streets allocated for public transport in cities by 20% a year over the coming years. There are some differences between the goals set in the EU sustainable development strategy and the target set in the Estonian Transport Development Plan 2006–2013. While the EU sustainable development strategy establishes a desirable average CO2 emission level for light duty vehicles (120 g/km by 2012), the Estonian transport development plan sets a similar goal of a 30% share of new cars with CO2 emissions less than 120 g/km. Some

local governments, mainly cities but also some rural municipalities, have started to promote cycling: several networks of roads with safe routes (special lanes and tracks) for cycling have been designed. For example, Tallinn, the capital city, started the construction and marking of special cycling routes in 1998. By today, the total length of these routes is approximately 160 km.

The Estonian Rural Development Plan 2007–2013 provides a special measure for promoting the establishment of protection forests. The objective of the measure is to ensure the good condition of the environment. With the establishment of protection forests, the share of agricultural lands vulnerable to the environment will be reduced and the need to establish protection forests on the account of commercial forests will be decreased. In the Development Plan of Estonian Forestry until 2010 (approved by the Parliament in 2002), the afforestation of at least 300 thousand hectares of abandoned agricultural lands is planned for. According to estimations, it will help to bind additionally about 1290 Gg of carbon dioxide by the year 2020.

1.5. Projections and the total effect of policies and measures

Projections are given for all the greenhouse gases considered in the Kyoto Protocol and for the following sectors: energy (incl. transport), industry, agriculture and waste. They are estimated for the period of 2006 to 2020 and compared to the inventory data for 1990. These projections were compiled on the basis of 2006 data as long as the work was carried out in 2008 when only 2006 data were available.

The projections are based on the use of the energy supply development model **NEEDS** (or NEEDS/TIMES). This energy development model is elaborated in the framework of the Sixth Framework Program within the project "New Energy Externalities Development for Sustainability" (NEEDS). The main source for the base-year of all countries of the model is the Eurostat database. The section "Energy and Environment" of this database provides all the energy flows for the base- year (2006).

Two scenarios are presented in this report. First, the "With Measures" (WM) scenario evaluates future greenhouse gas emission trends under current policies and measures. In the second scenario, a number of additional measures and their impacts are taken into consideration, forming the basis of the scenario "With Additional Measures" (WAM).

With measures scenario for 2006–2020. The basic indicators for this scenario is set in the National Long-term Development Plan for the Fuel and Energy Sector until 2020. Several studies, conducted with regard to the development of the Estonian energy supply, have shown that the level of GHG and especially the amount of CO2 emission can not be reduced without applying special measures. For the elaboration of the required complex of measures, the plan of renewable sources utilization, outlined in the Estonian energy development projections, was applied. Minimum limits were set for the amount of electricity produced from renewable sources, also for the share of biofuels used in the transport sector.

To carry out the calculation, several assumption and prognosis for the time period 2006-2020 were made. For example, it is assumed that the total gross inland energy consumption in Estonia generally remains on the same level for the time period of up to 2020, with minor deviations. However, the structure of the primary energy used undergoes some essential changes. These changes become apparent, above all, in the reduction of the use of oil shale as the main energy source, the share of which falls from 54.3% in 2006 to the level of 32.9% in 2020. The consumption of electricity in Estonia is not going to increase essentially by 2020 in relation to 2006. The electricity generation structure is also going through some essential changes, primarily in the decreasing share of electricity generation in conventional condensate power plants. This share falls from the level of 88.3% in 2006 down to the level of 70% in 2020 while the share of CHP plants grows from the level of 10.7% in 2006 up to the level of 13.3% in 2020.

The calculation interval was 5 years and calculations were made for the main economical sectors influencing GHG emissions. The results on the calculation show a significant decrease of the total GHG emissions. According to the inventory results, the total emission of GHG in 2006 was 18,876 Gg CO_2-eq. The implemented measures will assure the reduction of emissions to 15,615 Gg CO_2-eq by 2020.

In the scenario "With Additional Measures", some additional requirements were added to the set of data. The performed calculation showed that when implementing additional measures, the decrease of GHG could be even higher; it is assumed that the total emission could be reduced to 13,012 Gg CO_2-eq. The most significant influence to the reduction will come from the energy sector.

The projections of the total aggregated emissions (converted to the equivalent amount of CO2 using GWP) for the three scenarios of WM, WAM and WOM (Without Measures) in the period of 2005-2020 are summarized in Table 1.2.

	1990	1995	2000	2005	2006	2010	2015	2020
WM	41.593	20.803	18.246	19.313	18.876	15.960	16.376	15.615
WAM	41.593	20.803	18.246	19.313	18.876	15.974	15.790	13.012
WOM	41.593	20.803	18.246	19.313	18.876	17.915	19.187	19.041

Table 1.2 Projections of the total aggregated GHG emissions, Gg CO2-eq

1.6. Vulnerability assessment, climate change impacts and adaptation measures

The impacts of climate change in Estonia are relatively small compared to the southern and northern regions of Europe. Therefore, no significant consequences are expected for biodiversity or public health. Some species may disappear and some new species will probably emerge, but these changes are quite negligible.

The rise in temperature and precipitation will have a positive rather than negative effect on the Estonian economy. For example, it will probably be favourable for agriculture, especially

grassland husbandry. The total growing season will lengthen and a greater number of harvests will become possible. In the case of higher temperatures and higher rainfall, the growth and development of herbaceous plants will quicken and harvesting times will shift to an earlier period. Livestock will be better provided with fodder in summer and winter.

The main hazards and economic losses in Estonia will result from the rise of sea level which will cause flooding in coastal areas, the erosion of sandy beaches and the destruction of harbour constructions.

Precipitation increases during the cold half-year and also in June. The duration of snow cover and sea ice decreased significantly during the second half of the 20th century.

Over the last century, the mean wind speed increased by 0.5-0.8 m/s. The increase of mean wind speed is characteristic mainly of the cold season (November to February). The distribution of wind directions indicates quite substantial changes in the frequency of wind directions, south-westerly and westerly winds have increased.

A study for determining the extreme wet and dry days during the past 50 years confirmed that the inter-annual variability of the number of extreme wet, extreme dry and total extreme days shows an apparent increasing trend in Estonia. The ASTRA winter storm study concludes that flooding and storms (especially during winter season) are already a major threat in the Baltic Sea Region.

A cyclone called Gudrun in the Nordic countries developed over the North Atlantic and travelled over the British Isles, Scandinavia, and Finland on January 7–9, 2005. As a result of the high initial levels of the Baltic Sea, the fast moving cyclone with a favourable trajectory and strong south westerly and westerly winds created a record high storm surge (275 cm) in Pärnu and many other locations along the West Estonian coast. The total direct damage caused by the storm was 47,868,096 EUR.

The climate warming is quite likely to influence Estonian forests. Increase in temperature prolongs the growing season and enhances the decomposition of soil organic matter, increasing the supply of nitrogen, all of which enhance forest growth, timber yields and carbon sequestration. The improved forest productivity will create opportunities for increased utilisation of forest resources.

The rise of the average annual temperature is also likely to be favourable for grassland husbandry in Estonia in the future. The total growing season will lengthen and a higher number of cuttings will be available from grasslands. In recent years, it has been possible to have 3 cuttings instead of 2. The development of agricultural varieties will become quicker and the growing period will shorten. Research shows that the optimum sowing time will shift on average to a 4–11 days earlier period, and in order to get the maximum yield, the whole cultivation period ought to be prolonged by 10–30 days on average. It is estimated that due to climate change, Estonian agriculture will be more efficient and competitive in the future.

Estonia does not have a national adaptation strategy. In recent years, there have been some projects for gaining information on the adaptation to climate change.

1.7. Financial resources and transfer of technology.

Estonia does not belong to the list of Annex II Parties, therefore no information is delivered here.

1.8. Research and systematic observation

Scientific research projects in Estonia are financed from different financial sources - Estonian Research and Development funding under the Ministry of Education and Research; the Environmental Investment Centre, from the European Regional Development Fund and the Social Fund, Ministry of the Environment, etc.

The Estonian Meteorological and Hydrological Institute, Tartu Observatory and the Institute of Geography at the University of Tartu, Estonian University of Life Sciences, the Institute of Ecology at Tallinn University, the Marine Institute at the University of Tartu, the Marine Systems Institute at Tallinn University of Technology, Centre for Nonlinear Studies, Institute of Cybernetics at Tallinn University of Technology, SEI Tallinn (Stockholm Environmental Institute Tallinn Centre) are conducting related studies on climate change. A detailed list and description of projects are given in section VIII.

Estonian Meteorological and Hydrological Institute is a governmental service under the Ministry of the Environment. EMHI's responsibilities include all the activities typically carried out by a national meteorological and hydrological service incl, monitoring.

1.9. Education, training and public awareness

According to the survey on Europeans' attitudes towards climate change that was carried out in January and February 2009, only 49% of Estonians see climate change as a serious problem. That is the lowest percentage among European Union (EU) member states. Estonia is the only country in EU where the majority of citizens consider climate change as an unstoppable process. According to Estonians, the emissions of CO_2 have a marginal impact on climate change. According to 37% of Estonian citizens, the seriousness of the climate change phenomenon has been exaggerated; this percentage has reached a relatively high level from 30% in spring 2008.

However, Estonians' attitude towards sustainable lifestyle has changed during the past decade. People used to build large energy-consuming houses and use vehicles with poor fuel economy without regard for sustainability. In recent years, the trend has changed, one factor being the economic recession. The general discussion of environmental issues, including the dissemination of information to the public through the media and Internet, has increased in the recent years. Most people get their information from the media, especially from television.

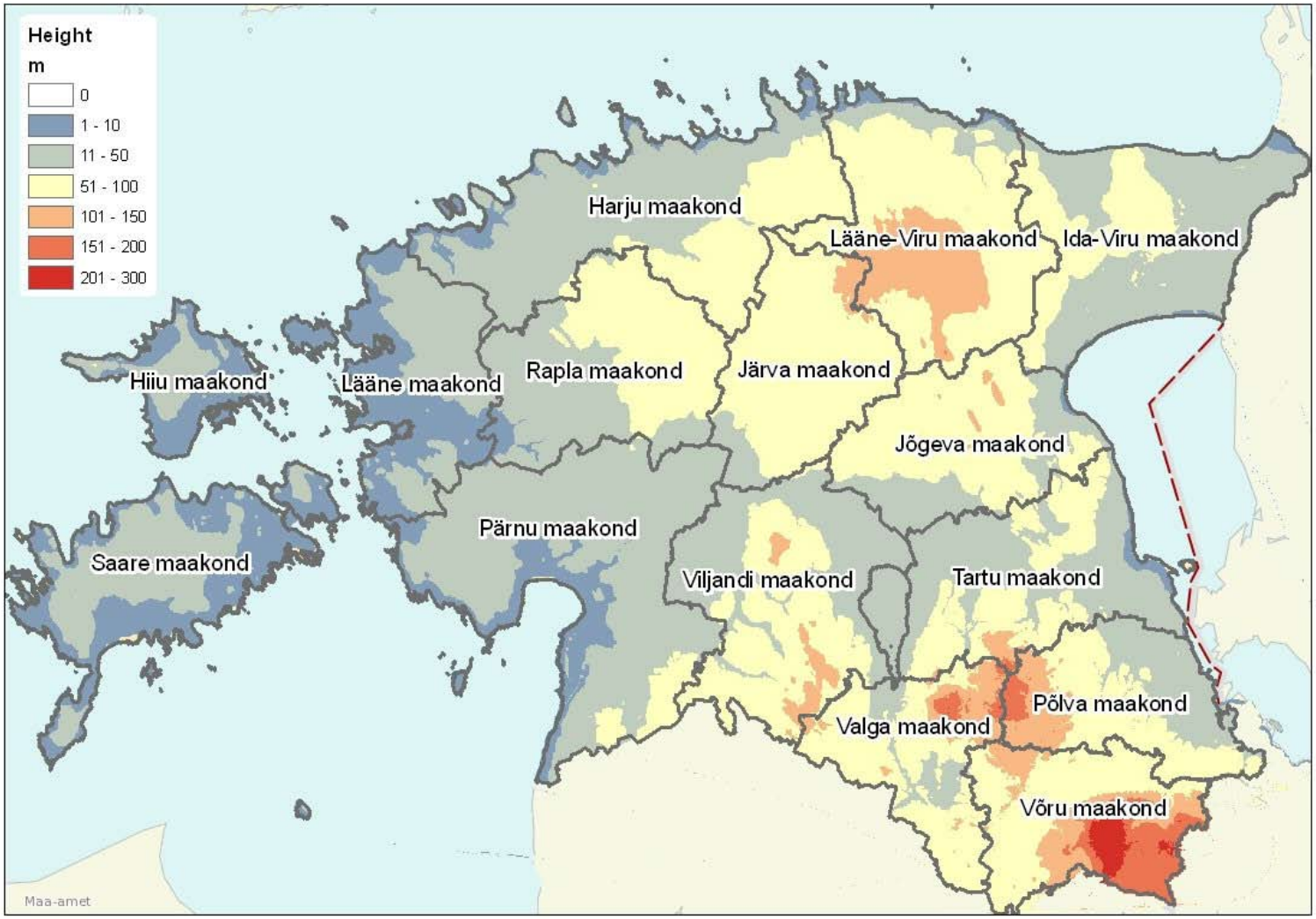
The Ministry of the Environment has been making efforts to introduce the subject of climate change at various environmental seminars for different stakeholders.

The access to environmental information in Estonia is regulated mainly by the Public Information Act. The special electronic system eJustice for coordinating draft legislation is available at http://eoigus.just.ee/.

Most of the environmental information in Estonia is published by the Estonian Environment Information Centre administered by the Ministry of the Environment. The website of EEIC www.keskkonnainfo.ee is a source of environmental data consisting of indicators, analyses and reports. Different reports on air quality, environmental monitoring, nature conservation, water quality and the state of the environment are available on the website. It is also the main source of information on climate policy and its implementation. The Ministry of the Environment has its own website at www.envir.ee to publish environmental information, but unfortunately no information on climate change is included.

Climate change education in primary and secondary schools is possible through public awareness campaigns and projects organised by different organisations. Several school projects supported by the Ministry of Education and Research are being carried out in Estonia. Estonian universities do not offer the possibility to study climate change as a separate major, but many universities provide Bachelor or Master level programmes in environmental studies which incorporate climate change issues.

The Estonian community has become more aware of the significance of climate change as a separate issue. A broad range of non-governmental organisations (NGOs) are actively involved in the capacity building of climate change issues through research, lobbying, education and training, and media activities. Estonian Green Movement, student society Sorex and Estonian Fund of Nature are the most active in this field. Many projects are financed and supported by the Archimedes Foundation.



II NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

2.1. Government structure

The institutional structure of the Estonian state is set out by the Constitution adopted in 1992. Estonia is a parliamentary democracy with the **Riigikogu**, Estonian Parliament, exercising the supreme legislative power, the President of the Republic acting as the head of the state and the Government of the Republic exercising the executive power.

The **Riigikogu** is the single-chamber parliament of Estonia, with the main task of fulfilling the function of establishing normative acts. The second important task of the Riigikogu is the approval of annual state budget. A member of the Riigikogu has the right to request explanations from the Government of the Republic and its members and other high-ranking public servants. This enables the members of the parliament to observe the activities of the executive power (government) and the abovementioned high state officials.

The Head of the State of Estonia is the **President** of the Republic who is elected indirectly by the parliament or, if no candidate wins a two-thirds majority in the parliament, by an electoral college composed of members of the parliament and representatives of local councils. Estonia holds presidential elections every five years. The President proclaims the laws passed in the Riigikogu and ratifies or denounces treaties. He/she represents Estonia in international relations, appoints diplomatic agents of Estonia and receives the credentials of the diplomatic agents of other countries. It is also his/her competence to appoint the Prime Minister, other ministers, the President of the Bank of Estonia and several other senior public servants. The President has his/her Academic Advisory Board.

The **Government** of the Republic is, as a rule, formed by 2-3 coalition partners who constitute the majority in the Parliament. The Government of the Republic is comprised of the Prime Minister and other ministers. The ministers are divided into those who run ministries (the so-called portfolio ministers) and those who do not run ministries (the so-called ministers without portfolios). The Cabinet contains up to 15 ministers, including the Prime Minister. At present, there are 11 portfolio ministries (including the Ministry of the Environment and the Ministry of Economic Affairs and Communications, which are the main ministries responsible for climate issues) and one minister without portfolio (minister for regional affairs).

The Government has the executive power of the state. The definition of the executive power of the state also includes a limited scope of legislative drafting and administration of justice. In order to implement laws, these must often be further specified. This is made by regulations of the Government of the Republic and the ministers. The executive power is divided between two functions: governing and administration. The Government of the Republic has the function of co-ordination and supervision of institutions of the executive power of the state.

The next level of government in Estonia is the **local level**. Pursuant to the Constitution, the municipalities enjoy autonomy from the central government. The state is divided into 15 counties, which, however, do not constitute a separate level of regional government but act as representatives of the central government in the respective regions.

There are 227 local government units, including 194 rural municipalities and 33 cities. Their size varies from the capital city of Tallinn with over 400 000 inhabitants to the small island of Ruhnu with only 103 inhabitants. However, the functions of all the municipalities are the same by the law and they are primarily responsible for education, public works, housing, local road maintenance and primary level health care. Local government units are financially heavily dependent on the central government as only 22 of them manage without any central government subsidies. The size of the subsidies from the central government to local government equals to one third of the income earned by the municipalities themselves.

2.1.1. Implementation of climate policy within the government structure

In Estonia, there are two principal ministries responsible for the climate and energy policy – the Ministry of the Environment and the Ministry of Economic Affairs and Communications. The Ministry of the Interior is in charge of the risk analyses of emergency situations, and relevant response plans.

The coordination lies with the **State Chancellery**, whose task is to support the Government of the Republic and the Prime Minister in policy drafting and implementation. There are two offices in the State Chancellery involved in the climate policy: the Strategy Office coordinates the drafting and implementation of the Government's action plans, as well as strategic development plans for increasing the country's competitiveness and for promoting sustainable development. The second office - the European Union Secretariat coordinates the development of Estonia's positions on issues relating to the European Union and the transposition of European Union legislation. It also advises and supports the Prime Minister in issues relating to the European Union and in the preparation of European Council summits.

When necessary, climate issues are also addressed at regular meetings of higher state public servants that take place in the State Chancellery at regular intervals.

The **Ministry of the Environment** is primarily responsible for the implementation of UNFCCC, Kyoto Protocol and relevant legal acts of the European Community. The Ministry of the Environment elaborates Estonia's climate policy by preparing environmental action plans and strategies, and drafts the legislation required for the implementation of UN, EC and Estonia's climate policy. The Ministry of the Environment also supervises the preparation of annual GHG inventories, National Communications, implementation of joint implementation projects and the European Union emission allowance trading scheme (ETS). In addition, the Ministry of the Environment coordinates the preparation of national allocation plans for Estonia. The Ministry has a special administrative unit at the Estonian Environmental Information Centre, for practical implementation of climate policy. It coordinates GHG reporting (inventories, projections, policies and measures), implements EU ETS and joint implementation, and administrates the GHG emission

trading registry. Another major institution in the climate context under the Ministry of the Environment is the Estonian Meteorological and Hydrological Institute – a governmental service that performs meteorological and hydrological measurements, issues weather forecasts, prepares the climatological survey of Estonia, etc.

The **Ministry of Economic Affairs and Communications** elaborates and implements the national economic policy and prepares economic development plans in the fields that have a direct impact on climate change: industry, trade, energy, housing, building, transport, traffic management (e.g. Estonia's Electric Energy Development Plan, Fuel and Energy Management Long Term Development Plan, Energy Saving Programme, Development Plan for the Housing Sector, Transport Development Plan, etc).

The Ministry of Economic Affairs established a special Credit and Export Guarantee Fund KredEx in 2001 with the aim to improve *inter alia* giving loans to enable people to build or renovate their homes and promote energy efficiency in Estonia.

In addition to the abovementioned two ministries, the **Ministry of the Interior, Ministry of Agriculture, Ministry of Education and Research as well the Ministry of Social Affairs and the Ministry of Foreign Affairs** are involved in different aspects of the climate issue at the state level. Regulation of crisis management and rescue work is, in principal, the task of the Ministry of the Interior who is also responsible for the risk analyses of emergency situations (including storms, floods[1] and extreme weather conditions) and drafting relevant response plans.

If one ministry has a leading role in a certain climate related strategy or development plan, other involved ministries participate in the working groups for the development of such strategies.

In recent years, also local governments have become more active in integrating climate aspects into spatial planning and transport management. Also, participation in different projects that have an impact on reducing GHG emissions has increased. Several local governments that are prone to be affected by floods have developed detailed adaptation and action plans as to how to deal with storms and floods.

2.2. Population profile

In terms of population, Estonia is one of the smallest nations in Europe. In early 2009, the population of Estonia was 1.34 million. In the post-war decades until the turn of the 1990s, the population growth in Estonia was very intensive, supported by the direct and indirect effects of positive net migration. This growth came to an end at the beginning of the 1990s. The changes in migration flows and the balance between birth and death rates worked in the same direction and strengthened each other, resulting in one of the most rapid population declines in Europe in

1 Map of flood risks and dams
http://www.envir.ee/orb.aw/class=file/action=preview/id=327382/%FCleujutusalad_paisud+%28Parandatud03.2007%29.pdf

the 1990s. However, in the recent years, the population decline has decreased.

In the 1980s, the turnaround in the urban-rural migration flows signalled the advent of a new stage in urbanisation processes. In the beginning, as early as in the 1970s, it reflected the emergence of sub-urbanisation, while features of counter-urbanisation were added in the 1980s. The population growth in several remote communities started to exceed that in the regional centres, which they surrounded. The second half of the 1990s witnessed an accelerating trend in de-urbanisation. This has mainly been related to the suburbanisation process around regional centres, which in particular has diminished the proportion of the population residing in medium-sized cities with a population of 50–100 thousand inhabitants. For a long time, Estonia was characterised by quite a stable proportion of population in small settlements with a population of less than 2,000; the decrease in their proportion indicates, on the one hand, to a trend towards the enlargement of small ones, and, on the other hand, the depopulation of remote areas (Table 2.1).

Size of settlement	1970	1979	1989	1995	2000	2005	2008
100,000+	26.7	36.4	37.8	36.7	36.6	36.9	37.3
50,000-99,999	16	9.9	13.5	12.9	5.0	5	5
10,000-49,999	12	13.1	11.3	10.2	17.0	16.9	17.7
2,000-9,999	8.6	9	8.8	10.2	12.3	12.3	11.2
up to 2,000	36.7	31.6	28.6	30	29.1	28.9	28.8

Table 2.1. Distribution of population by settlement size, Estonia 1970–2008, per cents
Source: Herm et al 1999, for 2000, 2005, 2008 ESA 2008 (www.stat.ee 05.12.2008)

In 2009, the population density was in 30.9 persons per sq km and the decline in this indicator has also stopped over the last 5 years. In Estonia, the estimation of urban-rural population is based on the mixture of administrative and labour division of municipalities. In case of administrative division, urban population made up almost 69%, while the population in urban municipalities constituted 63.3% in 2009. The biggest town in Estonia is the capital - Tallinn with more than 390 thousand inhabitants, forming approximately 30% of the total population. Low density areas are mainly in the western part of Estonia, including two islands and the region of Läänemaa. The most densely populated counties are Harjumaa, Ida-Virumaa and Tartumaa.

Regarding internal migration, the urban-rural direction is becoming dominant in the migration system within Estonia. The phenomenon relates to suburbanisation and spatial redistribution of the population to the outskirts of urban centres. One of the conspicuous outcomes of these trends is the increasing intensity of commuting and widening distances between the places of work/study and residence. Commuting between work and home may imply a rise in the incidence of multiple residence, with living close to workplace during weekdays, and returning to the family during the weekend.

2.3. Geographic profile

Being rather small in size (45,227 sq km), Estonia is characterised by diverse climatic conditions and quite pristine biodiversity mainly due to its location and low population density. Situated on the eastern coast of the Baltic Sea and bordered by Peipsi and Pihkva lakes from the east, this small country can be geographically considered almost an island. Estonia has a variety of geographical features that form the basis of its climatic value: long coastline, both at seaside and lakeside; high number of islets (ca 1,620); large untouched bogs (ca 15% of territory); large number of lakes (ca 1,450) and rivers; very flat relief (almost two thirds of the territory lies less than 50 m above sea level. The highest point is Suur Munamägi, 317 m above sea level); unique baserock openings – limestone cliffs – all along the nordic coastline of the mainland and largest islands.

Estonia's neighbours are Russia in the east, Latvia in the South, Sweden in the west and Finland in the north. Its land border is 645 km long, with half of it running along rivers (one of them, Narva River, is the largest river in terms of water volume in Estonia) and lakes (Lake Peipsi and Lake Pihkva).

Located between latitudes 57°30' N and 59°49' N and longitudes 21°46' E and 28°13' E, Estonia has typical conditions for Boreal bio-geographic region. Although due to the strong influence of the Baltic Sea, half of the country can be considered to have boreo-nemoral and the other half more continental boreal conditions.

Almost half of the land surface is covered by forests (ca 47%), one-third is agricultural land (cropland 28% and pastures 7%), around 2% is under settlements and the rest of the territory is covered by mires and bogs. There are about 1,450 natural and man-made lakes in Estonia (6.1 per cent of the country's territory).

Compared with other territories of a similar size situated north of the 57th parallel, Estonia's biological diversity is one of the richest. This is due to the varied climatic conditions, the existence of island and continental sectors, the abundance of sea and inland waters and the variety of base rocks with correspondingly diverse soil conditions, all of which formed the basis for the evolution and development of a wide diversity of ecosystems. Almost 40,000 living species are thought to be represented in Estonia. So far about 26,600 or 67% of them have been found. The other 13,400 species or 34% of biota are yet to be discovered.

Although Estonia is a moderately small country by area, it has a relatively great proportion of unspoiled protected nature. This is mainly due to the low human population density – slightly more than 30 inhabitants per square kilometer and even that is very polarized, being almost 2/3 in urban and only 1/3 in rural areas. Not many countries in Europe can afford to have more than 15% of land under nature protection. In Estonia, the figure is almost 18%.

	Total area (hectares)	% of territory	Under protection in 2000 (%)	Under protection in 2006 (%)	Trend
Built-up areas	37,133	1	4	4	stable
Brushland	293,694	7	18	16	declining
Parks and gardens	59,972	1	6	6	stable
Agricultural land	1,474,152	34	5	5	stable
Natural grasslands	56,192	1	58	59	rising
Deciduous forests	446,264	10	15	15	stable
Coniferous forests	802,121	18	24	25	rising
Mixed forests	838,720	19	14	14	stable
Marshes	305,922	7	64	64	stable
Coastal habitats	39,088	1	69	69	stable

Tabel 2.2 Protection for selected CORINE land cover categories in Estonia in 2000 and 2006.

2.4. Climate profile

The main factor influencing Estonia's climate is the country's geographical position. Estonia belongs to the mixed-forest sub-region of the Atlantic continental region of the temperate zone and lies in the transition zone between maritime and continental climate.

According to Köppen climate classification, the western part of Estonia belongs to the zone Cfb (marine climate with mild winters) while the eastern part to the Dfb zone (humid continental climate with severe winters).

Local climatic differences are due, above all, to the neighbouring Baltic Sea, which warms up the coastal zone in winter and has a cooling effect, especially in spring. The topography, particularly the heights in the southeastern part of Estonia, plays an important role in the distribution and duration of snow cover.

As a result of these factors, the summers are moderately warm (the mean air temperature in July is 15-17 °C) and winters are moderately cold (the mean air temperature in February is between –3.5 to –7.5 °C). Since annual precipitation exceeds evaporation approximately twofold, the climate is excessively damp. The mean annual precipitation is about 550-650 mm, ranging from 520 mm on some islands to almost 730 mm in the uplands. The seasonal variation in precipitation is similar throughout the country, the driest months being February and March. From then on, precipitation gradually increases until July and August, after which it decreases towards winter and spring. The lowest annual precipitation may be less than 350 mm on the coast, but inland regions sometimes have more than 1,000 mm. The highest daily rainfall recorded is 148 mm.

The snow cover is established earliest in the Haanja, Pandivere and Otepää Heights usually at the beginning of December and stays there up to the end of March. On Saaremaa and Hiiumaa

islands, the permanent snow cover predominantly forms in the middle of January. In some years, permanent snow cover does not form at all.

The prevailing winds are south-westerly, southerly and westerly. Winds from the northern sector are more frequent in spring and early summer. The average wind velocity is 5-7 m/sec in coastal areas and 3-5 m/sec inland. The strongest wind occurs in the autumn and winter months, especially in November, December and January (average wind velocity 4.6 m/sec). The weakest wind is in summer (July-August – average wind velocity 3.3-3.4 m/sec).

The mean annual total solar radiation in Estonia is 3,300-3,600 MJm^2, sunshine duration varies from 1,900 hours on the islands to 1,650 hours inland.

The sum of effective temperatures (over 5 °C) is up to 1350° in northern Estonia and up to 1500° in the southern part of Estonia.

A number of extreme weather conditions developed in 2005-2008: for instance, there was a violent storm in January 2005 and an enormous daily precipitation amount occurred in August 2008.

The largest rise in the maximum temperature was recorded in Jõhvi: from +32.3°C in 1961-2004 to +33.6 °C in 2005-2008.

A characteristic feature of the weather pattern in 2004-2008 was very warm December and January. For instance, in December the average air temperature exceeded the average of the previous period by 3.7 °C; in January, by 3.2 °C. December 2006 turned out to be the warmest, with new records set for the average monthly air temperatures for the period of 1961-2008 practically in every weather station.

The greatest precipitation amount fell in the south-western and western part of the Estonian mainland; a considerable amount of precipitation fell also in the Jõhvi area in northeastern Estonia. In Jõhvi, also a new precipitation record – 116 mm for a 24-hour period was set on August 21, 2008.

The weather pattern and precipitation amounts caused fluctuations in the water level and flow rate in water bodies. A strong storm occurred on January 9-11, 2005 (winds gusting to 33-38 m/s), and in the city of Pärnu, lying in southwestern Estonia, next to the sea, the sea level rose up to 275 cm over the Kronshtadt zero level, resulting in quite a large area of flooded streets and houses. People had to be evacuated from their flooded homes. The same storm resulted in a sudden surge in the water level of rivers in northern and southwestern Estonia, which exceeded the previously recorded winter levels. Precipitation at the end of August and September 2008 had saturated the soil with water to the point that flooding would have occurred even in the conditions of average precipitation.

2.5. Economic profile

During 2000-07, Estonia's economy experienced one of the highest growth rates among emerging market economies and until 2005 a low inflation. However, in recent years, the domestic demand was mainly driven by a housing investment boom, fuelled by high expected income growth and accommodated by large capital inflows and cheap credit, as well as tax incentives.

GDP per capita in PPS has undergone a noticeable growth since 2000. Eight years ago, Estonia's GDP per capita in Purchasing Power Standards was only 45% of EU27 average, but by now it has grown to 68.2%. The total GDP per capita in Purchasing Power Parities reached 20,657 $ in 2008. GDP in domestic currency calculated in current prices has gone through a massive growth because high inflation levels over the recent years. From 2000 to 2008, GDP grew more than 2.5 times.

In 2008, GDP at current prices was 16.1 billion euros. According to the preliminary calculations, the gross national income (GNI) was 15.1 billion euros. Thus, the primary income payable by resident units to non-resident units was bigger by 0.9 billion euros than the income receivable by resident units in the rest of the world. At the same time, the gap has decreased substantially compared to 2007. GDP growth in nominal terms decelerated steeply to 3.9%, which is the smallest figure since 1995. In 2008, GDP in real terms decreased by 3.6%. The decrease in GDP accelerated gradually in the course of the year, influenced by the fast decrease in domestic demand (7.4%). In addition, exports of goods and services decreased due to the decline of external demand.

The structure of GDP has been quite stable during the recent years. The main contributors to GDP are real estate, renting, business activities (20.1%)and manufacturing (16%). Since 2000, the share of the primary sector has fallen from 4.8% to 2.9%.

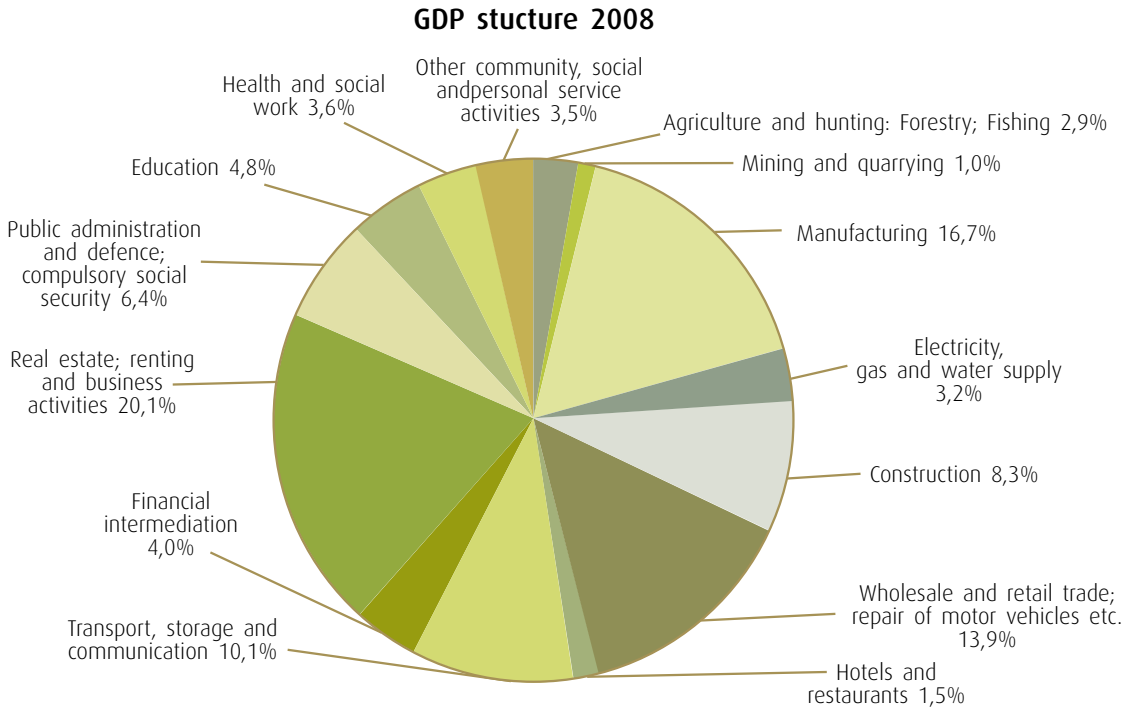


Figure 2.1 Estonian GDP structure 2008
Source: Statistics Estonia

Tightening loan standards in the wake of the severe international financial crisis, falling house prices and an abrupt turnaround of consumer confidence have put an end to the expanding domestic demand, which has been shrinking since mid-2008. Pro-cyclical fiscal policy is adding a negative stimulus. Moreover, the strong wage growth and real appreciation weakened Estonia's external competitiveness.

As of 2008, foreign investments have been made to Estonia from the nearby countries by integrating Estonia's economy closely with the Nordic economy. Sweden (39% of all foreign direct investments made to Estonia) and Finland (23.9%) maintain a solid leading position, the percentage of which has remained relatively stable in the recent years. 26% of the Finnish investments have been made to the processing industry.

The Estonian domestic market is small and with limited growth potential, thus, Estonia's economic growth is directly dependent on the exports of different goods and services to the foreign markets. For the last three years, the neighboring countries of Finland, Sweden, Latvia and Russia have been among the front line of the Estonian export markets. The percentage of exports in Estonia's GDP in 2008 was 76%, having stayed within 70%-80% in the last 8 years which is quite a high indicator. Total exports amounted 8.5 billion euros in 2008, while the trade deficit was 670 million euros. In 2007, about 17.5% of the companies in Estonia were engaged in export.

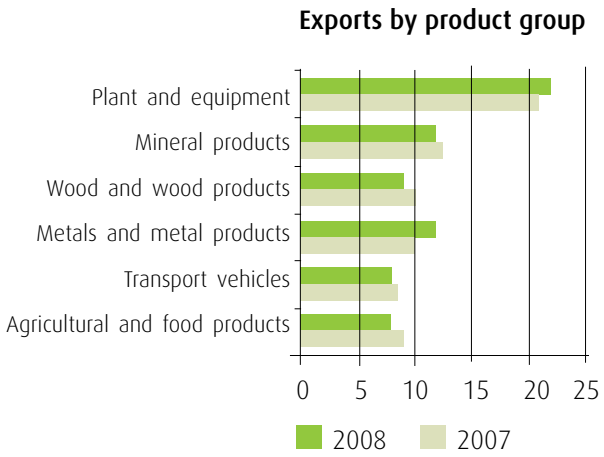


Figure 2.2 Estonian exports by product group 2007-2008
Source: Statistics Estonia

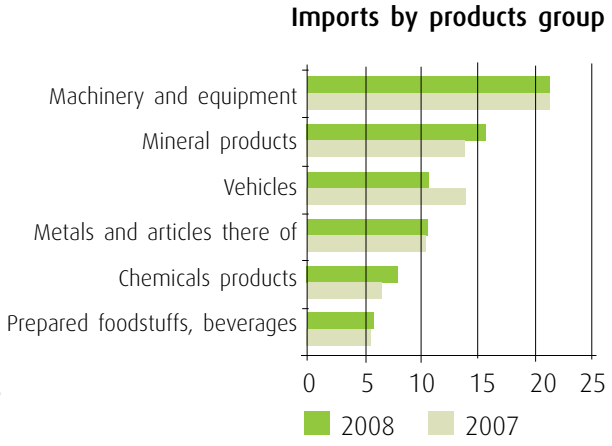


Figure 2.3 Estonian imports by product group 2007-2008

2.6. Energy

The main purpose of the fuel and energy sector in Estonia is to supply the country with high-quality fuels, electricity and heat and to ensure the optimal functioning and development of the fuel and energy sector. The main task is to reduce the negative environmental impact of energy sector, to enhance the efficiency of energy production and consumption, and to increase the use of renewable energy sources. Oil shale as a main natural resource ensures for Estonia the independence but has a negative impact on the environment.

Estonia ranks among the first ten EU countries with the primary energy production per capita. In 2008, the primary energy production in Estonia decreased mainly due to the fall in oil shale production used as a fuel in electricity production. At the same time, the production of shale oil increased — since 2000, it has been steadily increasing. Compared to 2007, 2% more shale oil was produced. In 2008, the production of electricity totalled to 10,581 GWh — 13% less compared to 2007. The fall in electricity generation was caused by 16% smaller exports. At the same time, the imports from Lithuania increased by about four times. Estonia has a long-time tradition of using hydro- and wind power. Since 2005, electricity production from renewable energy sources has increased. Compared to 2007, the wind energy production increased 43% and hydroenergy production nearly a third in 2008— both together still accounted for only 1.5% of the total electricity production.

Estonia is on the average level among the EU states with the generation of electricity per capita (7.4 MWh per capita).

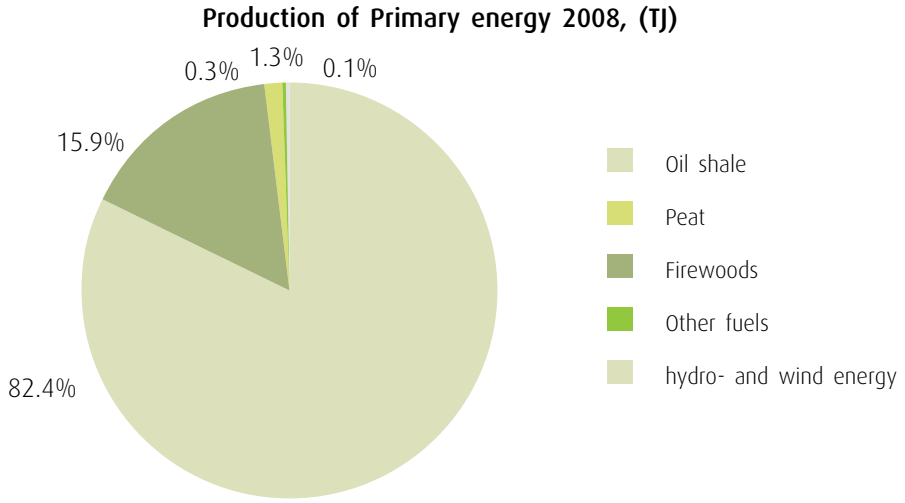


Figure 2.4 Production of Primary energy 2008 (TJ) by fuels
Source: Statistics Estonia

Oil shale, natural gas, and shale oil serve as the primary fuels for power plants. Compared to 2007, nearly a tenth less oil shale was used for electricity production in 2008. At the same time, the use of natural gas and shale oil did not change significantly.

Power plants continued the application of combined heat and power (CHP) generation, which is cleaner in terms of the environment. Combined heat and power plants can be operated on

the basis of different fuels, but at a stable thermal load. In 2008, there were 17 CHP plants in Estonia which gave 9% of electricity and 30% of heat energy.

There were no great changes in heat production in 2003–2007, but in 2008 the production of heat decreased by 9% due to a warmer winter.

	2004	2005	2006	2007	2008
Coal and coke, th tons	58	56	70	130	129
Oil shale, th tons	15,501	14,804	14,028	16,810	15,704
Peat, th tons	299	289	371	455	294
Peat briquette, th tons	15	14	12	13	17
Firewood**, 1000 m³ solid volume	3,463	3,584	3,229	3,325	3,294
Natural gas, mio m³	966	997	1009	1003	961
Liquefied gas, th tons	6	7	6	8	8
Heavy fuel oil, th tons	17	13	6	6	7
Shale oil, th tons	130	121	101	77	76
Light fuel oil, th tons	141	131	106	110	104
Diesel oil, th tons	417	447	480	528	500
Gas/Diesel oil, th tons	558	578	586	638	604
Motor gasoline, th tons	288	290	308	323	320
Aviation fuels, th tons	29	47	31	49	28
Shale oil gas, mio m³	0	0	0		0
Other fuels, 1000 tce	195	204	228	260	228

Table 2.3 Consumption of fuels
Source: Statistics Estonia

Energy taxation is a substantial source of revenue for the State. Electricity fuel excise, electric excise and other taxes related to fuels and energy production form annually more than 14% of all tax revenue. Electricity excise was levied for the first time in 2008. Electricity is taxed by excise which amounts to 3.2 euros per MWh.

Using renewable energy sources is subsidized in Estonia. For example, using fire wood or wind for producing electric energy is subsidized by 5.4 euro cents per kWh.

In 2006, a new 350 MW submarine cable was opened between Estonia and Finland which substantially extended energy trading possibilities. There are plans to build a new 650 Mw cable by 2014.

2.7. Transportation

The Estonian transport network consists of the infrastructure needed for road, rail, water and air traffic. The total length of national roads as at January 1, 2009, was 16,487 kilometers, i.e. 28.4% of the total length of the Estonian road network, which is 58,034 kilometers. 38,489 km were local and private roads accounting for 66.3% of the total road network. 9,922 kilometres of the national roads were paved and 6,565 kilometres were gravel roads. The density of the national roads is 380 km per 1,000 km^2 and the density of the entire registered road network is 1,336 km per 1,000 km^2 of the territory. The rail transport system in Estonia consists of about 1,200 kilometres of railway lines, of which 919 kilometres are currently in public use and 133 kilometres have been electrified.

Estonia has a very long coastline of 3,794 km as well as a dense port network. Port of Tallinn is one of the biggest ports in the region. There are 48 ports in the State Port Register with a maximum depth of over 17 meters.

Estonia has 12 airports with paved runways. In 2008, about 1.9 million passengers were served in Estonian airports. It is 6% more than in 2007 and also more than ever. Over 1.8 million passengers were served in Tallinn Airport in 2008.

Like in most European countries, mainly buses are used by the passengers using public transport in Estonia, followed by rail transport. In 2008, the bus transport performance was about 122 million passengers — 12% less than in 2007. Less passengers used city transport (buses, trams and trolley buses) compared to 2007.

	2004	2005	2006	2007	2008
Total	224976.5	209708.7	214235.6	212939	193378.8
Road transport (buses)	149582.8	139870.6	141587.5	139552.2	122434
..urban transport (buses)	114220.5	105216.1	107505	105451.6	91067.4
Electric transport	63730	57626	60027.3	60446.4	57898.1
Railway transport	5273.8	5154.7	5302	5442.3	5285.4
Sea transport	5408.2	5536.1	5851.2	6352.6	6952.2
Inland waterways transport	11.7	5.1	2.8	3.9	3.5

Tabel 2.4 Passenger transport by type of transport (thousands)
Source: Statistics Estonia

In 2008, 7.4 million passengers visited Estonian ports in international traffic. This is more than ever. Regardless of less regular sea trips performed by Estonian maritime enterprises, the number of passengers using ships increased also in 2008.

In 2008, 36.2 million tonnes of goods were transported through Estonian ports — nearly a fifth less than in 2007 and over a fourth less than in 2006. Nevertheless, Estonia stands out among the European Union Member States due to the quantity of loaded and unloaded goods (in tonnes) in ports per capita — in 2008, the relevant indicator amounted to 27 tonnes.

	2004	2005	2006	2007	2008
Total	**95.116**	**96.301**	**92.625**	**108.286**	**89.619**
Road transport	28.076	27.358	30.349	38.523	35.788
Railway transport	65.648	68.187	61.284	68.538	52.752
Public railway	43.327	44.926	45.068	36.966	26.237
Sea transport	1.388	751	987	1.221	1.077
Inland waterways transport	0	0	0	0	0
Air transport	4	5	5	4	2

Tabel 2.5 Transport of goods by type of transport (th tons)
Source: Statistics Estonia

Entered in the register	2004	2005	2006	2007	2008
Sea ships	133	123	126	120	119
Aircrafts	25	33	30	26	25
Passenger cars (th)	471.2	493.8	554	523.8	551.8
Lorries (th)	85.7	86.2	92.9	80.2	83.3

Table 2.6 Transport fleet
Source: Statistics Estonia

2.8. Industry

Estonia's economy is highly export-oriented. Manufacture of machinery and equipment, wood industry and manufacture of food and beverages have highest share in Estonian industry. Over the years, high-tech and knowledge intensive industries have been gaining a higher share in industrial production.

The stable growth in industrial output which was around 10% during the last years slightly decelerated compared with the previous year. The output volumes of the manufacturing industry have doubled during the last five years but the number of employees has stayed the same. Manufacture of electrical and communications equipment, metal industry, production of machinery and equipment and chemical industry have experienced a rapid growth. Food industry and wood industry have contributed the most to the sales growth of the manufacturing industry during the last five years. A considerable part of the production is exported; in 2008, 60% of the output was sold in foreign markets.

The production of manufacturing industry increased 12% in 2004 compared with 2003, but only 6% in 2007 compared with 2006. At the same time, the production of electric energy grew noticeably — in 2007, it was nearly 16% bigger compared with 2006. In 2007, the percentage of electricity sales increased by about three times compared with the total sale of industrial production to non-residents.

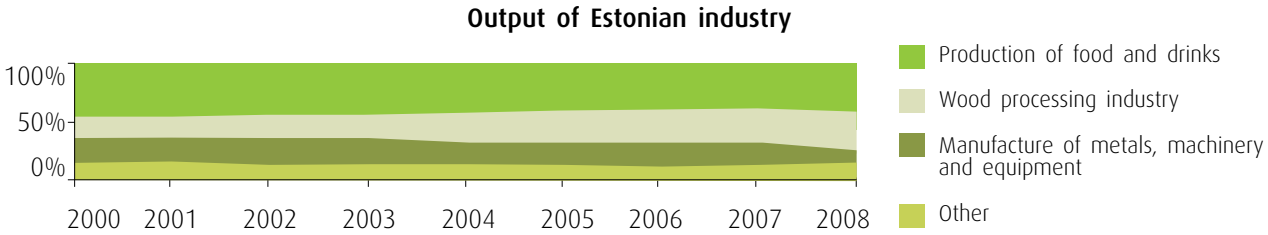


Figure 2.5 Share of Estonian industrial output
Source: Statistics Estonia

Machinery and metalworking sector makes up only 24% of manufacturing companies, it contributes 42% in total exports and 43% in total imports (2008). The most export-oriented subsector is machinery and mechanical appliances, which contributes 22% of total exports.

Estonia's wood processing industries - like other industrial sectors - underwent a rapid restructuring process in the early 1990s. The recovery has been sound and presently the share of wood processing in manufacturing industry is 18.9 %. In 2008, the sales of wood processing and furniture production companies totaled 1.4 billion EUR, accounting for 16.5% of the industrial sales of all Estonian manufacturing enterprises.

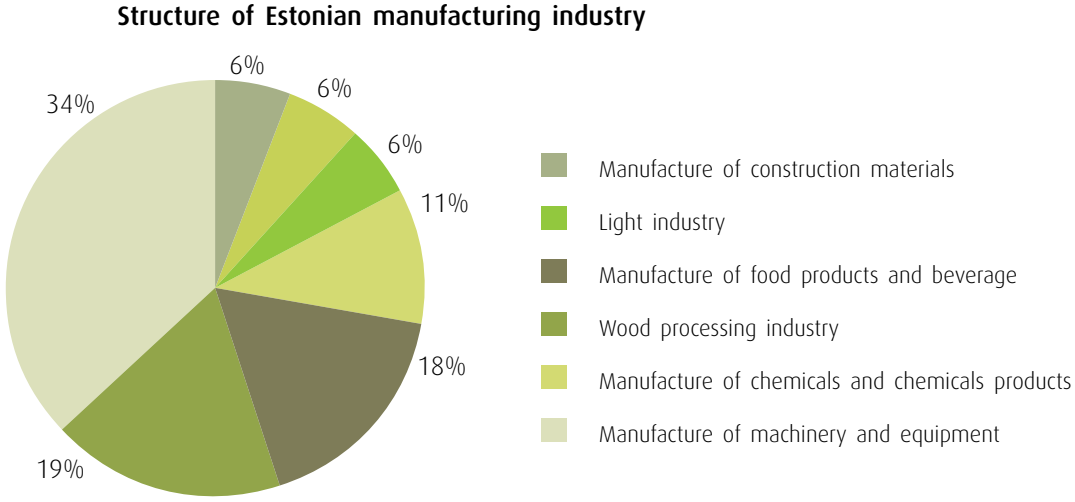


Figure 2.6 Structure of Estonian manufacturing industry 2008
Source: Statistics Estonia

The manufacture of electrical appliances and optical instruments has been one of the fastest developing industries in Estonia. Over the last six years, sales have grown by six times. Employment has doubled during the same period. The sector has adopted a strong orientation

to export markets; most of the larger enterprises are based on foreign capital. About 380 companies engage in the manufacture of electrical appliances and optical instruments.

2.9. Waste

The development of waste management in Estonia up to 2008 was based principally on the National Waste Management Plan approved by the Riigikogu (the Parliament) in 2002. The strategic targets and goals in this area have been established considering the common environmental policy of the EU and Estonia where the main objective is to prevent waste generation and to promote the recovery of waste, including reuse and recycling. In 2008, the Government of the Republic approved the new National Waste Management Plan, which establishes the main guiding principles of the waste management in Estonia up to 2013.

The most important of them have been the continuous reduction of the number of landfills non-compliant with the environmental requirements, increase of recovery rates of different waste categories, development of source separation and collection of municipal waste. The system of organized municipal waste transport and collection has allowed extending the waste management services to the countryside.

In 2007, a total of about 21.2 million tonnes of waste was generated in Estonia. In the years of economical growth, the trend of waste generation has generally been increasing. Also, during the years, the amount of annually generated municipal waste has been on the level of about 400 kg per habitant. In 2007, the total amount of the collected municipal waste was 570,000 t.

In 2003-2007, more than 80% of wastes were generated by industries, whereby 72% of the total waste generation happened in the oil-shale industry and energy production.

Considering together the municipal wastes and packaging wastes generated in the households, then the summary trend of generation is to some extent increasing – on the average of 3% per year. The separately collected waste fractions are paper and cardboard, then glass, metal and wood, also biodegradable food waste. The share of separately collected fractions has been formed about 11% of the total generation of municipal waste. Disposal of wastes on the landfills has substantially decreased. For the most part, only mixed municipal waste is disposed which is previously partially sorted by the waste generators or by the specific sorting facilities. Recovery of municipal waste has increased; organic recycling (composting) is one of most widely used recovery methods. Metal, paper and plastic wastes are recycled as a secondary raw material. Wood waste is used primarily as fuel.

The new Packaging Act of 2004 founded the basis for establishing a nationwide system for the collection and recovery of packaging waste. The rapid economic growth up to 2008 increased also the consumption and generation of packaging waste (162,000 t in 2007). The total recovery rate of packaging waste of 50% prescribed by the EU law was exceeded in

2006. The principle of "producer's responsibility" has been implemented since 2005 in the field of collection and treatment of WEEE.

Waste recovery has increased over the years, total recovery rate in the country was 32-37% in 2006-2007. Nearly 100% of wood processing waste is recovered. A considerable part of oil shale mining waste, construction and demolition waste (including excavated soil), waste generated in agriculture and dairy industry, metal waste, sewage sludge, garden and park waste is recovered as well.

Deposition of wastes on landfills has, nevertheless, been the main method of waste disposal in the country and will remain the predominant means also in the future as long as the intensive mining and use of oil-shale for energy and oil production will continue. The amount of oil-shale wastes disposed on landfills was in the given period in average 95%, taking into consideration the total waste disposed. Although the share of disposed waste in comparison with generated waste has decreased year-by-year e.g. from 69% in 2003 to 58% in 2007.

The requirements for the establishment, use, closure and aftercare of landfills are set forth by the EU Council Directive 1999/31/EU on landfills implemented in Estonia since 2001. A positive impact of this directive is, above all, the sharp decrease of landfills in Estonia during 2001-2009. While in 2000 there were still about 170 different functioning landfills, then in 2007 there were only 30 landfills in use. There are only 6 landfills for municipal and other non-hazardous waste in operation after July 16, 2009.

One of the biggest and nearest challenges in the field of municipal waste management in Estonia is the restriction of disposal of biodegradable waste on the landfills in accordance with the targets of the directive 1999/31/EU. It is important primarily from the viewpoint of minimization of GHG generation and climate change. According to the Estonian Waste Act, the content of biodegradable waste in the disposed municipal waste has to be less than 45% by weight from 16.07.2010, less than 30% from 16.07.2013 and less than 2% from 16.07.2020.

2.10. Building stock and urban structure

The settlement structure has been changing due to socio-economic changes in Estonia during the 1990-2000s. Tallinn acts as a magnet for the entire Estonia, while other towns Tartu, Pärnu and Jõhvi play the same role on the regional level. In the urban pattern, still highly concentrated districts of apartment houses dominate though the urban environment of the city centre is upgraded in major cities. The formation of urban sprawl along the seacoast and major roads constitutes one of the most characteristic features of the development of Tallinn as the city region has expanded within a radius of 50 km. Every third household lives in Tallinn or in the surroundings.

Estonia is relatively well stocked with housing as regards the number, but its quality and energy efficiency are very poor in comparison with the more developed EU member

states. In terms of the percentage of buildings' final energy consumption to the total energy consumption (% buildings/total) Estonia ranks third with 53.5% after Latvia and Hungary.

There were 638 200 dwellings in Estonia in 2007, with a majority of them, i.e. 96% being privately owned. The total floor area of inhabited dwellings was 38,760,000 m^2 and the average floor area per capita was 28.9 m^2. The average household had 2.3 members. Residential buildings are assumed to account for about 50-60% of the total housing stock. It estimated that there are 97,500 office, commercial, and industrial buildings. 1.11 dwellings per household indicates the result of restitution and the second home's problem. 66% of dwellings are situated in cities and towns, 34% in the countryside. Just 10% of all households live in farmhouses, 20% in terraced houses and majority, 71% in apartment buildings.

The massive share of apartment buildings in the housing stock, 61% of dwellings, resulted from the structure of construction activities in 1960-1990. 5-9 storey apartment blocks in the outskirts of cities as homogeneous districts dominate in the cityscapes. These apartment blocks are gradually reaching the end of their life as prescribed by the applicable standards. The 1990s saw a total collapse in construction volumes, which began to recover in the 2000s due to the booming economy. The 2000s were mostly characterised by the construction of single-family dwellings which caused an urban sprawl into the hinterland of major cities, in particular Tallinn metropolitan area, less in Tartu and Pärnu. More than 170 new residential settlements (each having at least five dwellings) were built in the Tallinn metropolitan area during 1991-2006. As a rule, these residential areas are physically as well as socially fragmented and lack a direct access to primary services in the residential area and public transport, which leads to commuting of residents, and the environmental impact of extensive mobility is substantial. The lack of technical and environmental infrastructure or temporary solutions is a serious climate change problem as well. Construction volumes of new buildings, being not too high in comparison to the Soviet years, were again hit by the global economic crises since 2008. Consequently, Estonian housing stock has been gradually deteriorating due to ageing over the past two decades.

The principal aims in the field of housing are stated in the Estonian National Housing Development Plan for 2008-2013. During the next decade, the need for reconstruction will go up by several times, more than 8,000 apartments, i.e. more than 350,000 m^2 annually in 2010-2014 due to the replacement of the outdated housing stock from the 1950s. Also, the issue of energy conservation of the Soviet era housing stock has come to the limelight with the transposition of the EU directive on the energy performance of buildings. According to experts, renovation of apartment buildings could yield an average energy saving of 20-30%, having a major impact on climate change policies. Due to the Nordic climate, buildings are heated for the greater part of the year, whereas the quality of insulation varies. Another area of national policies is to improve spatial planning for a comprehensive development of the urban environment. The development boom of the 2000s has led to *ad hoc* project-by-project planning, semi-chaotic and disconnected prevalance of detailed plans, in particular in peri-urban areas. Stronger comprehensive and thematic planning should smooth the badly located and energy inefficient outcomes of the new built environment.

2.11. Agriculture

The total area of Estonia is 45,227 km^2, including 43,200 km^2 of land area. More than a half of the land area is forest land, one third is agricultural land, and one fifth is covered by mires and bogs.

The value added, produced by agriculture and hunting, to the Estonian national economy in 2008 was about 248.36 million EUR, which constituted ca 1.7% of the total gross value added of all sectors. The primary sector is closely related to food industry. The gross value of food industry (including drinks and tobacco) was about 321,4 million EUR in 2008, which was 2.3% of the total gross value added of all sectors. There has been a decrease in the agricultural sector compared with 2004 when the respective figure was 2.3%, and a slight increase in food industry, where the share of gross value added in 2004 was 2.2%.

In 2007, based on the information of Farm Structure Survey (FSS), there were 23,336 agricultural holdings in Estonia. 94% of the total number of the agricultural holdings (21,889) belonged to private persons and 6% (1,447) to legal persons.

In 2007, 21.1% of the holdings specialised in crop production, 30.4% in livestock farming and the majority of holdings – 48.5% engaged in mixed production.

According to the FSS data from 2007, 7,301 agricultural holdings in Estonia exceed the threshold of the economic size (2 ESU - *European Size Unit*) defined for the purpose of the *Farm Accountancy Data Network* (FADN). According to FADN, the population of agricultural holdings covers 92.6% of the standard gross margin of Estonian agricultural production, 31.3% of the total number of agricultural holdings and 87.0% of the utilized agricultural area.

In 2008, there were 802,281 ha of utilized agricultural land in Estonia, including 74.5% under arable land, 24.5% under permanent grassland and 1% under permanent crops. 51.8% of the arable land (597,791 ha) is used for cereals production, 13.1% for industrial crops and 28.2% for green fodder. According to FSS 2007 data, the average land use share was: legal persons 48%, on the average of 315 ha per legal persons and private persons 52%, on the average of 21.5 ha per holding. Compared with FSS 2003, the average of number of hectares per legal persons has decreased almost by one third and per private persons increased 1.6 times.

In 2008, there were 237,9 th cattle, incl 100,4 th dairy cows, 364,9 th pigs, 78,2 th sheep and goats, 1757,3 th poultry in Estonia. Compared to 2004, the number of cattle has decreased 5% (including dairy cows 14%), number of pigs has grown 7%, the sheep herds are twice as big and poultry has decreased by one quarter.

According to FSS data from 2007, 54% of holdings with livestock farming raised cattle, 24% sheep and goats, 21% pigs, 60% poultry, and 17,5% bees. The main cattle raising area in Estonia is central Estonia. The sheep and goats are grown in the western and southern part of Estonia.

The crop output share was 38% and animal output 51%, the rest were agricultural services and non-agricultural inseparable secondary activities (11%).

2.12. Forest

Forest area and growing stock

According to the National Forest Inventory (NFI) of the 2007, the total forest land area of Estonia is 2,213,000 hectares, which represents approximately half of the country (Figure 2.7).

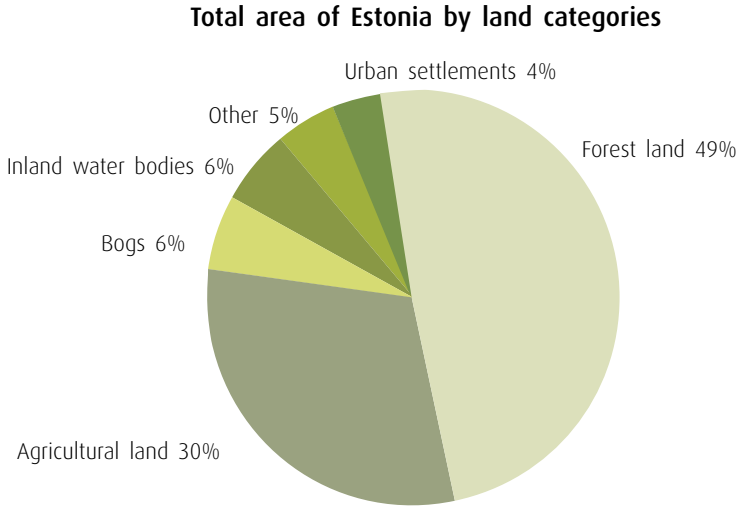


Figure 2.7 Total area of Estonia by land categories

According to the inventory of 2007, the supply of growing stock was 451 million cubic metres. Approximately 204 cubic metres of timber grow on every hectare of forested land. Moreover, 6.4 million cubic metres of timber grow in coppices and on grassland. There are 15 million cubic metres of standing dead trees and 13 million cubic metres of broken and fallen trees in forests. The annual increment of stands was 11.9 million cubic metres.

There are 1.7 hectares of forested land and 337 cubic metres of timber per capita in Estonia on average. Based on the total forested area (49%), Estonia is ranked fifth in Europe after Finland, Sweden, Slovenia and Latvia. By quantity of timber per capita, Estonia is only beaten by the forest-rich Scandinavian countries of Finland and Sweden.

Based on the geographical division of plants, Estonia primarily belongs to the northern area of the nemoral-coniferous or 'mixed forest' belt of the temperate zone of the North. The proportion of predominant deciduous tree and coniferous tree forests is more or less equal, comprising 52% and 48% of total stand area, respectively (Figure 2.8). According to the volume of growing stock, the proportions favour coniferous trees, which form 54% of the stock of growing forests. Deciduous trees make up 46%. The three most widespread tree

species are Scots pine, Norway spruce and birch. As predominant tree species, they account for 82% of the forested land and 76% of the stock of growing forest. The next three species are aspen, grey and black alder. These species form 16% of the area of forested land and 20% of the stock of growing forests. The proportion of other tree species is small.

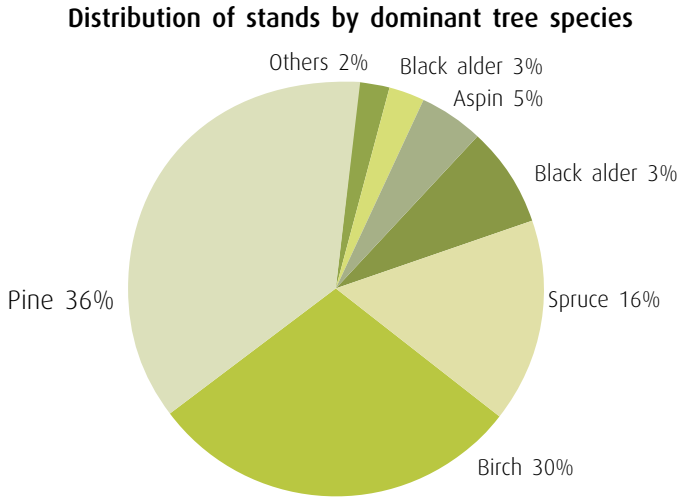


Figure 2.8 Distribution of stands by dominant tree species

In 2006, the proportion of wood and wood products formed 14.7% of the total industrial output of Estonia. In 2008, the value added by woodworking industry in current prices was 271 million EUR, which made up 1.9% of the total GDP value added. The structure of Estonia's forest-based industry consists of all of the main branches of the forest industry. The pulp and paper industry is, however, relatively small. The strongest sector of the Estonian industry is sawmilling.

In 2007, the total felling volume was 5.59 million m^3, 4.01 million m^3 of that was felled with regeneration fellings (incl. 3.82 million m^3 of clear felling) and 0.92 million m^3 with maintenance fellings (incl. 0.71 million m^3 of thinning).

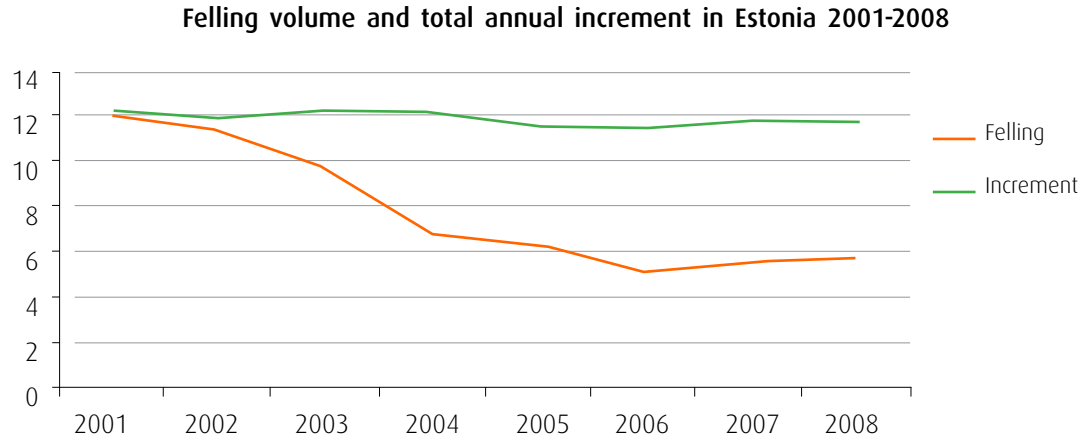


Figure 2.9 Felling volume and total increment in Estonia 2001-2008

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III GREENHOUSE GAS INVENTORY INFORMATION, INCLUDING INFORMATION ON NATIONAL SYSTEMS AND

3.1. Introduction

This chapter provides information on the national system for Estonia's greenhouse gas (GHG) inventory, taken from Estonia's GHG inventory submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in April 2009. It shows the trends in GHG emissions and removals by sinks in Estonia for the years 1990–2007.

The GHGs covered are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated gases – hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). Estimates of the emissions for nitrogen oxides (NO_x), carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs) and sulphur dioxide (SO_2) were also included in the inventory.

Estonia's base year for calculating the emissions of CO_2, CH_4 and N_2O is 1990, and the base year for the emissions of fluorinated gases is 1995.

3.2. Summary tables, trends in emissions

The trend in total emissions of GHGs in CO2-eq has been calculated using the IPCC Global Warming Potentials (GWP) for a time horizon of 100 years.

A summary of Estonia's national emissions and removals for 1990–2007 is presented in Figure 3.1. More detailed information on the emissions and removals by sector and gas can be found in the Common Reporting Format (CRF) tables (Summary 1.A, Summary 2 and Table 10) in Annex 1. In 2007 the total emissions of GHGs in CO_2-eq were 14 115.63 Gg and without Land Use, Land Use Change and Forestry (LULUCF) 22 018.68 Gg.

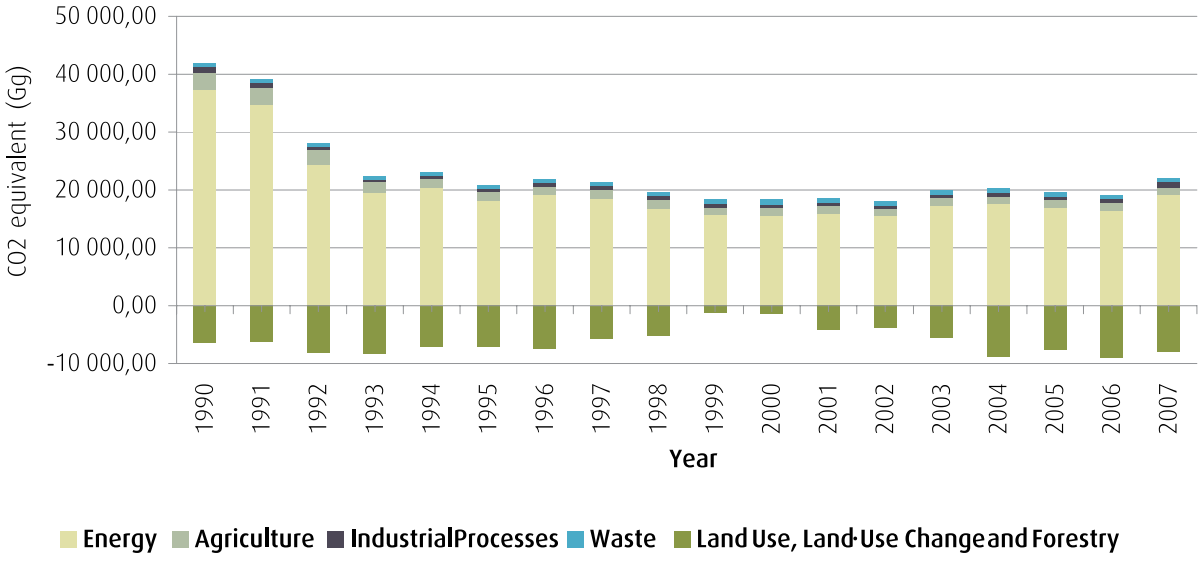

Figure 3.1. GHG emissions by sectors, 1990–2007 (Gg CO_2-eq)

Source: Estonia's National Inventory Report 1990–2007

From 1990 to 2007 the emissions decreased by 47.49%. This decrease was mainly caused by the transition from planned economy to market economy and the successful implementation of the necessary reforms.

In 2007, the most important GHG in Estonia was carbon dioxide (CO_2), contributing 86.71% of the total national GHG emissions expressed in CO_2-eq, followed by methane (CH_4), 7.83%, and nitrous oxide (N_2O), 4.79%. Fluorinated gases (the so-called "f-gases") account for about 0.66% of the total emissions (Figure 3.2). Energy sector accounted for 86.69% of the total GHG emissions, followed by agriculture (6.05%), industrial processes (4.09%) and waste (3.17%).

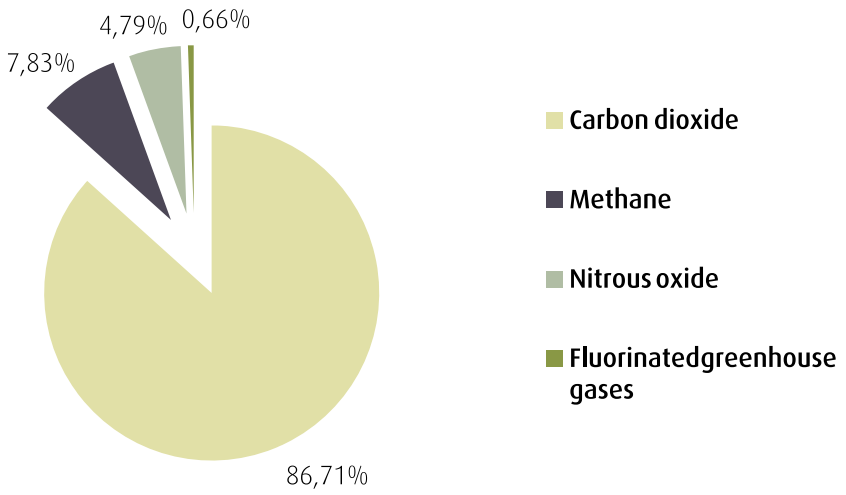

Figure 3.2. GHG emissions by gas, 2007
Source: Estonia's National Inventory Report 1990-2007

3.3. Emissions by sector

3.3.1. Energy

Estonia's emissions from energy sector are divided into the following emission categories: energy industries, manufacturing industries and construction, transport, other sectors and fugitive emissions from fuels. The share of emissions by category is presented in Figure 3.3.

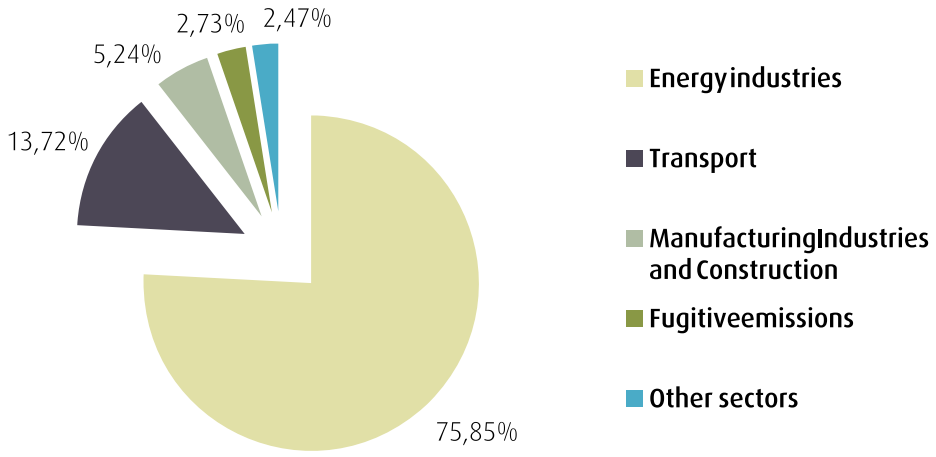

Figure 3.3. Emissions from energy sector, 2007
Source: Estonia's Greenhouse Gas Inventory 1990–2007

Energy sector is the main source of GHG emissions in Estonia. In 2007, the energy sector contributed 86.69% of the total emissions, totalling 19.09 Tg CO_2-eq. Most of the energy sector emissions, 97.3%, originated from fuel combustion (84.3% of the total GHG emissions in 2007) and only 2.7% were contributed by fugitive emissions. Energy-related CO_2 emissions varied mainly in relation to the economic trend, the energy supply structure and climate conditions.

Compared to the base year 1990, the emissions decreased by 48.8% (including: energy industries -51%; manufacturing industries -51%; transport -23% and other sectors -70%). This big decrease was caused by the structural changes in the economy after 1991 when Estonia became independent. There has been a drastic decrease in the consumption of fuels and energy in energy industries (closing of the factories), in agriculture (reorganisation and dissolution of collective farms), in transport (the proportion of new and environmentally friendly cars has increased; the number of agricultural machines has decreased), in households (energy saving), etc. The overall progression of GHGs in the energy sector in CO_2-eq is presented in Figure 3.4.

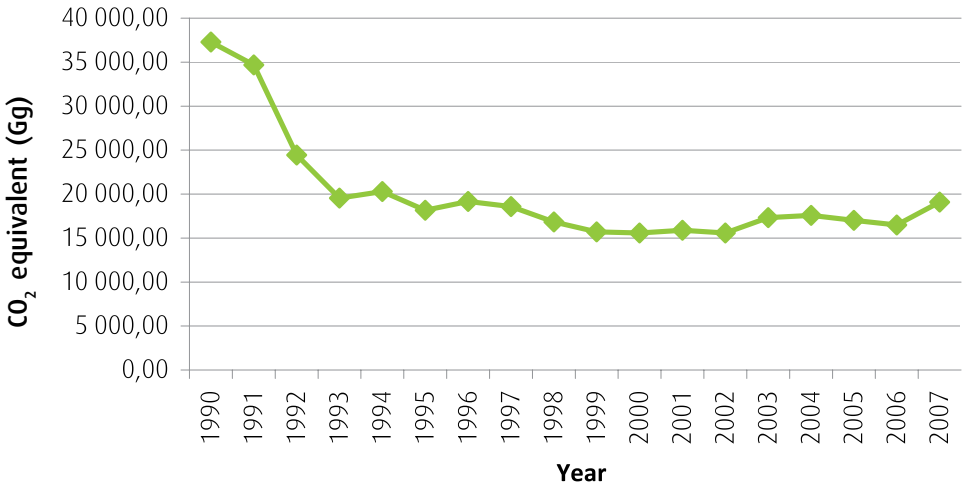

Figure 3.4. Emissions from the energy sector, 1990–2007 (Gg CO_2-eq)
Source: Estonia's National Inventory Report 1990–2007

The predominant part of the primary energy utilised in Estonia is of domestic origin. Imported fuels (natural gas, fuel oils, coal, motor fuels and liquid gas) accounted for up to 33% of the fuels utilised in 2007. The share of renewable energy in total consumption was about 10%, of which wood fuels formed the main part and the part of the other sources remained at 0.4%. From the energy of primary fuels (240 PJ) 45% was used for electricity production, 16% for heat production, 15% for the production of secondary fuels, about 3% as raw material in industry and 21% for immediate final consumption (the rest of the energy used for final consumption was converted to energy).

In 2007 the fuel contribution for electricity and heat production was the following: 73% oil shale, 13.9% natural gas, 4.3% wood, 3.5% oil shale gas, 2% shale oil, 1.4% peat and 1.5%.

In 2007 the primary energy production increased mainly due to the growth in oil shale production resulting from the increase in the proportion of oil shale used as a fuel in electricity production. The production of shale oil has been increasing continuously since 2000. Compared to 2006, 12% more shale oil was produced. More than half of the production was exported - mainly to the Netherlands, Finland, Denmark and Latvia.

3.3.2. Industrial processes

Estonia's emissions from industrial processes sector are divided into the following emission categories: mineral products, chemical industry, consumption of halocarbons and SF_6 and other production. Under 'mineral products' Estonia reports emissions from cement production and lime production. Emissions from ammonia production are reported under 'chemical industry'. The category 'consumption of halocarbons and SF_6'covers the emissions of f-gases from refrigeration and air conditioning, foam blowing, aerosols and electrical equipment, as well as some smaller sources, such as fire extinguishers and other. Under 'other production' Estonia reports NMVOC emissions from the pulp and paper and food industries. The share of emissions by category is presented in Figure 3.5.

The categories 'iron and steel production' and 'glass production' are under investigation and the data will be presented in the 2010 national GHG inventory.

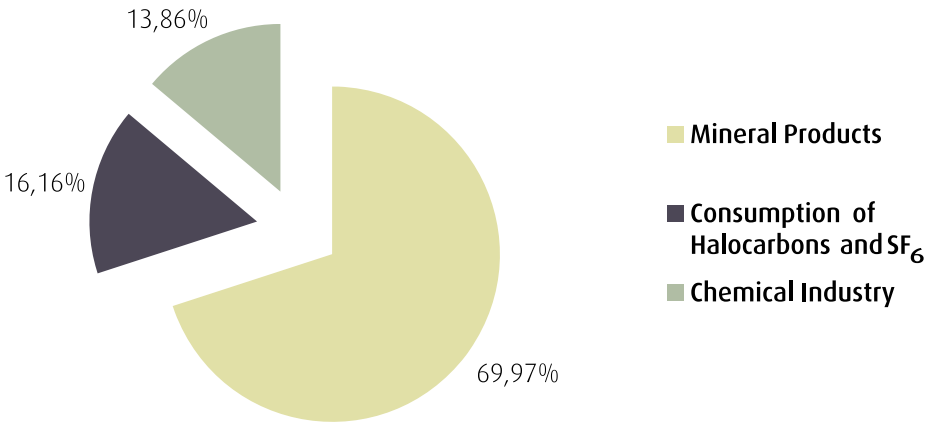

Figure 3.5. Emissions from industrial processes sector, 2007
Source: Estonia's National Inventory Report 1990–2007

Industrial GHG emissions contribute 4.09% of the total GHG emissions in Estonia, totalling 901.17 Gg CO_2-eq. The most important GHG emissions from industrial processes in Estonia's inventory in 2007 are the CO_2 emissions from the cement, ammonia and lime production with 2.7%, 0.57% and 0.16% respectively, and HFC emissions from refrigeration and air conditioning equipment and foam blowing which account for 0.49% and 0.15% of the total GHG emissions, respectively. F-gas emissions comprised altogether about 0.66% of the total GHG emissions in Estonia.

Industrial CO_2 emissions have decreased considerably since 1990, reaching the lowest level in 1993. The decrease in the emissions during the early 1990s was caused by the transition from planned economy to market economy after 1991 when Estonia became independent. This led to lower emissions in industrial production, and to an overall decrease in the emissions from industrial processes between 1991 and 1993. In 1994 the economy began to recover and production increased. The decrease in emissions in 2002 and 2003 was caused by the decrease in ammonia production, because the only existing ammonia factory was being reconstructed. The sudden increase in emissions in 2007 is mainly caused by the increase of cement production, as the only cement factory AS Kunda Nordic Cement renovated its third kiln. The overall progression of GHGs in the industrial processes sector in CO_2-eq is presented in Figure 3.6.

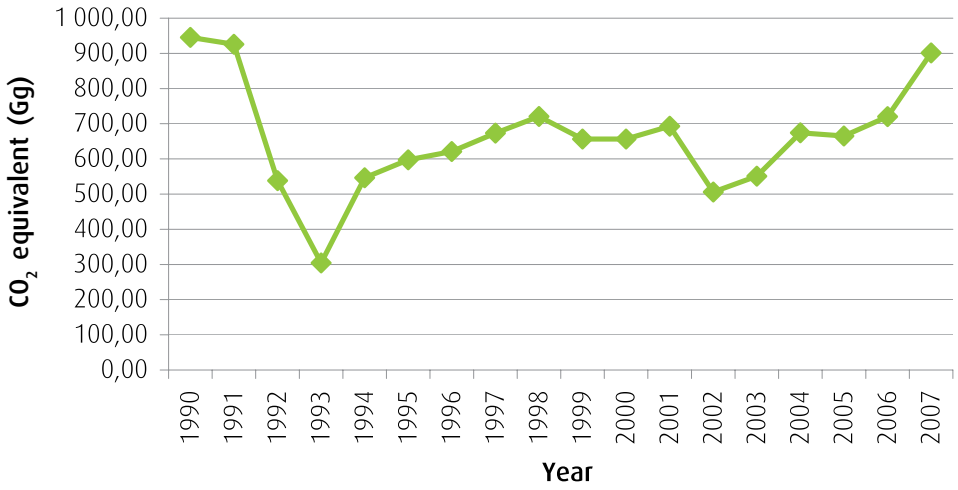

Figure 3.6. Emissions from the industrial processes sector, 1990–2007 (Gg CO_2-eq)
Source: Estonia's National Inventory Report 1990–2007

The total emissions of f-gases have increased significantly since 1995, especially HFC emissions from refrigeration and air-conditioning equipment, which is the major source of halocarbons in Estonia. A key driver behind the growing emission trend in refrigeration and air conditioning sector has been the substitution of ozone depleting substances with HFCs. The second largest source is foam blowing which shows relatively steady increase of emissions throughout the years, except two major decreases. In 2001 one of the two big Estonian producers of one-component foam replaced HFC-134a with HFC-152a, with the other producer following suit in 2007. Due to the much lower GWP of HFC-152a the emissions decreased suddenly in the subsequent years.

3.3.3. Agriculture

Agricultural GHG emissions in Estonia consist of CH_4 emissions from the enteric fermentation of domestic livestock (for 14 sub-categories of livestock) and CH_4 and N_2O emissions from manure management systems, and direct and indirect N_2O emissions from agricultural soils. Direct N_2O emissions include emissions from synthetic fertilizers, emissions from animal waste and sludge applied to agricultural soil; from the cropping of N-fixing crops; emissions from crop residues and the cultivation of organic soils. Indirect N_2O emissions include emissions from atmospheric deposition, and leaching and run-off. The share of emissions by category is presented in Figure 3.7.

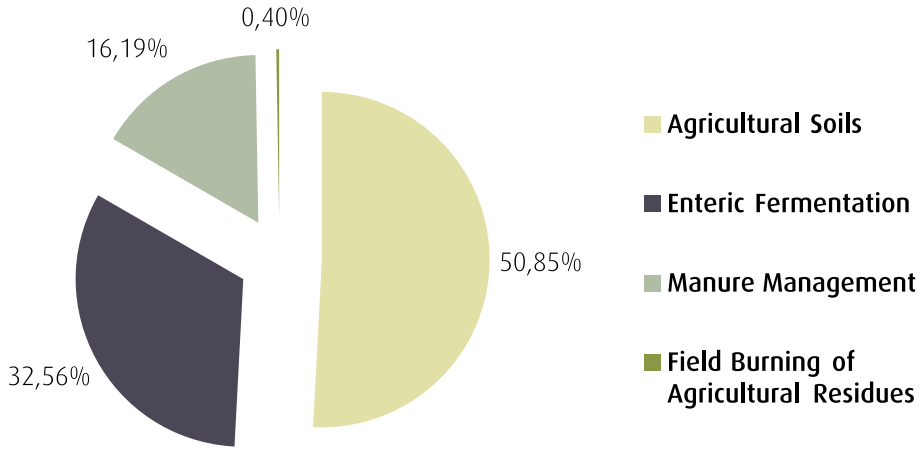

Figure 3.7. Emissions from the agricultural sector, 2007
Source: Estonia's National Inventory Report 1990–2007

In 2007 the agriculture sector contributed 6.05% of the total emissions, totalling 1333.09 Gg CO2-eq. Emissions from the enteric fermentation of livestock and direct emissions from agricultural soils contributed the main share of the total emissions from the agricultural sector.

Emissions from agricultural sector have declined 2.3-fold compared to the base year, mostly due to the decreasing livestock population and the quantities of synthetic fertilizers and manure applied to agricultural fields. The overall progression of GHGs in the agriculture sector in CO_2-eq is presented in Figure 3.8.

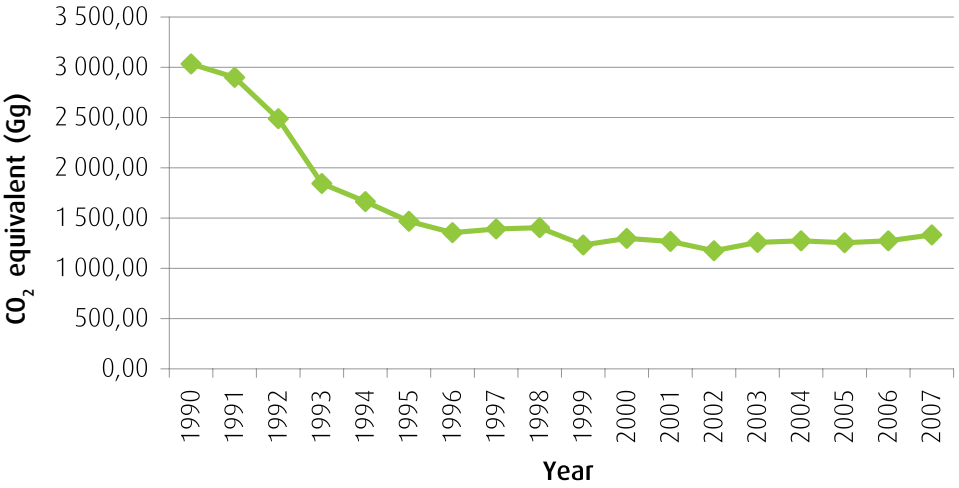

Figure 3.8. Emissions from the agriculture sector, 1990–2007 (Gg CO_2-eq)
Source: Estonia's National Inventory Report 1990–2007

The CH_4 emissions from enteric fermentation and manure management and N_2O emissions from animal manure applied to agricultural soils have decreased because of the drop in livestock population. The total number of swine decreased 2.3-fold, horses – 1.6-fold and poultry – 4.4-fold. The number of dairy cattle decreased 2.7-fold: from 280.7 thousand to 103 thousand, and the number of non-dairy cattle decreased from 477 thousand in 1990 to 137.9 thousand in 2007. The number of sheep decreased 1.9-fold and the number of goats increased from 0.9 thousand to 4 thousand from 1990 to 2007.

The decline in the N_2O emissions from synthetic fertilizers applied to soils was due to the decrease in the quantities of synthetic fertilizers applied to agricultural soils.

3.3.4. LULUCF

The LULUCF sector plays an important role in Estonian carbon cycle.

Estonia's emissions from the LULUCF sector are divided into the following emission categories: forest land, cropland, grassland, wetlands and other lands.

In 2007 the LULUCF sector acted as a CO_2 sink, totalling 7903.05 Gg CO_2-eq. The LULUCF sector in Estonia has been a net sink during the whole reporting period 1990–2007 as the removals in the sector exceed the emissions. The main sink of CO_2 in Estonia is forest land. Reported net CO_2 removals in the LULUCF sector increased by 24.10% between 1990 and 2007. Land use has changed in recent decades. The area covered by forest has increased from 38% in 1970 to 49% in 2007 (increase: 491 thousand hectares). The rise has taken place mostly due to the abandonment of grassland areas and the overgrowing of wetlands. The areas of grasslands and wetlands decreased by 142 and 198 thousand hectares respectively.

The total net CO_2 removals from LULUCF in 1990–2007 are presented in Figure 3.9. The sharp decreases in 1999 and 2000 are explained by the sharp increase in the forest felling in these years.

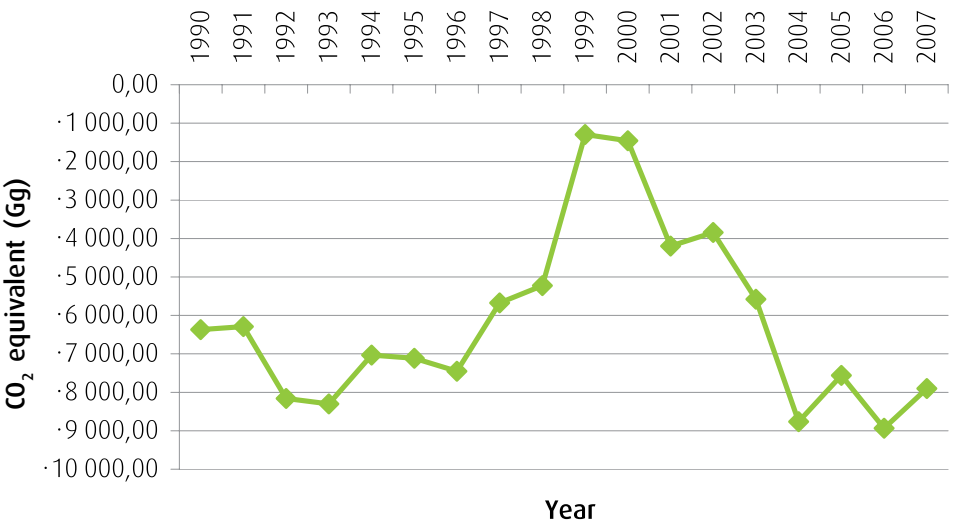

Figure 3.9. Removals from the LULUCF sector, 1990–2007 (Gg CO_2-eq)
Source: Estonia's National Inventory Report 1990–2007

3.3.5. Waste

Estonia's emissions from waste include CH_4 emissions from solid waste disposal sites including solid municipal and industrial wastes, domestic and industrial sludge. The waste sector covers GHG emissions from waste incineration and composting. The N_2O emissions from sludge application in agriculture are reported in the agriculture sector. The share of emissions by category is presented in Figure 3.10.

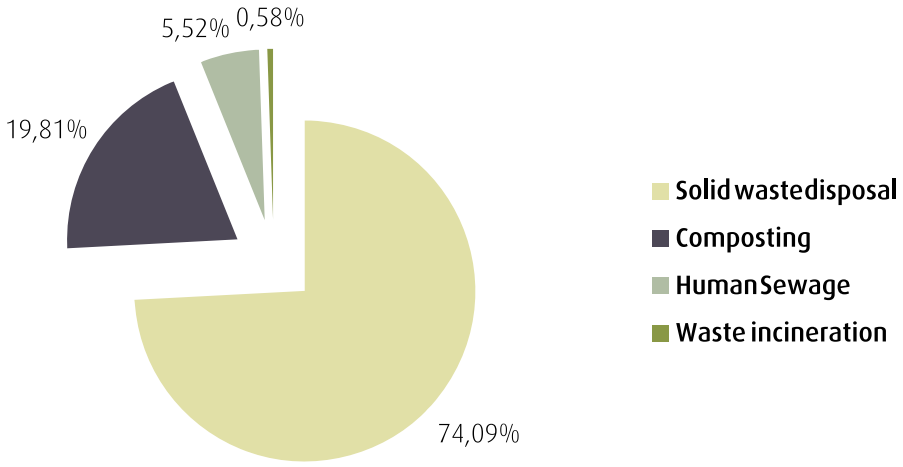

Figure 3.10. Emissions from the waste sector, 2007
Source: Estonia's National Inventory Report 1990–2007

In 2007 the waste sector contributed 3.17% of the total emissions, totalling 697 Gg CO_2-eq. CH_4 emissions from landfilled solid waste and CH_4 and N_2O emissions from composting processes were the most significant emissions of the waste sector in Estonia in 2007.

The total emissions in CO_2-eq from the waste sector increased negligibly – by 3.8% compared to the base year: the emissions from landfilled solid waste decreased by 14% while the emissions from waste composting processes increased more than 100-fold – from 1.26 Gg in 1990 to 138 Gg in 2007. The overall progression of GHGs in the waste sector in CO_2-eq is presented in Figure 3.11.

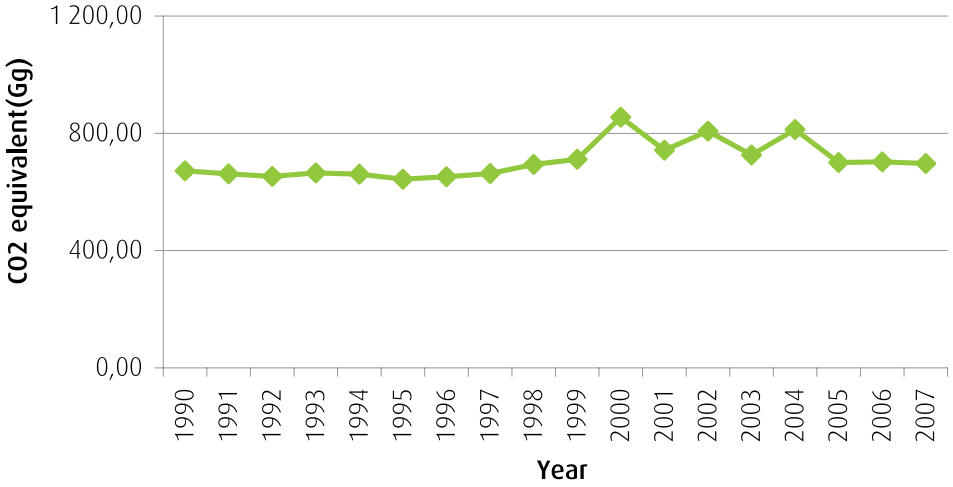

Figure 3.11. Emissions from the waste sector, 1990–2007 (Gg CO_2-eq)
Source: Estonia's National Inventory Report 1990–2007

In 2007, 21 million tons of waste was generated in Estonia. About 65% of the waste was generated by the oil shale industry.

3.4. National systems in accordance with Article 5, paragraph 1, of the Kyoto Protocol

The single national entity with the overall responsibility for the Estonian GHG inventory is the Ministry of the Environment (MoE)

Narva mnt 7a
15172 Tallinn
Estonia

The contact in MoE with the overall responsibility for the national system is

Ms. Karin Radiko
Adviser of the Climate and Radiation Department
Tel. +372 626 2977
Fax. +372 626 2801
Karin.Radiko@envir.ee

The inventory is produced in the collaboration between MoE, Estonian Environment Information Centre (EEIC), Tallinn University of Technology (TUT) and Estonian Environmental Research Centre (EERC).

In accordance with § 117 of the Ambient Air Protection Act (RT I 2004, 43,298; 2007, 19, 95), the activities for the reduction of climate change are organised by MoE on the basis of the requirements for the restriction of the limit values of GHG emissions provided by UNFCCC and its Kyoto Protocol.

EEIC works under the jurisdiction of MoE and in accordance with its Statute (RTL 2004, 1, 3), the Climate and Ozone Bureau deals with the implementation of climate change legislation. The responsibilities of MoE and EEIC concerning the GHG inventory are regulated by the Directive of the Minister of the Environment.

MoE is responsible for coordinating the overall inventory preparation process; approving the inventory before its official submission to UNFCCC; concluding the formal agreements with inventory compilers annually by 1st of July (TUT, EERC, etc); coordinating the cooperative work between the inventory compilers and UNFCCC; informing the inventory compilers of the requirements of the national system and ensuring that the information available in national institutions is taken into consideration and used in the inventory where appropriate; and coordinating the UNFCCC inventory reviews.

The Climate and Ozone Bureau in EEIC is responsible for compiling the National Inventory Report (NIR) according to the parts submitted by the inventory compilers; reporting the GHG inventory to UNFCCC, including the NIR and CRF tables; coordinating the quality assurance and quality control

(QA/QC) plan; preparing the UNFCCC inventory reviews; and coordinating the communication with the expert review team, including the responses to the review findings and overall archiving system. Official inventory submissions are made available to the public on the EEIC website www.keskkonnainfo.ee.

The Department of Thermal Engineering and the Department of Chemistry at TUT prepare the estimates for the energy, agriculture, waste and LULUCF sectors. EERC is responsible for the industrial processes sector together with the fluorinated gases estimates, which were prepared during the Twinning project EE05-IB-EN-01 "Enhancing the capacity to reduce the emissions of fluorinated GHGs in Estonia" (twinning partner Germany). Starting from 2010, the submission of the waste sector will be performed by the EERC.

MoE signs the annual agreements with TUT and EERC. Through these agreements, the institutions are collecting inventory data, calculating the emissions for their specific sector and are committed to implement the QA/QC and archiving procedures, documentation, making information available for review, and delivering data and information in a timely manner to meet the deadline for reporting to the European Commission (EC) and UNFCCC.

The four core institutions: MoE, EEIC, EERC and TUT work together to fulfil the requirements for the national system. An overview of the allocation of responsibilities is presented in Figure 3.12.

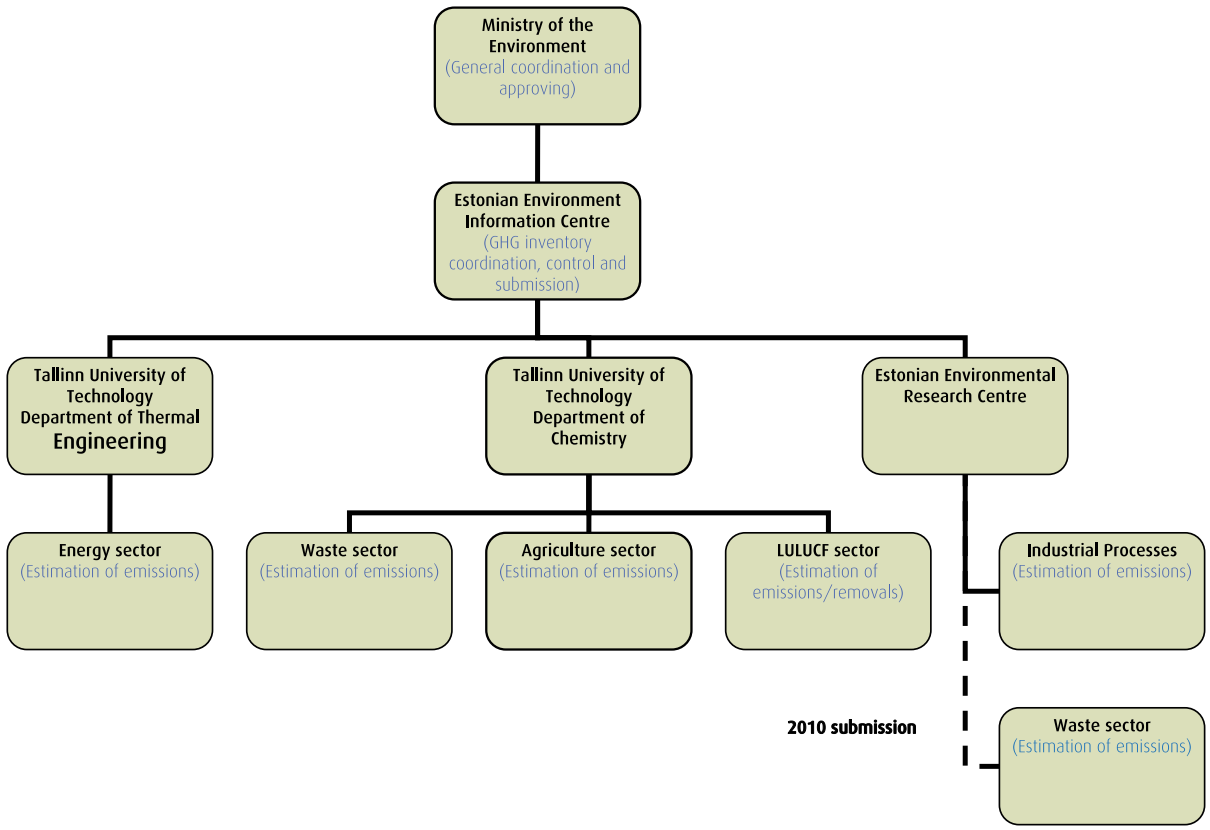

Figure 3.12. National System for GHG inventory in Estonia
Source: National Greenhouse Gas Inventory System in Estonia

The National System is designed and operated to ensure the transparency, comparability, completeness, accuracy and timeliness of GHG emission inventories. The methodologies, activity data

collection and the choice of emission factors are consistent with the guidance in the Revised 1996 IPCC Guidelines and the IPCC good practice guidance reports. The main sources of data are the Statistical Yearbooks and other publications issued by Statistics Estonia. Additional data for the preparation of the inventory is obtained from different companies (plant specific data), EEIC, Estonian Animal Recording Centre, via questionnaires, etc.

The objective of Estonia's GHG inventory is to comply with the requirements, principles and elements of UNFCCC, Kyoto Protocol, IPCC guidelines and the European Union (EU) GHG monitoring mechanism. The general QA/QC procedures applied to all categories follow the IPCC Good Practice Guidance.

QA/QC procedures

All institutions involved in the inventory process (MoE, EEIC; TUT and EERC) are responsible for implementing the QC procedures to meet the data quality objectives. MoE as a national entity is responsible for overall QC and is in charge of checking on an annual basis that the appropriate QC procedures are implemented internally in TUT, EERC and EEIC. EEIC as the quality coordinator has an overall responsibility for coordinating and implementing the QA/QC plan. EEIC checks the QC reports of TUT and EERC performed by sectoral experts, and the QA report performed by an independent expert from TUT.

The quality coordinator steers and facilitates the QA/QC process, and the experts of all calculation sectors implement and document the QA/QC procedures. The inventory meetings with participants from all institutes participating in the inventory preparation are held four times a year and the bilateral quality meetings between the quality coordinator (EEIC) and the expert organizations are held whenever necessary.

As part of the general QC procedures, it is good practice to document and archive all information required to produce the national emissions inventory estimates. EEIC bears the responsibility of archiving and Estonia's central inventory archive is located there.

All data collected and reported by the institutions involved in the inventory process is reviewed by an independent expert from TUT. Also a public review is carried out annually. The draft NIR is uploaded to the EEIC website www.keskkonnainfo.ee where all interested parties have an opportunity to comment on it.

One part of QA is the UNFCCC reviews. The reviews are performed by a team of experts (sectoral experts and a generalist) from other countries. They examine the data and methods used in Estonia, check the documentation, archiving system and the national system. In conclusion they report whether Estonia's overall performance is in accordance with the current guidelines. The review report points out the specific areas where the inventory is in need for improvements.

Estonia also had a Twinning Light project EE06-IB-TWP-ENV-06 "Improving the quality of Estonia's National Greenhouse Gas Inventory" with Finland in 2009. The project was directed at improving the implementation of article 3.1 of Decision No 280/2004/EC of the European Parliament and of the

Council of 11 February 2004 concerning a mechanism for monitoring Community GHG emissions and for implementing the Kyoto Protocol.

During this project all five sectors (energy, industrial processes (except F-gases), agriculture, waste and LULUCF) were analysed. Terms of reference were elaborated in order to develop a single national IT system to facilitate GHG emission data handling, calculation and reporting. Concept and suggestions were developed to improve the QA/QC procedures and the uncertainty management of Estonia's GHG inventory.

A brief description of the process of inventory preparation

UNFCCC, the Kyoto Protocol and the EU GHG monitoring mechanism require Estonia to submit NIR and CRF tables annually. The annual submission contains emission estimates for the year before the previous one, so that the 2009 submission contains estimates for the calendar year 2007. The organisations preparing and reporting Estonia's GHG inventory and their duties are described above. The expert organisations involved in the inventory system are in charge of the inventory data for the different reporting sectors and producing emission estimates according to contracts with MoE and according to the UNFCCC guidelines. EEIC compiles national reports from the data produced by expert organisations and submits them to the UNFCCC Secretariat and to EC. The reports are approved by MoE before their official submission. The preparation of the annual inventory follows the schedule of the reporting stated in the QA/QC plan. Within the EU monitoring mechanism the annual inventory is submitted to the EC by 15 January. The Member States may complement and update their submission by 15 March. The GHG inventory is submitted to the UNFCCC Secretariat by 15 April.

A more detailed description of Estonia's national system, the methodologies, activity data and emission factor sources, key source identification results and the process for recalculation is presented in Estonia's NIR which is available on the UNFCCC website.

3.5. National registry

The name and contact information of the registry administrator designated by Estonia to maintain the national registry

Estonian Environment Information Centre
Mustamäe tee 33
10 616
Tallinn
Estonia
Tel. +372 6 737 577
Fax: +372 6 737 599
E-mail: info@ic.envir.ee

Information on other Parties with which Estonia cooperates by maintaining their respective registries in a consolidated system

Since October 2008 Estonia's national registry is linked through International Transaction Log (ITL) to other European Union Emission Trading System (EU ETS*)* registries and to non-EU ETS registries[1].

The description of the database structure used in the national registry

EEIC is responsible for operating the national registry. The national registry administrator in the Climate and Ozone Bureau acts as the first-level helpdesk for the users of Estonia's national registry. The registry data-centre (hard- and software, also technical support for infrastructure and networking) is geographically located in Finland and maintained by a hosting company that is responsible for the daily support and operation of the system.

Since 2005 Estonia has been using the Greenhouse Gas Registry for Emission Trading Arrangements (GRETA) registry software developed by United Kingdom. The latest available versions of the software have been used in both test and production environments of the national registry. The GRETA registry software is installed in the MS SQL server 2000 standard edition. Web Service support is provided by MS.NET.

The national registry has around 80 active accounts and 200 users.

As of November 2009, Estonia is in the process of changing its national registry software from GRETA to Community Registry software.

A description of how the national registry conforms to the technical standards for the purpose of ensuring the accurate, transparent and efficient exchange of data between national registries, the clean development registry and the independent transaction log

1 The European Commission, Member States and the Secretariat of UNFCCC established the live connection between the Community Independent Transaction Log, the UNFCCC ITL and Member State registries on 16 October 2008. http://unfccc.int/files/press/news_room/press_releases_and_advisories/application/pdf/20081014_press_release_itl_citl.pdf

Estonia's national registry is operating in accordance with the EC Regulation No 2216/2004 for a standardised and secured system of registries pursuant to Directive 2003/87/EC of the European Parliament and of the Council and Decision No 280/2004/EC of the European Parliament and of the Council[2].

All EU Member States registries under EU ETS have to comply with the Data Exchange Standards specified for the Kyoto Protocol. Estonia's registry system has been tested successfully with the ITL and Community Independent Transaction Log (CITL) and has live connections with both Transaction Logs[3].

In autumn 2008 Estonia successfully passed the Annex H testing for national registry set out in Data Exchange Standards (DES) under the Kyoto Protocol. The national registry has fulfilled all requirements regarding its conformity with the DES. These requirements include adequate transaction procedures, adequate security measures to prevent and resolve unauthorised manipulation, and adequate measures for data storage and registry recovery. The registry is therefore deemed fully compliant with the registry requirements defined in decision 13/CMP.1 and 5/CMP.1.

An overview of the security measures employed in the national registry to prevent unauthorised manipulation and operator error, and of how these measures are kept up to date

The security measures employed in Estonia's national registry to deter unauthorised manipulation and minimise operator errors are:

- Access to the national registry can be obtained only with a username and password;
- The actions that a user can perform are controlled by a permissions system, hence preventing unauthorised access to restricted actions;
- All performed actions are recorded;
- The registry requires the validation of all user input to ensure that only valid details are submitted for processing;
- Database manipulation is carried out only by protected, internally stored procedures which are not accessible directly from the user interface and can only be invoked by the institution's internal web-services.

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

2 Updated with Commission Regulation (EC) No 916/2007 of 31 July 2007 and with Commission Regulation (EC) No 994/2008 of 8 October 2008

3 Data available at: http://unfccc.int/files/press/news_room/press_releases_and_advisories/application/pdf/20081014_press_release_itl_citl.pdf

In order to minimise discrepancies between the national registry and the Transaction Logs, the following approach has been adopted for the registry system development under the EU ETS:

- Communication between the national registry and the ITL shall go through web-services using XML messages – as specified in the UNFCCC DES document. These web-services, XML message format and the processing sequence shall be used as specified in the UNFCCC DES document;

- To the fullest extent possible, the national registry shall validate data entries against the list of checks that are performed by the ITL – as documented in Annex E of the UNFCCC DES Annexes document – before forwarding the request to the ITL for processing. This helps to minimise sending incorrect information to the ITL for approval;

- All units that are involved in a transaction shall be earmarked internally within the national registry, thereby preventing the units from being involved in another transaction until a response has been received from the ITL and the current transaction has been completed;

- The web-service that sends the message to the ITL for processing shall ensure that a confirmation is received from the ITL before completing the submission of the message. If no confirmation is received following a number of retries, the web-service shall terminate the submission and reverse any changes made to the unit blocks involved;

- If a 24-hour clean-up message is received from the ITL, the existing web-service shall reverse any pending transactions in the units involved, thereby preventing any discrepancies in the unit blocks between the national registry and the ITL;

- Finally, if an unforeseen failure were to occur, the data discrepancies between the national registry and the ITL can be corrected via a manual intervention function within the national registry's user interface. Following this, reconciliation will be performed to validate that the data is synchronised between the national registry and the ITL.

A list of the information publicly accessible through the user interface of the national registry

All publicly accessible information is available on the national registry website http://khgregister.envir.ee under the public reports link.

An explanation of how to access information through the user interface of the national registry

Publicly accessible information is available at http://khgregister.envir.ee as described above. Access to the more restricted/detailed information (e.g. account holdings, transactions, etc) requires user authentication.

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

A detailed plan of the actions taken in the event of a disaster for national registry was submitted to UNFCCC prior to the Go-Live in 2008[4]. In general, any single database failure would be detected and the national registry would automatically switch over to the information from the remaining "correct" databases. If necessary, an off-site disaster recovery site is used. Data is archived once every 24 hours and if the main site has become inoperable, the off-site will be used in the case of disaster recovery. Reconciliation with ITL will follow, and manual intervention processes – in order to check for any inconsistencies that may exist in the national registry – will be conducted to restore the necessary data.

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

To demonstrate the ability of the national registry to perform the processes required under the EU ETS and UNFCCC requirements, test cases are based mainly on prior work including:

- The EC Regulation No 2216/2004 – the document contains the detailed specifications of the technical aspects of EU ETS, including the details of the Web Services Description Language and the definitions of the process flows to be tested;
- The Data Exchange Standards for Registry Systems (the latest version validated or agreed-upon by ITL) under the Kyoto Protocol – the document contains the description of the processes, transaction types and supplementary transaction types applicable to the national registry.

A testing plan has been validated by the national registry administrator (all test cases in compliance with requirements) and testing has been conducted for the purpose of verifying that the requirements set out in the UNFCCC and EC Data Exchange Standards have been implemented properly. A summary of the test results (including the executed test plan and other related log files from the database) has been sent shortly after the testing to the concerned parties.

References

Estonia's National Inventory Report 1990-2007. 2009, Tallinn, Ministry of the Environment;

National Greenhouse Gas Inventory System in Estonia. 2009, Tallinn, Ministry of the Environment.

4 General summary available: http://unfccc.int/resource/docs/2007/irr/est.pdf

IV POLICIES AND MEASURES

4.1. Policy-making process

The policy on environment related issues is discussed at a wider level but approved, as a rule, at national level: the major documents are either passed by the Parliament (Riigikogu) or adopted by the Government. The relevant measures can be taken at national and/or local level. In Estonia the Parliament (Riigikogu) is the highest legislative body.

The Government of the Republic of Estonia is the supreme executive body and the Ministry of the Environment – the highest executive body responsible for carrying out the national environmental policy.

The State Chancellery's main mission is to support the Government and the Prime Minister in policy drafting and implementation. The Strategy Office supports planning the work of the Government and coordinates the drawing up and carrying out of the Government's action plan, as well as strategic development plans. The Department of Legislative Drafting makes sure that the draft legislation of the Government of the Republic complies with the Constitution and laws. The function of the European Union Secretariat (a division of the State Chancellery) is to coordinate the development of Estonia's positions on issues relating to the European Union (EU) and the transposition of EU legislation.

Regarding international relations in general, the Ministry of Foreign Affairs has an important role. Issues related to the environment and energy are among the responsibilities of the 4th Division (Energy and Environment) in the External Economic and Development Cooperation Department.

As a rule, new national environmental legislation is initiated by the Government or by the Ministry of the Environment. In some aspects, the initiative can come from the Ministry of Economic Affairs and Communications or from the Ministry of Agriculture.

The Ministry of the Environment (MoE) comprises sixteen departments, including Environmental Management and Technology, Forestry, Waste, Strategy and Investment Planning departments. The jurisdictional structure of MoE includes several subordinated entities:

- five state authorities (incl. Environmental Research Centre, State Forest Management Centre, Private Forest Union, etc.);
- eight state-owned companies and commercial enterprises;
- three governmental authorities: Land Board, Environmental Inspectorate, Environmental Board.

The Environmental Board is a new institution started on 1 February 2009. The Environmental Board was established, merging the functions of three previous bodies: State Nature Conservation Centre, Radiation Centre and the departments of environmental services. The Environmental Board includes six subdivisions in regions covering all 15 counties of Estonia and implementing national environmental, nature protection, forest and fisheries programmes and action plans at regional level.

Some aspects having impact on the environment and climate are in the scope of the responsibilities of other ministries. The Ministry of Economic Affairs and Communications (MoEAC) is responsible for energy related issues, including energy efficiency and conservation, also for the use of renewable sources in the energy sector. The Ministry of Agriculture advises the Government in the field of agriculture and rural life. Some responsibilities of the Ministry of Finance include matters important for environmental management – taxation, use of state budget funds, etc. All ministries are in charge of national development plans and programmes.

The responsibilities of the Ministry of the Interior (MI) include environment and energy related tasks related to handling and solving crises. The functions of the Crisis Management Department of the MI include developing and organizing the implementation of a state crisis management policy based on the Emergency Preparedness Act; organizing the work of the Crisis Management Committee of the Government; coordinating nationwide training in the area of crisis management; and coordinating the crisis management related activities of the institutions in the MI's area of government.

Up to now, there is no energy agency or any institution with similar functions in Estonia. In September 2009, it was decided to establish an energy and climate agency subordinated to the MoEAC. The main tasks of the planned institution would be:

- analyzing and surveying energy and climate related activities;
- promoting sustainable development with relevant supporting investments.

According to the current plans, the agency should be launched before the end of 2009.

There has been an increase in the number of NGOs which deal with environmental problems and raise public awareness of matters related to the environment and sustainable development. Several NGOs have taken active part in the preparation of environment related development plans.

During the period elapsed since Estonia regained its independence, a great progress has been made in developing the legislation. Estonian legal acts were amended in the process of integration with the EU, and today Estonian legislation, including the legislation on environmental management, is harmonized with the *acquis communautaire* of the EU.

According to §5 of the Constitution of the Republic of Estonia the natural wealth and resources of Estonia must be used economically, and §53 prescribes that everyone has a duty to preserve the human and natural environment and to compensate for the damage inflicted on the environment.

It is important to emphasize that §123 of the Constitution stipulates that if the laws or other legislation of Estonia are in conflict with international treaties ratified by Riigikogu, the provisions of the international treaty shall prevail.

Estonia does not have effective system for monitoring and evaluation of climate change related policies and measures. Also procedures in case non-compliance are missing under domestic law.

4.2. Legislation, strategy documents and programmes

4.2.1. International agreements and conventions, EU legislation

Since regaining its independence Estonia has concluded a great number of bilateral or trilateral environmental agreements and has become a party to many environmental conventions and protocols. The conventions Estonia has acceded include: Arhus (1998), Espoo (1991), Helsinki (1992), Geneva (1979), New York (1992), Rio de Janeiro (1992), Vienna (1985), Washington (1973), etc. Regarding ozone layer depletion: Vienna (1985), Montreal (1987), London (1990) and Copenhagen (1992) amendments, etc.

Estonia signed the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) on 3 December 1998, the Protocol was ratified by the Estonian Parliament in September 2002. According to the Protocol, during 2008–2012 Estonia has to reduce the GHG emissions by 8% in comparison with the 1990 level. The obligation to reduce GHG emissions established in the Kyoto Protocol has already been achieved in Estonia as a result of the significant re-organization of economic sectors, particularly of energy production but also of industry and agriculture, i.e. as a result of the qualitative and quantitative restructuring of the whole economy, mainly at the beginning of 1990s.

At present, the Estonian environment related legislation is harmonized with the relevant *acquis* of the EU. There are only some exceptions. For example, regarding large combustion plants (Directive 2001/80/EC), emissions from large oil shale firing power plants have to be fully compliant with EU requirements by 1 January 2016.

There are several EU legal acts that have direct or indirect impact on climate change. The directive on the promotion of electricity produced from renewable energy sources in the internal electricity market (2001/77/EC) sets for Estonia the indicative share (5.1%) of electricity produced from renewable energy sources in total electricity consumption to be achieved by 2010. The directive on the promotion of the use of biofuels or other renewable fuels for transport (2003/30/EC) stipulates the minimum percentage of biofuels and other renewable fuels that the member states should place on their markets, setting national indicative targets to that effect. A reference value for these targets shall be 5.75% by 31 December 2010.

The purpose of Directive 2006/32/EC is to enhance the cost-effective improvement of energy end-use efficiency in the EU member states by providing the necessary indicative targets as well as mechanisms, incentives and institutional, financial and legal frameworks to remove the existing market barriers and imperfections that impede the efficient end use of energy. The directive stipulates that all member states have to adopt and aim to achieve an overall national indicative energy savings target of 9% for the ninth year of application of the directive, to be reached by way of energy services and other energy efficiency improvement measures.

In December 2008 the European Parliament adopted a set of legislative documents (the so-called EU climate and energy package) for transforming Europe gradually into a low-carbon

economy and for increasing energy security. An agreement has been reached on legally binding targets, by 2020:

- to cut GHG emissions by 20%,
- to establish a 20% share for renewable energy in final energy consumption, and
- to improve energy efficiency by 20%.

Regarding the reduction of GHG emissions, the package contains an offer to go further and commit to a 30% cut in the event of a satisfactory international agreement being reached.

Directive 2009/28/EC sets legally binding targets for each EU member state, in order to reach the EU aggregated target of a 20% share of renewable energy by 2020. It creates cooperation mechanisms for achieving the targets in a cost effective way. Several administrative barriers and other burdens will be removed, confirming the 10% target for renewables in transport, and biofuels sustainability criteria are fixed to ensure that only those biofuels are supported that have no negative environmental impact. The directive also has implications for small-scale emitters in sectors such as transport, buildings, agriculture and waste. By 2020, emissions from these areas are to be reduced by an average of 10% compared to 2005, divided between member states according to differences in GDP per capita. National targets were set for member states, together with a linear legally binding trajectory for the period 2013–2020 with annual monitoring and compliance checks.

Directive 2009/31/EC establishes a legal framework for the environmentally safe geological storage of carbon dioxide (CO_2) to contribute to the fight against climate change.

Directive 2009/30/EC provides a set of binding targets for the emissions from the fleet of new cars which is an important tool for meeting emission targets in the non-ETS sectors. The directive sets targets to ensure that emissions from the new car fleet are reduced to an average of 120 g CO_2/km. The long-term target is set to 95 g CO_2/km to be reached by 2020.

Decision 406/2009/EC lays down the minimum contribution of EU member states to meeting the GHG emission reduction commitment of the Community for the period from 2013 to 2020 for GHG emissions covered by this decision, and rules on making these contributions and for the evaluation thereof. Here, Estonia is among the 12 member states with an allowed increase of GHG emissions by 2020 (see Table 4.1). The decision provides that a member state with a positive limit (i.e. an increase of GHG emissions allowed) shall ensure that its GHG emissions in 2013 do not exceed a level defined by a linear trajectory, starting in 2009, on its average annual GHG emissions during 2008, 2009 and 2010.

The main climate and energy related targets set in various legal acts of the EU for Estonia are listed in Table 4.1.

Indicator	Act	Target
Share of renewables based electricity in gross electricity use	Directive 2001/77/EC	5.1% (by 2010)
Share of renewables in energy end-use	Directive 2009/28/EC	25% (by 2020)
Share of renewables in the fuel use of transport	Directive 2003/30/EC	5.75% (by 2011)
	Directive 2009/28/EC	10% (by 2020)
Saving on energy end-use	Directive 2006/32/EC	9% (by 2016)
Limit for GHG emissions (compared to 2005)	Decision 406/2009/EC	+11% (by 2020)

Table 4.1. Energy and climate related quantitative targets in EU legal acts for Estonia

All requirements and provisions of the new EU climate and energy package have been taken into account upon preparing the latest national strategy documents in Estonia described in the following sections.

4.2.2. Strategy documents

The *Estonian National Strategy on Sustainable Development – Sustainable Estonia 21* is the most general national strategy document aimed at developing the Estonian state and society in the time frame until the year 2030, integrating the economical factors with the principles of sustainable development. The strategy was compiled under the coordination of the Estonian Ministry of the Environment (MoE) in close cooperation with experts and stakeholders from various fields, and its approval was preceded by a thorough public discussion. The strategy document was approved by the Parliament (Riigikogu) in 2005. Among the four main goals of the strategy there is one that requires sustaining the ecological balance in all planned activities. The following items are indicated as sub-goals of the aim to achieve an ecological balance:

- the use of natural resources in a way and in the amounts that ensure maintaining the ecological balance;
- the reduction of pollution;
- the preservation of biological diversity and natural areas.

The national strategy is based on the *Sustainable Development Act*[1], adopted by the Parliament in 1995, which establishes, first and foremost, the principles for the sustainable use of the natural environment and natural resources. No separate plan has been compiled to implement the National Strategy on Sustainable Development as the strategy is being implemented through different sectoral strategies and development plans.

1 Texts of all Estonian legal acts are available (in Estonian) on the website of the *State Gazette* (Official Journal): www.riigiteataja.ee.

More concrete long-term objectives related to environmental development are formulated in the *National Environmental Strategy until 2030* that was endorsed by the Parliament in February 2007. Also in February 2007, the Government of Estonia approved the *Environmental Action Plan for 2007–2013* prepared by the Ministry of the Environment. The plan identifies the basic activities that help to achieve the goals set in the longer-term environmental strategy. Among other items, the plan establishes measures for the reduction of waste generation, for balancing the use of forests, for eliminating the use of substances depleting the ozone layer, for developing an environment-friendly and comfortable public transport system, etc. The plan includes both EU-oriented and national activities initiated for reducing environmental impact of the energy sector and eliminating residual pollution. The estimated implementation costs of the action plan valid until the year 2013 amount to more than 100 billion EEK (6391 MEUR). The funds come mainly from various EU foundations, as well as from the state, local governments and companies. The action plan is planned to be reviewed in three years and, if necessary, to be upgraded then.

The Environmental Action Plan has been prepared for the years 2007–2013. During that period, thorough monitoring must be carried out twice – in 2010 (the monitoring period 2007–2009) and in 2013 (the monitoring period 2010–2012), i.e. every 3 years. The second monitoring report must be prepared by 1 March 2013, as the data contained in that report need to be used in the process of updating the plan.

It has to be emphasized that the Regulation of the Government No. 302 (13 December 2005) *The types of strategic development plans and the procedure for drafting, amending, evaluating and reporting on their implementation* stipulates that all strategic development plans for increasing the country's competitiveness and for sustainable development shall be taken as a basis when compiling sectoral development plans.

4.2.3. Legislation

The *Sustainable Development Act* prescribes the principles of sustainable development, thus serving as a basis for all environment related legislation and relevant national programmes. Therefore, the legal acts regulating the energy, industrial and transport sectors, i.e. sectors that are the most important in relation to greenhouse gases, usually take into account major environmental issues. Several aspects of the environmental legislation are stipulated in the form of the Government and minister regulations.

The *Electricity Market Act* regulates the generation, transmission, sale, export, import and transit of electricity and the economic and technical management of the power system. Regarding the planning for the development of the electricity sector it is stipulated in the Act that every three years, the Ministry of Economic Affairs and Communications has to prepare a development plan for the electricity sector and submit it to the Government for approval. This plan also has to include environmental protection aspects.

The *Liquid Fuel Act* prescribes the quality requirements for liquid fuel and the mechanisms for controlling fuel enterprises. The environmental requirements for fuel quality have become gradually more stringent and are stipulated by the regulations of the Minister of Economic Affairs and Communications.

The *District Heating Act* regulates the activities related to heat production, distribution and sale in district heating networks and terms for the connection to the network. The Act provides also that in order to increase energy efficiency, to preserve the quality of the environment and to use natural resources rationally, the Government has to approve an energy conservation (efficiency) programme accompanied with the related action plan.

Regarding other laws related to energy and environment the Energy Efficiency of Equipment Act should be pointed out. In compliance with the EU requirements the Act regulates the requirements for the energy efficiency and energy labelling of certain types of household appliances (refrigerators, washing machines, electric ovens, etc.), heating equipment and installations as well as provides the bases of and the procedure for their conformity assessment and attestation in order to increase energy efficiency.

Due to the large share of buildings in total energy use the improvement of energy efficiency in residential and tertiary sectors has an important role also from the emission reduction aspect. Here the impact of the EU Directive 2002/91/EC on the energy performance of buildings (EPBD) has to be pointed out. In Estonia, the transposition and implementation of the EPBD is the responsibility of the Ministry of Economic Affairs and Communications. The provisions of the EPBD have been transposed into the Building Act and the Energy Efficiency of Equipment Act. Several detailed requirements were enforced using acts of secondary legislation. The most important secondary level act is the regulation (No. 258 of 20 December 2007) of the Government on the Minimum Requirements for Energy Performance of Buildings. The regulation transposes articles 3–6 of the EPBD, and applies to new buildings as well as the existing ones undergoing major renovation. Since 1 January 2009 the regulation (No. 107 of 17 December 2008) providing the format and issuance procedures for the energy performance certificate of buildings is in force. On 19 January 2009 another regulation (No. 194 of 30 December 2008) related to energy performance certificates entered into force. The regulation provides a list of the types of buildings where the certificate must be placed in a prominent place clearly visible to the public. Regarding the experts performing energy audits and/or issuing relevant certificates, the Building Act provides that only registered legal persons can issue the energy certificate or perform the energy auditing of buildings. The Estonian Technical Surveillance Authority has the authority to carry out the quality control of energy audits and building energy certificates. As for the training of experts, the Ministry of Economic Affairs and Communications initiated a project "Development of energy audit practices" in 2007. The project was funded by the EU Transition Facility. In 2007 the professional standards for energy auditors and energy certification specialists were elaborated and a training programme developed for the training course of energy auditors. The pilot training courses were carried out in 2008 and the first energy auditors were certified in October 2008. Several rounds of training have already been carried out. The aggregated

energy saving effect from the introduction of energy performance requirements for new and renovated buildings has yet to be calculated or estimated. According to the opinion of experts the impact may be high.

The *Ambient Air Protection Act* regulates the activities which discharge emission of pollutants into the ambient air, as well as damage to the ozone layer and the appearance of factors causing climate change. The Act provides main principles for the control of ambient air quality, sets basis for emission standards, foresees measures for the reduction of air pollution, etc. The main objective of the Act is to maintain the quality of the ambient air in areas where the quality of the air is good, and to improve the quality of the ambient air in areas where the quality of the air does not conform to the requirements. The Act stipulates that the activities for the reduction of climate change have to be organised by the MoE. The Act also provides that the possessors of pollution sources must take additional measures to reduce the emission levels of carbon dioxide and other GHG. The major environment related provisions of the EU are transposed into the legislation of Estonia using this Act. A number of secondary level legal acts have been issued on the basis of this Act.

The *Environmental Monitoring Act* provides the requirements for the organization of environmental monitoring, the procedure for processing and storing the obtained data, and the relations between the persons carrying out environmental monitoring and the owners or possessors of immovables. Environmental monitoring is defined as the continuous observation of the state of the environment and the factors affecting it, with the main purpose of predicting the changes in the state of the environment and obtaining data for programmes and plans and for the preparation of relevant development plans.

The *Environmental Register Act* provides the basis for the entry of data regarding natural resources, natural heritage, the state of the environment and environmental factors in the environmental register, for the retention of data in the register and for the processing and release of the data.

The *Environmental Impact Assessment and Environmental Management System Act* provides the legal basis and procedure for the assessment of likely environmental impact, the organization of eco-management and audit scheme. The Act also forms legal bases for awarding the eco-label in order to prevent environmental damage, and establishes liability for the violation of the requirements of the Act. It also transposes the provisions of five relevant EU directives. The act specifies the procedure and principles of environmental impact assessment; strategic assessment in particular is regulated in detail. Strategic environmental assessment is mandatory in the case of national, county and local plans and programmes.

The *Environmental Supervision Act* defines the nature of environmental supervision and establishes the rights and obligations of persons and agencies who exercise environmental supervision, the rights and obligations of persons and agencies which are subject to environmental supervision, and the procedures for supervisory operations.

For a more effective implementation of the "polluter pays" principle and a more efficient reaction to environmental damage the *Environmental Liability Act* was passed by the Parliament in November 2007. This act specifies the regulations for the prevention and correction of environmental damage, ensuring the restoration of the environment by those who have caused the damage.

The *Integrated Pollution Prevention and Control Act* determines the environmentally hazardous activities and lays down the bases for the integrated prevention and control of pollution arising from such activities, in order to prevent or reduce the harmful effect of human activity on the environment. The Act transposes the provisions of Directive 96/61/EC.

As for the impact on the environment, the *Organic Farming Act* is important among the legislation regulating the agricultural sector. A number of secondary legislative acts have been issued on the basis of this act for regulating various aspects of organic farming.

The *Forest Act* regulates the management of forests as a renewable natural resource. The Act provides the legal bases for forest survey, forest planning and forest management. It prescribes the obligation to prepare a forestry development plan at least every ten years.

The new *Waste Act* provides the general requirements for preventing waste generation and the health and environmental hazards arising therefrom. It also prescribes the organization of the waste management with the objective of reducing the harmfulness and quantity of waste.

4.2.4. Joint implementation and international emission trading

According to the National GHG Inventories Estonia's emissions have decreased significantly between 1990 and 1993. Since then the annual emissions have stayed approximately 50% below the 1990 level. That gives a clear indication that Estonia does not have problems with meeting its Kyoto target. "National Programme for reducing GHG emissions for the years 2003–2012" is the only programme in which reaching the Kyoto target serves as the main objective. As the programme was developed in 2002 it does not contain up to date information and so far no research for analyzing the implementation of the programme has been carried out. The text of the programme, like other legislative documents, is published in the State Gazette (Official Journal) and is also available (free of charge) at the homepage of the State Gazette – www.riigiteataja.ee.

Estonia is using two out of the three Kyoto flexible mechanisms – Joint Implementation and International Emissions Trading. Not having problems with achieving the Kyoto target, Estonia is acting as a seller within both mechanisms. The Clean Development Mechanism is not used as Estonia is not a developing country.

The legal entities participating in the flexible mechanisms under the Kyoto protocol are the Ministry of the Environment as the Focal Point and the Estonian Environment Information Centre as the administrator of the National Register.

4.2.4.1. Joint implementation

In 1993 Estonia started cooperation with Sweden in projects preceding Joint Implementation – Activities Implemented Jointly – where no actual emission reductions were transferred. Altogether 21 projects were implemented. Information on these projects is available on the UNFCCC website.

Since 2002, Estonia has been active in carrying out joint implementation (JI) projects under the Kyoto flexible mechanisms. JI and Clean Development Mechanisms as Kyoto flexible mechanisms and their relation to the EU Emission Trading Scheme and the National Register are regulated with the Ambient Air Protection Act.

Since May 2006 the Minister of the Environment has been designated by the Government to sign international agreements for JI projects. The Designated National Focal Point for Joint Implementation is the Ministry of the Environment. The implementing agency for JI is the Climate and Ozone Bureau in the Estonian Environment Information Centre (EEIC). The website of EEIC is used to publish information on JI projects. Guidelines for the procedure and implementation of the JI projects in Estonia are available on the UNFCCC website. By Dec. 2009, five JI projects have been registered in UNFCCC as Track 1 projects. Estonia meets all the eligibility requirements for using Track 1 and as the procedure is faster and more flexible, most of the investor countries have indicated their interest in using Track 1 procedure instead of Track 2.

Estonia has signed a memorandum of understanding for JI projects with Austria, Denmark, Finland, the Netherlands, and Sweden. Also, Estonia has signed the Agreement on a Testing Ground for Application of the Kyoto Mechanisms on Energy Projects in the Baltic Sea Region. Parties to the agreement (Denmark, Estonia, Finland, Germany, Iceland, Latvia, Lithuania, Norway, Poland, Russia and Sweden) agreed to establish a Testing Ground for the Baltic Sea Region to gain experience from and facilitate the use of JI under Article 6 and Emissions Trading under Article 17 of the Kyoto Protocol and to implement projects generating emission reductions prior to and during the commitment period commencing in 2008, in order to reduce anthropogenic emissions of GHG cost-effectively.

Estonia has seven early mover projects that started generating emission reductions before 2008 and for those years Assigned Amount Units (AAUs) will be transferred to the investor countries. During the commitment period 2008–2012 all projects will generate Emission Reduction Units (ERUs). Execution of JI projects brings additional investments to Estonia in the form of technology and knowledge. So far JI projects have been implemented in cooperation with Finland, Austria, Sweden and the Nordic Environment Finance Corporation as the Fund Manager for the Testing Ground Facility.

By Dec. 2009, eight projects have been approved and implemented, resulting in a total emission reduction of 1.47 Mt CO2 -eq. by 2012 (see Table 4.2).

Project	Emission reductions, t CO2- eq.
Tamsalu (biomass)	32.406
Kadrina (biomass)	46.100
Paide (biomass)	100.000
Saaremaa (biogas)	88.605
Virtsu III (wind)	90.935
Esivere and Virtsu II (wind)	265.070
Viru-Nigula (wind)	393.934
Pakri (wind)	450.257
Total	**1.467.307**

Table 4.2. Emission reduction from JI projects in Estonia (2002-2012)

4.2.4.2. International emission trading

Regarding the activities under Kyoto Protocol, in August 2009 the Government decided to sell excess Assigned Amount Units through Green Investment Scheme. Special working group with participants from the Ministry of the Environment, the Ministry of Finance, the Ministry of Foreign Affairs and the Ministry of Economic Affairs and Communications was created for conducting negotiations with possible buyers. Agreements shall be approved by the Government and signed by the Minister of the Environment.

4.2.5. Information on activities under Articles 3.3 and 3.4

The Ministry of the Environment is responsible for implementing the activities under Articles 3.3 and 3.4.

A study regarding the availability of the data required for estimating carbon flows under Article 3.3 was carried out in Estonia. However, until now Estonia does not have quantitative estimates of the projected anthropogenic GHG emissions and removals from forestry under Article 3.3 of the Kyoto Protocol during the commitment period. Currently the Ministry of Environment is developing system of calculation GHG from forests.

4.3. Policies and measures

4.3.1. Cross-cutting measures

4.3.1.1. National programmes

The improvement of energy efficiency can be considered as a goal of increasing the priority of the Government. A new *National Energy Efficiency Programme for 2007–2013* has been prepared, through which investments will be made in energy efficiency, relevant information will be made more widely available and consumers will be informed about energy saving options. The Programme is one of the documents prepared for implementation of the *National Long-term Development Plan for the Fuel and Energy Sector Until 2015*[2] that was approved by the Government of the Republic in December 2004. The Energy Efficiency Programme determines the areas that need to be prioritised in order to meet fuel and energy saving goals. The Programme also sets strategic aims and objectives for priority areas, as well as the measures

for achieving these objectives. It also takes into account the task of achieving the indicative energy efficiency objective set by Directive 2006/32/EC, i.e. saving 9% on energy end-use during the period of 2008–2016.

The main objectives of the Programme are:

- disseminating energy efficiency related information;
- improving the availability of skills and experts;
- increasing the efficiency of the consumption, production and transfer of fuels and energy;
- performing the tasks arising from the EU energy efficiency policy.

It is estimated in the Programme that a total of 1.5 billion EEK (96.0 MEUR) is needed during the period up to 2013 for investments aimed at increasing efficiency in the fields of consumption, production and transfer of fuels and energy.

In Estonia, oil shale is the main indigenous fuel, therefore to ensure its long-term balanced use the Government initiated in 2006 the preparation of the *National Development Plan for the Use of Oil Shale 2007–2015*, specifying the plans for the use of oil shale as a nationally strategic domestic energy resource. These plans also include an assessment of the use of shale fuel oil and oil shale gas, taking into account economic, social, security and environmental issues. In the Plan, the upper limit on the amount of annual mining of oil shale has been set at 20 million tons with the intention of reducing it to 15 million tons by 2015. The Plan was endorsed by the Parliament in October 2008.

For carrying out measures foreseen in national programmes and plans the financing from state budget has been combined with international assistance. After Estonia's accession to

2 By now replaced with the new plan – *National Development Plan for the Energy Sector until 2020.*

the European Union the *Estonian National Development Plan for the Implementation of the EU Structural Funds – Single Programming Document for 2004–2006* (SPD) served as a basis for the common activities of Estonia and the EU in promoting Estonia's social and economic development. Energy related measures were included into the Infrastructure and Local Development Priority (Priority No. 4). Projects of this priority were co-financed from the European Regional Development Fund (ERDF). Measures for improving energy efficiency were included in Measure 4.6 – "Development of local living environment"; and measures for deploying the energy use of renewables in the Measure 4.2 – "Development of environmental infrastructure". The conditions for applicant municipalities included the requirement of having an updated energy development plan for the whole municipality. In the framework of Measure 4.2 of the SPD, financial assistance in the amount of 2.1 MEUR was granted.

During the period of 2007–2013, EU funds are available for Estonia to a greater extent than before. In Estonia, the planning of EU structural assistance for years 2007–2013 was performed within the preparation of the general state budget strategy. The current *National Strategic Reference Framework 2007–2013* (NSRF) presents the general strategic objectives and priorities for developing the policy areas and sectors that are eligible for EU structural assistance in the years 2007–2013. At the same time, it enables to plan jointly both the activities co-financed from EU funds and the activities financed solely from Estonia's own budgetary funds. Joint planning and coherent implementation increases the effectiveness and efficiency of public sector activities. At the same time, the planning of structural assistance within the framework of preparing the general state budget strategy also helps to align the structural assistance best with the use of other EU financial instruments and external resources. Considering the importance of assistance issues a relevant law – *2007–2013 Structural Assistance Act* – was passed by the Parliament in December 2006.

Based on the strategy, operational programmes (OP) were prepared to specify the activities that will be co-financed from EU structural assistance and the volumes of the respective financing. These OPs are implementation documents of the NSRF in the domain of activities co-financed from EU structural assistance. Environment related issues are included mainly in the *Operational programme for the development of the living environment* (OP 2) which includes the following priorities:

- development of the water and waste management infrastructure;
- development of infrastructures and support systems for the sustainable use of the environment;
- development of the energy sector.

Measures and investments related to the transport sector are included in the *Operational programme for the development of the economic environment* (OP 3).

During the EU financial period of 2007–2013, the EU funds for supporting agriculture and

fisheries are no longer regarded as structural assistance as in 1999–2006. Therefore, the planning for the use of respective funds is undertaken separately from structural assistance planning – although in the same general framework of the preparation of the state budget strategy 2007–2010. *The Estonian Rural Strategy 2007–2013* as a strategic document and the *Estonian Rural Development Plan 2007–2013* (ERDP) as its implementation document are the bases for using the resources of the European Agricultural Fund for Rural Development. Environment related issues are included mainly in the following priorities of the ERDP:

- improving the competitiveness of the agricultural and forestry sector;
- improving the environment and the countryside.

For promoting the use of biomass and bio-energy, the Government has approved (in January 2007) the *Development Plan 2007−2013 for Enhancing the Use of Biomass and Bioenergy*. The objective of the plan is to create favourable conditions for the development of domestic biomass and bio-energy production to reduce Estonia's dependence on imported resources and fossil fuels and decrease the pressure on the natural environment. The measures of the development plan are directed at supporting the research and development of biomass and bio-energy and at raising the awareness of consumers, operators and market regulators. After carrying out appropriate analyses, the employment of different market based instruments will be considered to promote the use of biomass and bio-energy. Investment in bio-energy production will be supported using the measures of the *Estonian Rural Development Plan 2007–2013*.

Additionally, preparations have been started for compiling a national renewable energy action plan (NREAP). This is a requirement for all EU member states according to Directive 2009/28/EC. These plans are meant to set out Member States' national targets for the share of energy from renewable sources consumed in transport, electricity and heating, and cooling in 2020. In Estonia, the responsibility of preparing and adopting the NREAP lies mostly with the Ministry of Economic Affairs and Communications. Nevertheless, some cooperation is needed to from the Ministry of Agriculture and perhaps also from the Ministry of the Environment. The plan must be adopted by June 2010.

In 2006 preparations were started for compiling the *National Programme for the Reduction of Air Pollution from Stationary and Mobile Sources until 2015*. The programme covers the measures for reducing the emission of the following substances: SO_2, NO_x, NH_3, VOCs, solid particles (PM_{sum}), heavy metals, and persistent organic pollutants. Due to several reasons, the Programme has not yet been endorsed.

According to the National GHG Inventories Estonia's emissions have decreased significantly between 1990 and 1993. Since then the annual emissions have stayed approximately 50% below the 1990 level. That gives a clear indication that Estonia does not have problems with meeting its Kyoto target. Therefore, the National Programme of Greenhouse Gas Emission Reduction for 2003–2012 is the only programme in which reaching Kyoto target has been set as the main objective. The main goal of the Programme is to ensure compliance with the targets set by the UNFCCC and the Kyoto Protocol. The long-term objective of the National

Programme is the reduction of GHG emissions by 21% by 2010 as compared with the 1999 emission level.

The sub-objectives of the programme are the following:

- determining the possibilities of reducing anthropogenic emissions of GHGs and promoting the measures for reducing human impact on potential climate change;
- developing the flexible mechanism of Joint Implementation according to the principles of the Kyoto Protocol to reduce GHG emissions;
- determining project themes for Estonia, suitable for Joint Implementation on the basis of the Kyoto Protocol, and preparing a relevant database;
- increasing the energy efficiency of the Estonian economy (i.e., reducing energy intensity).

The quantitative targets of the Programme by sectors are given in the relevant sections of the current report. It has to be emphasized that as the Programme was developed in 2002 several items and targets of the document are out of date and therefore the Programme needs updating. By now, no research for analyzing the implementation of the Programme has been carried out.

4.3.1.2. Fiscal measures

The fiscal measures affecting GHG emissions in Estonia include excise duties on fuels, and pollution charges.

Excise duties

As a member state, Estonia has to comply with the EU requirements (Directive 2003/96/EC) for the taxation of fuels and energy. Nevertheless, Estonia has been granted some transitional time for the introduction of relevant taxes. Regarding oil shale, Directive 2004/74/EC stipulates that until 1 January 2013 Estonia is allowed to apply a reduced level of taxation for oil shale, provided that it does not result in taxation falling under 50% of the relevant Community minimum rate as from 1 January 2011. Regarding shale oil (oil produced from oil shale), Estonia is eligible to apply a transitional period until 1 January 2010 for adjusting the national level of taxation on shale oil used for district heating purposes to the EU minimum level of taxation. Nevertheless, Estonia has already introduced the tax on shale oil.

The tax exemption for natural gas (methane) is permitted by Directive 2003/96/EC, which allows an exemption on natural gas in those Member States where the share of natural gas

in energy end-use was less than 15% in 2000. The exemption applies for a maximum of ten years after the directive's entry into force or until the national share of natural gas in energy end-use reaches 25%, whichever comes first. Actually, Estonia imposed excise duty on natural gas on 1 January 2008 already. Directive 2004/74/EC allowed Estonia to apply a transitional period until 1 January 2010 to introduce the output taxation on electricity. Despite this exemption, Estonia introduced excise duty on electricity on 1 January 2008; not only that – the imposed rate of electricity excise is 3.20 EUR/MWh, while the EU minimum rate is 1.00 EUR/MWh (non-business use) or even 0.50 EUR/MWh (business use). The latest increase of excise rates was enforced on 1 July 2009. As a result of these increases some rates now exceed the EU minimum level by several times: 3.2-fold for light fuel oil, 2.3-fold for natural gas, etc. The current tax rates stipulated in the *Alcohol, Tobacco, Fuel and Electricity Excise Duty Act* are presented in Table 4.3.

Fuel / energy type	Unit	EUR/unit
Unleaded petrol	1000 l	398
Kerosene	1000 l	330
Aviation spirit	1000 l	72
Gas oil (diesel fuel)	1000 l	370
Gas oil fuel for specific purposes	1000 l	67
LPG as motor fuel	t	125
Gas oil (light fuel oil)	1000 l	67
Heavy fuel oil	t	15
Shale oil	t	15
Coal, coke	GJ	0.30
Natural gas	1000 m^3	23
Electricity	MWh	3.20

Table 4.3. Excise tax on fuels and energy (as of 1 September 2009)

The amendment (in force since 2005) to the Act stipulates that if biofuel has been added to motor fuel or heating fuel, the portion of biofuel contained in the motor fuel or heating fuel is exempt from excise duty. This provision, considered as state aid, needed approval from the European Commission (EC). In July 2005 the EC granted Estonia the relevant right: Estonia was authorized to exempt (until 2010) from excise duty non-synthetic biodiesel, vegetable oils made from biomass, and bioethanol made from agricultural or plant products.

Pollution charges

The Government's tax policy is based on objectives aimed at reducing environmental impact by increasing the rates of charges on pollution and resource use. According to the *Environmental Charges Act*, pollution charges and charges on the use of natural resources will be gradually increased in the following years. The sums derived from environmental charges go to the state budget and are mainly directed to environmental protection projects through the Environmental Investment Centre.

The pollution charge in the case of emissions into ambient air has to be paid by all enterprises that are required to have an air pollution permit. According to the regulation of the Minister of the Environment the air pollution permit is obligatory for all enterprises which own and operate combustion equipment (utilizing solid, liquid or gas fuel) with rated capacity equal to or higher than 0.3 MW in one location.

In Estonia the pollution charge for the release of carbon dioxide into ambient air was introduced in 2000, stipulated initially by the Pollution Charges Act, which was repealed at the end of 2005. Currently, the *Environmental Charges Act* (enforced in 2006) obliges the owners of combustion equipment to pay pollution charges for several pollutants emitted into air (e.g. sulphur dioxide, nitrogen oxides, etc.). At present, the CO_2 charge has to be paid by all enterprises producing heat, excluding the ones firing biomass, peat or waste (see Table 4.4).

2006–2007	2008	Since 2009
1.00	1.50	2.00

Table 4.4. Rates of pollution charge on carbon dioxide emission, EUR/t CO_2

In the case of CO2 emission in larger quantities than provided in the emission trading permit higher charge rates shall be applied: in 2006 and 2007 it was 40 EUR/t, since 1 January 2008 the penalty rate is 100 EUR/t.

The Government has decided to introduce the excise duty on electricity earlier than was stipulated in the Estonian EU Accession Treaty. Instead of the initially planned introduction in 2010, the electricity excise (50 EEK/MWh = 3.20 EUR/MWh) was imposed on 1 January 2008, from the same date the electricity producers no longer have to pay the pollution charge on CO_2 emissions.

The Environmental Charges Act provides a possibility for substituting the pollution charge (incl. CO_2 charge) with financing by enterprises. The financing shall replace the pollution charge if the polluter implements, at its expense, environmental protection measures which result in the reduction of pollutants or waste.

4.3.2. Energy supply

4.3.2.1. General strategy documents

Regarding the energy sector, Estonia's second *National Long-term Development Plan for the Fuel and Energy Sector until 2015* (approved by the Riigikogu in 2004) was replaced with a new one lately. The present structure of strategy documents for developing the energy sector is presented in Figure 4.1. The two plans – *Action Plan for Renewable Energy* and *Development Plan for Heat Supply* (in italics in the figure) – have yet not been prepared.

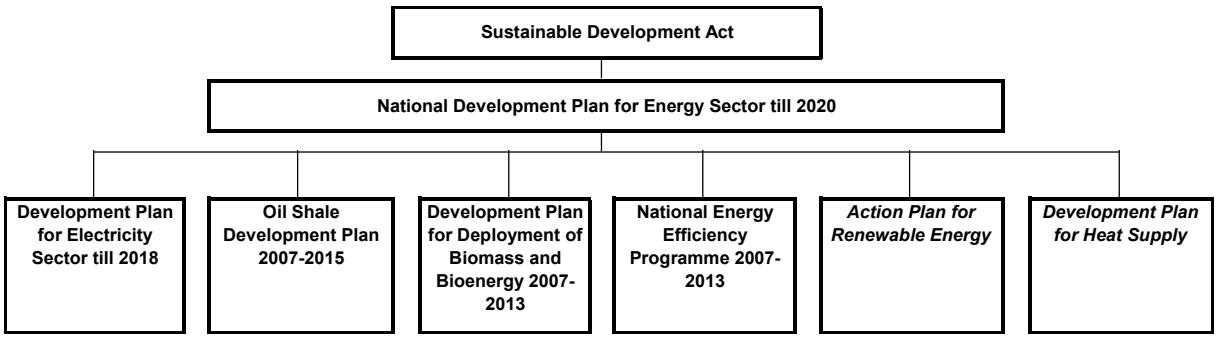

Figure 4.1. The current structure of strategy documents for the energy sector

The *National Development Plan for Energy Sector until 2020* was passed by the Parliament in June 2009. The plan defines the mission of Estonia's energy sector: to ensure a steady, efficient, environment benign energy supply with reasonable prices, while also ensuring the sustainable use of energy. In the plan three groups of major goals are set, all accompanied with relevant sets of specified measures:

- guaranteeing continuous energy supply (five measures);
- improving the efficiency of both the supply and use of energy (six measures);
- ensuring reasonable energy prices (five measures).

The major measures (or sub-measures) to be taken that have some impact on the emission of GHG s include:

- developing and applying support schemes for the use of renewable energy;
- preparation and implementation of measures fostering the cogeneration of heat and electricity;
- further development of energy efficiency in all sectors;

- improving the energy efficiency of oil shale use;
- developing and introducing up-to-date energy technologies;
- elaboration and implementation of the action plan for the deployment of renewable energy;
- elaboration and implementation of the action plan for heat supply (district heating) systems;
- transposition and implementation of the EU regulations on sustainable energy use;
- analysis of taxation alternatives for the energy sector.

Neither the more detailed scope nor the impact of the planned measures on the emission of GHG has been indicated.

The most general measurable target of the plan is the gradual reduction of primary energy use (total primary energy supply) which in 2007 was 124.44 PJ. For several measures, target level indicators have been set. Some quantitative indicators related to the emission of GHG are presented in Table 4.5.

Indicator	Current level	Target level
Share of oil shale in meeting the domestic energy demand	45% (2007)	<30% (2020)
Shares of other energy sources in energy balance	All <20% (2007)	All <20%
Share of renewables in energy end-use	17.5% (2006)	25% (2020)
Share of CHP electricity in gross electricity use	10.2% (2007)	20% (2020)
Energy saving (annually)	5 TJ (2007)	9800 TJ (2016)
Share of renewables in the fuel use of transport	0.06% (2007)	10% (2020)
CO2 emissions from the energy sector	15.7 Mt (2007)	7.85 Mt (2020)

Table 4.5. Electricity sector development indicators

As to other targets related to emissions, it has been established that the losses in electricity and district heating networks must have a declining trend from the current level – in 2007 the average losses had been 11.1% and 10.6% respectively.

Activities provided in the development plan will be financed from the state budget and from the budgets of energy companies. The amount of state expenditures on the activities planned will be approximately 32 billion kroons (2045 MEUR) until 2020. Together with the involvement of private capital and loan capital, the full implementation of the *Development Plan*

for the Energy Sector will cost more than 100 billion kroons (6391 MEUR). The final actual amount of investments will depend on administrative and political decisions.

The development of environment benign technologies has been defined as one of the priority areas for the *Estonian Research and Development and Innovation Strategy for 2007–2013*. In connection with this, the *National Energy Technologies Programme* has been prepared in 2007. The programme is directed at promoting the energy sector and making it more efficient. The bulk of the programme deals with the development of technologies related to renewable energy sources. The other two fields of the programme are the development of oil shale technologies and of new energy technologies. The programme supports product development as well as both fundamental and applied studies. For the development of innovative environmental technologies, the funds allocated to Estonia through the EU structural funds will be used.

4.3.2.2. Electricity generation

In February 2009 the Government approved a new *National Development Plan for Electricity Sector until 2018*. The plan is directed at a significant decrease in electrical energy production from oil shale and an increase in the proportion of other sources of energy. The construction of Estonia's own nuclear power plant is seen as a potential development option.

In the plan, it is emphasized that Estonia's electricity sector requires essential changes as the impact of electricity generation on the environment has to be reduced. This process is also affected by the need to use the resources of oil shale in a more sustainable way. Therefore, the plan provides scenarios for the restructuring of electrical energy production in Estonia within the next 10–15 years. For that purpose, the combined heat and power production should be expanded from the existing level of 200 MW to 300 MW by 2014 and two more units of Narva power plants with the total capacity of 600 MW should be reconstructed. Also the capacity of wind turbines (mainly wind farms) may be increased significantly (up to 900 MW) together with the required capacity reserves. Also, the plan considers the option of constructing of a nuclear power plant in Estonia by 2023. This option requires that relevant amendments in the legislation be made by 2012.

Estonia has exported a large share of the generated electricity, e.g. ca 20% in 2007. The plan stipulates the construction of a second submarine cable (EstLink 2) to Finland. Nevertheless, it is emphasized that after 2015 satisfying the domestic demand has to be the priority for electricity producers in Estonia and therefore relevant amendments in the legislation are planned for.

Regarding the options for electricity generation, the plan considers four main development scenarios. The projected annual increase rate of the peak load is 1.6–3.8%, the average taken to be 2.3%/year. As to consumption, the target is set to keep the domestic final consumption of electricity at the current level or lower (7180 GWh in 2007). The main precondition is that the whole electricity demand (peak load of 1800 MW in 2016) has to be covered by domestic

generation. All scenarios include the following common elements for generation:

- the currently used oil shale based units with fluidized bed boilers are still in operation;
- at least 200 MW of cogeneration units firing various fuels;
- some old units of oil shale pulverized combustion with desulphurization equipment.

In the proposed scenarios these elements are combined with the following generation options:

- wind turbines (onshore and offshore wind farms);
- additional oil shale based units with fluidized bed boilers;
- units of oil shale pulverized combustion with flue gas cleaning equipment;
- gas turbines firing various fuels (for covering peak loads and for coping with the intermittency of wind generation);
- combined cycle power plants firing coal;
- nuclear energy – either imported from Lithuania and/or Finland or generated in Estonia.

The scenario calculations were made using two price levels of CO_2 quota: 25 EUR/t and 50 EUR/t. Results of SWOT analysis for every scenario are provided in the plan.

The plan establishes measures for improving efficiency as well for managing the demand for electricity, for example:

- impact analysis of increasing the changing rates of excise duties and environment (pollution) charges;
- gradual internalization of environment related external (life cycle) costs;
- analysis and adjustment, if needed, of support schemes for the use of renewables and of cogeneration schemes in electricity production;
- deployment of energy audit system and running energy efficiency/saving campaigns.

Some quantitative indicators related to the GHG emission are presented in Table 4.6.

Indicator	Current level	Target level
Share of renewable electricity in gross electricity use	1.75% (2007)[1]	5.1% (2010) 15% (2015)
Share of oil shale based electricity in gross electricity production	93.6% (2007)	<70% (2018)
Share of CHP electricity in gross electricity use	10.2% (2007)	20% (2020)
Electricity end-use	7180 GWh (2007)	max 7180 GWh (until 2015)
Households' electricity use (per capita)	1320 kWh (2007)	EU27 average (2018)
Losses in electricity transmission networks	3.0% (2007)	<3% (2015)
Losses in electricity distribution networks	7.8% (2007)	<6% (2015)
CO2 emissions from the electricity sector	15.7 Mt (2007)	5 Mt (2018)

Table 4.6. Electricity sector development indicators

The activities provided in the plan will be financed from the state budget and from the budgets of energy companies. The amount of state expenditures on the activities planned in the electricity sector will be approximately 17.5 billion kroons (1118 MEUR) until 2018. The final amount of investments will depend on administrative and political decisions.

Regarding pollution, the most important part of the energy sector is the combustion of oil shale, as the major share of emissions are discharged by the oil shale based power industry. Introduction of new combustion technology allows reducing emissions from oil shale firing power plants which give almost 90% of electricity generation in Estonia. The development of oil shale based power production using environmentally sound technologies is an issue of high priority in Estonia. In order to comply with the requirements of Directive 2001/80/EC the owner of the largest power plants, Eesti Energia AS, has to reconstruct several units in the power plants of Narva Elektrijaamad AS (Narva Power Plants, including Eesti and Balti plants). Up to 2004, only the pulverized combustion technology of oil shale had been used in these power plants. The conventional pulverized combustion technique for burning oil shale is characterized by a low net average efficiency: 27–29%. This, together with the peculiarities of oil shale as a fuel, results in an extremely high specific emission of carbon dioxide per generated electricity – approximately 1.2 t CO_2/MWh_e. The use of pulverized combustion method also causes a high emission of SO_2 and solid particles. All these factors have rendered it unacceptable to continue using this technology in mid- and long-term future.

Based on relevant research, it was decided to commence with the gradual replacing of oil shale boilers of pulverized combustion with ones utilizing the circulating fluidized bed combustion (CFBC) method. The CFBC is a variant of atmospheric circulating fluidized bed combustion, which has been in use for particularly low-grade fuels. In CFBC boilers the sulphur dioxide is better bound with the ash and therefore the SO_2 emission can be reduced significantly. The

1 The corrected value for 2007 is 1.5% (Statistics Estonia, 22.09.2009)

higher combustion efficiency reduces fuel consumption, which in turn means substantially lower CO_2 emission as well – approximately 0.9 t CO_2/MWh_e. The first two new units (both 215 MW) in Narva Elektrijaamad AS, one at the Eesti and the other at the Balti Plant, equipped with new CFBC boilers, were commissioned in 2004. This has been the largest environment-related investment (245 MEUR) in Estonia for the protection of the atmosphere. The scope of further reconstruction of other units has not yet been decided. Nevertheless, the Eesti Energia group has gradually improved the environmental performance of oil shale firing power plants. Narva Elektrijaamad AS will invest in flue gas, sulphur and nitrogen emissions purification, in order to comply with the environmental requirements which will become stricter in 2012 and 2016. Preparations have begun for introducing a sulphur purification system in the old units of the Narva power plants.

In spite of the plans to continue using oil shale in electricity production, significant changes in the mix of energy sources utilized for electricity generation are planned for mid-term future. In addition to the national development plans for the electricity sector, major electricity utilities have relevant plans as well. As a rule, most of the planned changes would decrease the impact on environment. For example, the largest power company in Estonia – Eesti Energia AS – plans to cut the CO_2 emissions of its electricity production portfolio to 0.8 t/MWh_e by 2015 (from 1.1 t/MWh_e in 2007), and to 0.3 t/MWh_e by 2025. According to Eesti Energia, this will require a great amount of biofuels and waste to be used for power production, at least 1000 MW of electricity from wind parks, and an expansion of co-generation of heat and power production. Additionally, a significant holding in a nuclear power plant would be needed.

Special attention has been paid to the promotion of renewable energy in producing electricity. In Estonia the obligation for electricity network enterprises to purchase renewable electricity was introduced by the amendment to the *Energy Act* (enforced in 1998). The obligation was continued with the provisions of the *Electricity Market Act* (enforced in 2003). Later several amendments have been made to enhance the purchase obligation. The amendment to the Act enforced since 1 May 2007 rearranged the incentives for generating electricity from renewable sources – a producer has the right to sell electricity as fixed supply to a seller designated by the transmission network operator or to receive support from the distribution network operator for the electricity supplied and sold to the network. Up to 1 May 2007 only the purchase obligation had been in use, the feed-in tariff being 0.81 EEK/kWh (51.77 EUR/MWh). The new tariff rate related to purchase obligation is 1.15 EEK/kWh (73.50 EUR/MWh), the support, as a new measure, being 0.81 EEK/kWh (51.77 EUR/MWh). A producer cannot receive support for electricity which is sold by applying the purchase obligation. The incentives are in force during the first 12 years after commencing the generation. In the case of wind based electricity there is an additional restriction: after the total wind based generation reaches 200 GWh/a in Estonia, the purchase obligation will be terminated for all wind generators, and after it reaches 400 GWh/a the support will be terminated as well.

As a result of these schemes, the generation of renewable electricity has gradually increased 8.7-fold since 1998, when the purchase obligation tariff was introduced: from 17 GWh in

1998 to 148.6 GWh in 2007 that accounts for 1.5% of the gross inland use of electricity in Estonia. If this quantity (149 GWh) was generated in oil shale based electricity plants this would mean the emission of 156 thousand t of CO_2. Directive 2001/77/EC has set an indicative target of 5.1% (i.e. the share of renewable electricity in gross electricity use) by the year 2010 for Estonia. The new *National Electricity Sector Development Plan until 2018* has set the target to increase the share of renewable electricity up to the level of 15% by 2015.

Regarding wind based electricity, in June 2009 Eesti Energia AS commissioned the biggest wind park in the Baltics at Aulepa (Western Estonia). This wind park (39 MW) is planned to have an annual electricity output of over 100 GWh. Also, the procurement process for a wind park planned on the closed ash field of the Balti power plant (AS Narva Elektrijaamad) has been initiated. Besides Eesti Energia AS, there are tens of other investors and companies interested in starting and/or deploying wind based electricity generation in Estonia. There are wind based electricity projects of approximately 1000 MW in the phase of pre-feasibility studies, plus the same extent of offshore wind projects.

At present, the national support scheme combining feed-in tariffs with purchase obligation, as described above for renewable energy, also covers small scale efficient heat and power cogeneration (CHP) plants. The amendment to the Electricity Market Act enforced since 1 May 2007 introduced similar incentives for efficient cogeneration as well. In the amended Act it is stipulated that a producer has the right to sell electricity as fixed supply to a seller designated by the transmission network operator or to receive support from the distribution network operator for the electricity supplied and sold to the network if it is generated:

- in an efficient cogeneration regime, provided that waste (as defined in the Waste Act), peat or oil-shale processing retort gas is used as a source of energy;
- in an efficient cogeneration regime with a cogeneration installation which is established, replacing the previous DH plant that supplies customers with heat, and whose electric capacity does not exceed 10 MW.

The feed-in tariff rate related to the purchase obligation from CHP plants is 0.84 EEK/kWh (53.70 EUR/MWh), the support being 0.50 EEK/kWh (32.00 EUR/MWh). A producer is not eligible for support in the case of electricity which is sold by exercising the purchase obligation. The efficiency of the cogeneration process is defined according to Directive 2004/8/EC. The new *National Electricity Sector Development Plan until 2018* has set the target to increase the share of CHP related electricity generation to 20% of the total electricity consumption by 2020.

Significant changes in the mix of fuels used for electricity generation may take place in near future. At the end of 2008 the construction of some new private owned cogeneration plants firing (or co-firing) biomass was completed (e.g. Väo and Tartu CHP plants), some new CHP plants (e.g. in Pärnu) are currently in the construction phase. The state-owned Eesti Energia AS has started co-firing oil shale with wood chips in the largest power plants (Balti and Eesti). Also, Eesti Energia AS is making preparations to refurbish the previously oil shale

firing Ahtme plant for switching to biomass. As to biomass based electricity generation, the *Development Plan 2007−2013 for Enhancing the Use of Biomass and Bioenergy* has set the 3.0% (of electricity end-use) target for the share of electricity produced in biomass based cogeneration plants; in 2005 the respective share was 0.2%.

Regarding the use of oil shale in electricity production, it is proposed in the new *National Electricity Sector Development Plan until 2018* to increase the net efficiency of oil shale based electricity generation up to 35%, but at the same time to gradually reduce the share of oil shale electricity in the gross consumption of electricity.

The opening of electricity market in Estonia may affect the generation development significantly – in 2009 the market is opened by 35%, and by 2013 at the latest the opening has to be completed. Therefore, new possibilities to export and import electricity have to be taken into account when analyzing the impact of the energy sector on the environment. At the beginning of 2007 a direct submarine cable line (EstLink) with an interconnection capacity of 350 MW between Estonia and Finland was commissioned. As a result, in 2007 the exports of electricity from Estonia increased significantly, more than two-fold compared to 2006. In 2008 a total of 1.74 TWh was exported to Finland, while the exports of Eesti Energia AS to Nord Pool, the energy trading market of the Nordic countries, were 832 GWh in the financial year 2007/2008. At present, the construction of the second undersea cable (650 MW) from Estonia to Finland is planned to be completed by 2013.

4.3.2.3. Heat production

Heat supply, particularly district heating, is the next important sector with quite a large potential for increasing energy efficiency, which in turn results in lower emissions. Combined with the deployment of renewable energy sources, biomass in particular, it should have an increasing role in mitigating the impact of heat supply on the environment in Estonia.

Regarding biomass, a large amount of the primary energy arising from fuel wood (logs, chips, pellets and wood-waste) is used in heat production. But the development is hindered by a large-scale export of biomass, due to which local energy producers in some cases do not have enough biomass resources. The export results in elevated prices for some biomass products, especially wood pellets. The deployment of smaller scale cogeneration of heat and electricity (CHP) as an element of decentralized energy production strategy would increase the security of energy supply in Estonia. Therefore, the potential use of biomass in new CHP plants can be a development option. Small heat load and the fact that new equipment producing only heat has already been installed in many areas with a favourable heat load can be indicated as hindrances to the development of combined heat and power production based on biomass. Up to now, the other option for reducing CO2 emissions in energy production has been a wider use of biomass in district heating and other heat-only boiler (HOB) plants. In Estonia, the heat production in HOB plants is already relatively environment-friendly: in 2008 the share of wood was 26% and of natural gas 53%. Nevertheless, in the Develop-

ment Plan 2007–2013 for Enhancing the Use of Biomass and Bioenergy a target was set to increase the share of district heat produced from renewable resources in the total district heat from 21% in 2005 to 33% by 2013.

As a rule, district heating is more environmentally benign as a heat supply option than local heating. Therefore, it is important that the *District Heating Act* enables the zoning of district heating as an element of regional heat supply planning. The Act gives local governments the power to introduce the zoning of heat supply based on analyses, carried out for alternative heat supply options during the planning phase. The zoning of heat supply as an instrument of regulation of the energy sector gives municipalities the authority to avoid chaotic disconnection from district heating systems. The latter process had taken place in some towns and cities for many years. Planned zoning makes it possible to keep efficient DH systems in operation. Later these systems can form a basis for the introduction of CHP, which is not, up to now, a widely spread heat supply option in Estonia. In Estonia, tens of municipalities have introduced the zones of district heating.

Heat supply issues are essential elements of local governments' development plans. Energy action (development) plans have been made mandatory for municipalities in order to be prepared for applying financial assistance (grants, subsidies) from national or EU funds (projects, programmes) for energy sector measures. The total number of municipalities having compiled energy plans during the past 10 years is more than 50, of the total 227 (in 15 counties).

The policies and measures, together with their impact on GHG emission, stipulated in the *National Programme of Greenhouse Gas Emission Reduction for 2003–2012* for the whole energy sector are presented in Table 4.7.

Name of policy / measure	GHG affected	Type of instruments	Status	Implementing entity	Period of implementation	Emission reductions 2003-12 Gg (=10^3 t)
Renovation of Narva Power Plants (2 units)	CO_2	Regulatory	Implemented	Eesti Energia AS	2002–05	53.4
Renovation of large combustion plants (excl. Narva PP)	CO_2	Regulatory	Planned, on-going	Owners	2003–12	11.8
Introduction of cogeneration of heat and electricity	CO_2	Voluntary	Ongoing	Owners	2005–12	3.4
Renovation of DH boilers and boiler plants	CO_2	Voluntary	Ongoing	Owners	2003–12	10.0
Fuel switch	CO_2	Voluntary	Ongoing	Owners	2003–10	2.7
Enhancing of oil shale enrichment	CO_2	Voluntary	Planned, ongoing	Eesti Põlevkivi AS	2006–12	10.3
New methods for landfilling of oil shale ash	CO_2	Regulatory	Ongoing	Owners	2003–12	15-30
Installation of new wind generators (up to 75 MW)	CO_2	Voluntary	Planned, ongoing	Owners	2004–12	53.0

Table 4.7. Policies and measures in the energy sector

4.3.3.4. Energy consumption – industry

An increasing number of enterprises in Estonia have introduced environmental management systems (EMS). The main drivers for implementing EMS are usually market reasons, but at the same time the enterprises improve their environmental performance by a more efficient use of resources, and minimization of waste and emissions to air and water. Estonian enterprises have a choice to choose between two environmental management systems: international standard ISO 14001 or European Management and Audit Scheme (EMAS). The most common EMS implemented in Estonia is ISO 14001. At present, there are almost three hundred enterprises in Estonia which have the ISO 14001 certificate. As to EMAS, today there are only two enterprises certified to it in Estonia. In 2003 the Estonian Association of Environmental Management was established. At present, the Association has 22 full and 27 associated members. Organisations who participate are recognised as making a strong commitment to the environment and to improving their economic competitiveness.

Regarding eco-labelling, there is no national eco-label scheme in Estonia. Several food products are labelled with Estonian Organic Farming Label; in service sector the Green Key is used. Amongst the eco-labels there is a possibility to implement the EU Eco-label. In March 2008, the Estonian competent body – the Environment Information Centre – awarded the EU Eco-label for the first time to AS Eskaro for its ceiling paints.

Since January 2007 an amendment to *Integrated Pollution Prevention and Control Act* is in force with stricter requirements for using best available technique (BAT) in integrated environmental permits. Therefore, the gradual introduction of BAT would reduce the impact of industry on the environment.

Voluntary agreements (VA) are voluntary or negotiated agreements between governments and enterprises which can be defined as guidelines adopted or measures taken in the absence of mandatory regulation in order to improve environmental performance of the enterprise and to enhance corporate responsibility. The agreements are bilateral – between one company (or a group of companies) and the Ministry of the Environment (MoE). In Estonia, VAs have not included any subsidies or other financial elements from the public administration. Since 1999 several enterprises have made a voluntary agreement with the MoE. At present, seven agreements are in force. Usually, in the framework of a VA the MoE is obliged to inform enterprises of changes in legislation and involve them in amendment processes. To improve their environmental performance, enterprises are supposed to implement voluntary environment related measures which introduce stronger requirements than mandatory.

Additionally, the EU emission trading scheme has created incentives for the involved energy intensive enterprises to seek the most efficient ways for reducing emissions.

In 2008 and 2009, the Ministry of Economic Affairs and Communications ordered some surveys from consulting companies for mapping the situation in Estonia's manufacturing industry in relation to the possibilities of increasing energy efficiency and conserving energy.

As for the direct emissions of GHG from technological processes, carbon dioxide is formed mainly in the processes of cement and lime manufacturing in Estonia's industrial sector. Limestone decomposes at heating and carbon dioxide is emitted. By today, both of these manufacturing branches have almost reached their maximum output levels and a further growth of output is impossible, except by means of plant renovation and/or expansion. Some reduction of GHG emissions can be achieved only through the introduction of more up-to-date production technologies.

The policies and measures, together with their impact on GHG emission, stipulated in the *National Programme of Greenhouse Gas Emission Reduction for 2003–2012* for the industry sector are presented in Table 4.8.

Name of policy / measure	GHG affected	Type of instruments	Status	Implementing entity	Period of implementation	Emission reductions
						2003-12
						Gg (=10^3 t)
Efficiency improvements in cement production	CO_2	Voluntary	Ongoing	Owners	2003–10	12.9
Efficiency improvements in lime production	CO_2	Voluntary	Ongoing	Owners	2005–12	1.0

Table 4.8. Policies and measures in the industry sector

4.3.4. Energy consumption – residential, commercial and other sectors

As regards improving the energy efficiency of buildings, the EU Directive 2002/91/EC on the energy performance of buildings plays an important role. The transposition of provisions of Directive 2002/91/EC into Estonia's legislation was completed by 1 January 2009. The main provisions were introduced to make relevant amendments in the *Building Act* and in the *Energy Efficiency of Equipment Act*. The objective of these amendments was to introduce the energy auditing and labelling of buildings, to improve the energy performance of new and existing buildings, and to provide the users of buildings with an easier access to information about the building's energy consumption and energy saving measures.

Several detailed requirements were enforced, using acts of secondary legislation. The most important secondary level act is the Regulation of the Government on *Minimum Requirements for Energy Performance of Buildings* (No. 258 of 20 December 2007). The Regulation provides detailed requirements for the energy performance of buildings. The needed initial data and procedures for the calculation of performance indicators are defined.

The Regulation provides a set of definitions related to the energy performance of buildings, including several new ones, which had not been defined in the legislation of Estonia before, e.g. integrated energy performance indicator, net energy demand, weighting factors for energy and fuel types used in energy supply for buildings, etc. For small houses the maximum heat transfer values of building shell are fixed, for other types of buildings the impact of internal indirect sources of heat may play an important role. In Estonia there have been no similar integrated requirements for the energy performance of buildings in force before. Moreover, since Estonia regained independence in 1991, all heat transfer coefficients for building envelope had been the recommended ones only.

The *National Development Plan for Housing Sector 2008–2013* was approved by the Government in January 2008. Among the three main objectives of the Plan, the second one is targeted at improving the quality and sustainability of the housing stock in Estonia. The planned measures (2.1, 2.2 and 2.3) for reaching this goal include:

- support for the refurbishment of apartment buildings: securing targeted loans for dwelling houses built before 1993; special soft loans for houses built before 1940;
- elaboration of standard design documentation for the refurbishment of apartment houses built after 1945, and making these documents available free of charge;
- special awareness campaigns and training courses for a better maintenance and refurbishment of the housing stock;
- mapping of the actual situation of the whole housing stock, focusing on the constructional and energy performance issues of apartment buildings.

The energy saving effect of this Plan has not been estimated ex-ante. Nevertheless, there are target values (to be reached by 2013) stipulated in the Plan for some measures. The following ones are relevant to energy performance:

- the number of apartment houses which have received support for refurbishment – 8000;
- the share of the types of apartment houses with mapped energy performance – 95%;
- energy audits carried out (of the total number of buildings in the target group) – 30%;
- the share of apartment buildings with the indicator of the highest energy performance category – 10%.

Various measures for disseminating information on more efficient use of energy at national level have been taken in Estonia since the beginning of 1990s. The information campaigns have been mainly project-based: initially the campaigns were financed by bilateral aid programmes from Finland, Sweden and Denmark, later also in the framework of EU SAVE and PHARE Energy programmes.

In 2006 the Energy Efficiency Consulting Centre (EECC) was established as a subdivision of the Estonian Credit and Export Guarantee Fund (KredEx) in cooperation with the Ministry of Economic Affairs and Communications, with the goal of disseminating energy efficiency related information on apartment buildings free of charge, as well as to administer state support for the refurbishment of dwelling houses. The EECC provides information on the implementation of energy efficiency measures for apartment buildings, manages information pertaining to energy conservation in apartment buildings, and arranges meetings between various parties interested in the further development of efficient energy use in buildings in Estonia. The Centre also focuses on the distribution of information on energy conservation measures related to the renovation and structural repair of apartment buildings.

As to the practical refurbishment of residential buildings, already in 2003 the Government started to support repair work related to the reconstruction and restoration of the main structures of pre-1990 apartment buildings. The assistance covers 10% of the cost of these works. To apply for reconstruction assistance, the apartment building in question must have passed

technical inspection. To conduct such an inspection, the apartment/house union or the association of apartment owners may receive assistance in the amount of 50% of the inspection cost. During the period 2003–2007 KredEx has given financial support for the renovation of 2672 apartment houses with the total living area of approximately 9.4 million m^2. The very rough calculations made in the framework of the current ODYSSEE project indicate that refurbishment measures taken with the national financial support delivered by KredEx over the period of 2003–2007 have resulted in a reduction of specific heat demand in dwelling houses by approximately 30–60 kWh/m^2 a year. The corresponding savings of final energy in renovated housing stock calculated for 2007 are approximately 465 GWh, which in Estonia means ca 735 GWh savings of primary energy annually. Considering the fuel mix in heat production, the corresponding reduction of CO_2 emission is estimated to be 150 thousand tons.

In May 2009 the Minister of Economic Affairs and Communications issued an order (No. 137, 07.05.2009) adopting a new programme on the loan for the renovation of apartment buildings. The programme is implemented by KredEx. It makes financing the renovation of apartment buildings easier and more advantageous. The scheme and the relevant procedures for long-term loan were developed in cooperation with German Development Bank KfW Bankengruppe. The scheme allows the banks to combine the finances from the structural funds of the EU (financed from the European Regional Development Fund) and the additional loan from the CEB (Council of Europe Development Bank) to issue more advantageous loans with a longer refunding period (up to 20 years) to apartment buildings constructed before 1993. The aim of the renovation loan is to improve the energy efficiency of apartment buildings by at least 20% in apartment buildings with an area of up to 2000 m^2 and by at least 30% in apartment buildings with an area of more than 2000 m^2. Estonia is the first country to launch this type of reuse of EU structural funds.

As to domestic and other electric appliances, the EU directives on the minimum energy efficiency requirements and labelling of several types of electric appliances (e.g. refrigerators, freezers, ovens, air conditioners, etc. – Directive 92/75/EEC and the Directives implementing it: 94/2/EC, 95/12/EC, 95/13/EC, 96/60/EC, 97/17/EC, 98/11/EC, 2002/31/EC and 2002/40/EC) are fully transposed into Estonia's legislation with the relevant regulations of the Minister of Economic Affairs and Communications. In the *National Energy Efficiency Programme for 2007–2013* the target level for the share of A-label electric appliances sold at Estonia's market by 2013 was set at 75%, the level in 2006 being approximately 50% (estimation).

Regarding the public sector, to employ the principles of environmental sustainability better and to enhance the synergy between environmental sustainability and economic competitiveness, the priorities of green and sustainable public procurements for 2007–2009 have been determined, enabling the systematic development of the methods of environmentally friendly public procurement and the promotion of sustainable procurement. In implementing these priorities, measures will be applied gradually to achieve the following goals:

- adjusting the administrative and analytical capacities of public institutions in carrying out public procurement to the needs of sustainable development;
- ensuring the society's access to information on sustainable consumption and purchasing;
- expanding the market for environmentally clean and healthy products;
- encouraging sustainable product development and innovation in the adoption of environmental technologies;
- improving the organization of public sector statistics and surveillance, and particularly of its reporting relating to energy consumption and public procurement.

Despite the measures described above, it has to be noted that in 2008–2009 the National Audit Office (NAO) assessed whether the state had a clear action plan for a more efficient use of energy. The implementation of energy conservation principles in the public sector was also analysed. The major focus was targeted to the state's activities for purchasing energy efficient equipment and vehicles, as well as to the construction of public buildings. The NAO concluded that the state lacked a clear and agreed-upon policy for saving energy and there is no effective energy conservation plan. Although the subject has been discussed at length at the state level, there are few actual results. The NAO also notes that state agencies have failed to adopt energy saving principles and are not paying sufficient attention to energy conservation when carrying out public procurements and managing state buildings.

The policies and measures, together with their impact on GHG emissions, stipulated in the *National Programme of Greenhouse Gas Emission Reduction for 2003–2012* for the residential sector are presented in Table 4.9.

Name of policy / measure	GHG affected	Type of instruments	Status	Implementing entity	Period of implementation	Emission reductions
						2003-12
						Gg (=10^3 t)
Renovation of DH systems	CO_2	Voluntary	Planned, ongoing	Owners	2003–12	5.3
Renovation of residential buildings (total of 4 Mm^2)	CO_2	Voluntary	Planned, ongoing	Owners	2003–12	10.3

Table 4.9. Policies and measures in the residential and tertiary sector

4.3.5. Energy consumption – transport

The rates of excise taxes on fuels have been raised in several cases during the past few years. This has been done, among other reasons, with the objective of affecting the fuel demand of transport and making it more environmentally sustainable. The Government has increased fuel excise duties faster than stipulated in the EU directives. According to Directive 2003/96/EC, the EU minimum rates of fuel excise duty are to be reached by the beginning of 2010 in Estonia, but the Government decided to raise the excise duties to the EU minimum level already at the beginning of 2008. The next increase (since 1 July 2009) raised the rates of automotive fuels over the current EU minimum level: for petrol by 10.8% and for diesel fuel (gas oil) by 22.3%.

Regarding the use of biofuels in transport, EU has set common objectives for the share of biofuels in the consumption of all motor fuels: 5.75% by 2010 and 10% by 2020. In Estonia, the corresponding share was 0.06% in 2007 and 0.82% in 2008[3]. In the new *National Energy Sector Development Plan until 2020* it is declared that Estonia considers these targets binding only in case the use of second generation biofuels is economically feasible as well as fully sustainable. At the same time, the *Development Plan 2007−2013 for Enhancing the Use of Biomass and Bioenergy* sets the share of 6% of biofuels in the consumption of transport fuels as the target for 2013.

In January 2007, the Parliament approved the *Transport Development Plan for 2006–2013*, which includes at least three measures aimed at making transport more environment-friendly:

- developing the traffic management and coordination system;
- enhancing the competitiveness of public transport;
- promoting light traffic.

To increase the proportion of public transport users, the Government has set a goal to increase the number of lanes on streets allocated for public transport in cities by 20% a year over the coming years. As to passenger train transport, the goal for the coming years is to ensure that the passenger inter-city train traffic infrastructure can support speeds of at least 120 km/h. This would help to enhance the competitiveness of passenger train traffic in comparison with road transport.

In 2008 the Public Transport Department was established in the Estonian Motor Vehicle Registration Centre (at present both are subdivisions of the Road Administration) in order to improve the planning of public transport, as the importance of the latter had been decreasing during the past years.

3 Data from the Ministry of Finance. In the national energy balance compiled by the Statistics Estonia the production or consumption of liquid biofuels is not indicated.

There are some differences between the goals set in the EU sustainable development strategy and the target set in the *Estonian Transport Development Plan 2006–2013*. While the EU sustainable development strategy establishes a desirable average CO_2 emission level for light duty vehicles (120 g/km by 2012), the Estonian transport development plan sets a similar goal of a 30% share of new cars with CO_2 emissions less than 120 g/km. As there is no car industry in Estonia, the indicator here considers the new cars that are registered in Estonia. In 2005 the respective share of cars was approximately 0.5%.

As to the direct impact on the environment, the compliance of motor vehicles with the emission restrictions is regulated by the *Traffic Act* and relevant secondary legislation. At first, the Traffic Act stipulates that all types of motor vehicles, wheeled tractors and their trailers, and motorcycles put into service in Estonia for the first time are subject to type approval. The rules for the type approval of motor vehicles are established by the Minister of Economic Affairs and Communications and the rules for the type approval of wheeled tractors and their trailers are established by the Minister of Agriculture. At second, the Traffic Act provides that it is permitted to operate vehicles in traffic only if the roadworthiness of the vehicles complies with the requirements in force in Estonia. According to the Act, the rules for the registration of power-driven vehicles and their trailers and for the inspection of the roadworthiness thereof, and the requirements regarding their roadworthiness and equipment, as well as the rules for the regular mandatory inspection of vehicles are established by regulations of the Minister of Economic Affairs and Communications.

To promote the growth of biofuel use in transport, the amendment (in force since 2005) to the *Alcohol, Tobacco, Fuel and Electricity Excise Duty Act* provides that if biofuel has been added to motor fuel, the portion of biofuel contained in the motor fuel is exempt from excise duty. This provision, considered as state aid, needed approval from the European Commission (EC). In July 2005 the EC authorized Estonia to exempt from excise duty non-synthetic biodiesel, vegetable oils made from biomass and bioethanol made of agriculture products or plant products. The exemption is in force until June 2010.

Several local governments, mainly cities but also some rural municipalities, have started to promote cycling: several networks of roads with safe routes (special lanes and tracks) for cycling have been designed, etc. Some cities have elaborated development strategies for urban cycling to promote cycling in cities and to improve conditions for cyclists in cities. For example, Tallinn, the capital city, started the construction and marking of special cycling routes in 1998. By today, the total length of these routes is approximately 160 km. The City of Tallinn also promotes walking as an alternative to using private cars – for instance, the City Government has banned motor vehicles from entering the medieval city centre. Several other cities have been active in a similar way: promoting cycling, starting to provide bicycle-friendly networks on streets and roads.

The policies and measures, together with their impact on GHG emissions, stipulated in the *National Programme of Greenhouse Gas Emission Reduction for 2003–2012* for the transport sector are presented in Table 4.10.

Name of policy / measure	GHG affected	Type of instruments	Status	Implementing entity	Period of implementation	Emission reductions
						2003-12
						Gg (=10^3 t)
Subsidies for public transport	CO_2, N_2O	Regulatory	Ongoing	Government, MoEAC, municipalities	2002–12	32.0
Improvement of road quality	CO_2, N_2O	Regulatory	Planned, ongoing	Government, MoEAC	2007–12	21.0
Technical inspection of vehicles	CO_2, N_2O	Regulatory	Ongoing	MoEAC, Vehicle Registration Centre	2003–12	10.0
Increasing the share of new vehicles	CO_2, N_2O	Voluntary	Ongoing	Government, MoEAC, owners	2003–13	23.0

Table 4.10. Policies and measures in the transport sector

4.3.6. Agriculture

In Estonia, organic farming as an environmentally friendly agricultural production pattern has been supported since 2000. The area of land used for organic production has grown rapidly since then. In 2002, there were 583 approved organic producers in Estonia, who managed a total of 30 550 ha of organically farmed land or transitional land, while in 2008, a total of 87.4 thousand hectares of agricultural land was in organic use by 1245 farms. Support for organic production is granted for three crops groups: long-term natural grasslands; field crops and permanent crops; vegetables, medicinal herbs and aromatic herbs. In 2007, 92.5 MEEK (5.9 MEUR) of support was given to 1099 applicants who practice organic farming on a total of 69.8 thousand ha.

Improvements in environmental performance are expected as a result of basing the granting of integrated environmental permit conditions for stock farmers more strictly on the use of best available techniques (BAT) since January 2007. To assist this process in Estonia, local BAT instructions have been prepared for stock-farming. Technologies preventing the discharge or release of pollution into soil, air or water, and enabling a better utilization of waste are preferred. The optimal use of energy and water is also considered.

The *Development Plan for Organic Farming 2007–2013* together with the related *Action Plan for Organic Farming 2007–2013* to promote organic farming were endorsed by the decree of the Minister of Agriculture in May 2007. Some key indicators from these plans are presented in Table 4.11.

Indicator	2006	2013
Land area for organic farming (1000 ha)	72.8	120.0
Producers of organic products	1173	2000
Processors of organic products	14	75
Share of indigenous organic products on Estonia's food market	0.15%	3.0%

Table 4.11. Current status and projections of organic farming in Estonia

The use of environmentally friendly methods (including organic production) is encouraged in the new *Rural Development Plan 2007–2013* (the implementation document of the *Rural Strategy 2007–2013)* as well. In RDP 2007–2013 the environment-related measures in agriculture are included in the following priorities:

- improving the competitiveness of the agricultural and forestry sector:
    - investments into the production of bioenergy;
- improving the environment and the countryside:
    - agri-environmental support, incl. environmentally friendly management, support for organic production.

In 2007 the *Development Plan 2007−2013 for Enhancing the Use of Biomass and Bioenergy* was endorsed by the Government. The vision of the development plan is to ensure the efficient and sustainable use of Estonian land resource and biomass based on ecological, economic, social and cultural principles. This would include the optimum use of biomass in the materials industry and energy production.

Regarding agricultural land, the plan points out that most energy crops compete with food and fodder crops in their habitats, therefore the predicted growth areas of these crops should definitely be taken into account when evaluating the growing potential. As the area of agricultural land used for growing food and fodder crops is not expected to decrease in the decades to come, it could be predicted that energy crops will be cultivated on the remaining 300 000−400 000 hectares of agricultural land. Nevertheless, it is questionable how much of this land can be used in reality (also in case of support), and what the expenses, production volume and profit would be. If cultivating energy crops does not turn out to be profitable (with support), this potential will not be realized.

As a long-term projection, the plan foresees that, proceeding from the biomass resource available today, upon the implementation of the development plan it would be possible to produce 100% of heat, 15% of transport fuels and 6% of power from biomass in 2025. Some mid-term objectives related to GHG emissions from agriculture presented in the plan are given in Table 4.12.

Indicator	Explanation	Initial level and year	Target level and year
Greenhouse gas emissions from agriculture	CO_2-eq Gg	702 (2006)	702 (2013)
Area of arable land used	Arable land receiving single area payments	844,000 ha (2006)	877,000 ha (2013)
Area under energy crops	Arable land receiving aid for energy crops	0 ha (2006)	100,000 ha (2013)

Table 4.12. Agriculture related objectives from the Biomass Development Plan 2007–2013

The policies and measures, together with their impact on GHG emissions, stipulated in the National Programme of Greenhouse Gas Emission Reduction for 2003–2012 for the agriculture sector are presented in Table 4.13.

Name of policy / measure	GHG affected	Type of instruments	Status	Implementing entity	Period of implementation	Emission reductions 2003-12 Gg (=10^3 t)
Efficiency improvements and introduction of environment benign technologies in cattle breeding (stock raising)	CH_4, N_2O	Voluntary	Ongoing	MoA, owners	2003–10	105.0
New technologies in plant cultivation, reduction of fertilizers use, organic farming	N_2O	Voluntary	Planned	MoA, owners	2005–12	15.0

Table 4.13. Policies and measures in agriculture

4.3.7. Waste

The revision of the *National Waste Management Plan* (compiled in 2002) has been completed and in May 2008 a new strategy document *National Waste Management Plan 2008–2013* was endorsed by the Government. According to the new plan, the closure of non-conforming landfills will be supported. In addition, the establishment of regional landfills and other regional waste handling facilities (including incineration plants and facilities for treating biological waste, for example for use in composting fields, etc.) that comply with the designated requirements will be promoted by Government. Among other items, it is planned to set up a waste handling system for biodegradable waste and to improve the options for sorting waste at its place of generation. According to the *Waste Act* all landfills had to meet the established requirements by 16 July 2009. Landfills closed for waste deposit by this date will be conditioned in accordance with the requirements no later than 16 July 2013.

In order to reduce the pollution load, the Government has introduced a revised waste management system. A new waste management infrastructure has been established – waste sorting and recycling has been developed according to the national waste management plan. The main attention in the implementation of waste-related legislation has been paid to waste flows based on the responsibility of producers, like packaging and packaging waste, waste from electrical and electronic equipment, end-of-life vehicles and tyres. The producers and/or suppliers must be able to collect the aforementioned articles at least in the owner's county of residence or at a place within a 50 km radius of the owner's home.

The programme of collecting municipal waste separately by type has also been partially launched, enabling materials to be recycled to a greater degree, including recycling them as reusable materials. Recycling organizations have been appointed to organize the recycling of different types of waste and implement the principle of producer responsibility. Landfills, waste transfer stations and hazardous waste handling facilities that meet the set requirements have been established. More than 300 non-conforming landfills have been made environmentally safe and closed.

To reduce the amount of landfilled biodegradable waste and to increase the share of biodegradable waste recycling, an action plan has been compiled for 2008–2013 for the handling of such waste, offering opportunities to attain the objectives of sustainable waste management in handling biodegradable waste, and also providing suitable solutions for each county. To initiate the process of using waste as a source of energy, the development of incineration technologies and combined heat and power production from landfill gas emitted from closed landfills has begun.

The adaptation or closure of landfill sites that contain waste from the oil shale industry and oil shale fired power plants that did not comply with environmental requirements helps to reduce the load on the environment caused by energy production. Such landfills include the oil shale semi-coke landfills of Kiviõli and Kohtla-Järve, the ash landfills near Narva and some others.

Some key indicators for waste management from the *Environmental Action Plan for 2007–2013* are given in Table 4.14.

Indicator	Current level (2005)	Target (2013)
Amount of deposited municipal waste, kg/cap	283	230
Percentage of separately collected municipal waste (of total municipal waste collected)	11%	30%
Hazardous waste generation (1000 t/a)	7029	6300

Table 4.14. Current and projected indicators of waste handling

The policies and measures, together with their impact on GHG emissions, stipulated in the *National Programme of Greenhouse Gas Emission Reduction for 2003–2012* for the waste management sector are presented in Table 4.15.

Name of policy / measure	GHG affected	Type of instruments	Status	Implementing entity	Period of implementation	Emission reductions 2003-12 Gg (=10^3 t)
New requirements for landfills	CH_4	Regulatory	Ongoing	MoE	2003–07	3.3
Reduction of landfilled waste by 25% (re-cycling, etc.)	CH_4	Regulatory, voluntary	Ongoing	MoE, households, local governments	2003–12	4.2

Table 4.15. Policies and measures in waste management

4.3.8. Land use, land use change and forestry (LULUCF)

Approximately half of the Estonian land area is covered with forest. To promote sustainable forest management, the new *Forest Act* was passed by the Parliament (enforced since 1 January 2007) with the objective of ensuring the diversity of forest ecosystems and preserving the good condition and productive capacity of forests. It also encourages a better economic management and protection of forests, and the achievement of the social and regional objectives related to the forestry sector.

During the last decade, land use in Estonia has changed due to the increasing number of areas left out of use, and this is causing an increase in forest coverage in areas which would otherwise be productive agricultural lands. One of the possibilities for limiting the further

increase in the share of unused lands is the afforestation of protective belts on soils exposed to erosion, and the afforestation of the areas in the vicinity of water bodies, in order to ensure a good condition of the environment. *The Estonian Rural Development Plan 2007–2013* provides a special measure for promoting the establishment of protection forests. The objective of the measure is to ensure a condition of the environment. With the establishment of protection forests, the share of agricultural lands vulnerable to the environment will be reduced and the need to establish protection forests on the account of commercial forests will be decreased.

As over 30% of the forest in Estonia is protected, a monitoring and information system for sustainable forestry has been launched for gathering and analysing forestry information. This geographical information system enables the cross usage of data on the existence, condition and use of forest resources and the environment.

As regards the climate change, it has been considered important to develop and implement a reconstruction programme for land under cultivation which is overgrown and temporarily not used for agricultural purposes. In the *Development Plan of Estonian Forestry until 2010* (approved by the Parliament in 2002) the afforestation of at least 300 thousand hectares of abandoned agricultural lands is planned for. According to estimations, it will help to bind additionally about 1290 Gg of carbon dioxide by the year 2020. Also, natural forest growth on abandoned fields is possible. In that case the CO_2 emissions accompanying forest planting can be avoided. To better organize sustainable forest management the elaboration of the new *Forestry Development Plan for 2020* was initiated by the Ministry of the Environment in 2009.

In Estonia, international voluntary forest certification schemes FSC (Forest Stewardship Council) and PEFC (Programme for the Endorsement of Forest Certification Schemes) have been introduced with the aim of improving sustainability in forestry.

The concept and idea of PEFC certification was initially introduced in Estonia in 1999. In January 2001 the council for forest certification in Estonia – PEFC-Estonia was established. In 2002 the elaboration of national certification standards was initiated. In November 2002 the PEFC General Assembly in Luxembourg accepted Estonia as a new member. In March 2008 the national PEFC certification scheme, including the forest management (FM) standard, chain of custody (CoC) standard, and some additional documents were approved. At present, 14 institutions are members of PEFC Eesti. As of September 2009, PEFC Council has issued five CoC certificates to Estonian entities.

The first FSC certification assessment was carried out in 2000 and FSC forestry certificate was issued to an owner of 600 ha private forest holding. The elaboration of FSC based national standard was completed in 2008. At present (as o2f September 2009) there are 62 FSC registered certificate holders in Estonia – 60 holders of CoC certificates and two FM/CoC certificate holders.

As to the financial support for forestry, during the period of 2004–2006 the measures were provided by the *Estonian National Development Plan for the Implementation of the EU Struc-*

tural Funds – Single Programming Document for 2004–2006. During 2007–2013 the support is given in the framework of the *Rural Development Plan.* For example, in 2007, according to the Estonian Agricultural Registers and Information Board, a financial support of 21.9 MEEK (1.4 MEUR) was delivered for 646 projects in the field of forestry.

The policies and measures, together with their impact on GHG emissions, stipulated in the *National Programme of Greenhouse Gas Emission Reduction for 2003–2012* for the LU-LUCF sector are presented in Table 4.16.

Name of policy / measure	GHG affected	Type of instruments	Status	Implementing entity	Period of implementation	Emission reductions
						2003-12
						Gg (=10^3 t)
Re-forestation of out-of-use agricultural lands (approx. 100 thousand ha)	CO_2	Regulatory / voluntary	Ongoing	MoE, MoE, owners	2003–10	(700)
Re-forestation of used mining areas	CO_2	Regulatory / voluntary	Ongoing	MoE, MoE	2005–13	(7)

Table 4.16. Policies and measures related to LULUCF

4.4. Policies and measures expired or repealed during the reporting period

During the reporting period most of the policies and measures from the previous periods were continued without major changes. Nevertheless, some documents and measures expired due to the arrival of target dates. As a rule, these policy documents were replaced with the new versions, which generally carry on the same policy and apply similar measures. A brief overview of some major documents expired and replaced during the reporting period is given below.

National Environmental Strategy, approved by the Riigikogu (Parliament) in 1997 has been replaced by the *National Environmental Strategy until 2030* that was endorsed by the Parliament in February 2007. Also, the *National Environmental Action Plan* that was based on the objectives and tasks of the previous strategy expired, therefore, in February 2007, the Government approved the new *Environmental Action Plan for 2007–2013* prepared by the Ministry of the Environment.

Long-term National Development Plan for the Fuel and Energy Sector until 2015 approved by the Riigikogu in *December* 2004 has been replaced with the relevant new strategy document – the *National Development Plan for the Energy Sector until 2020* which was approved by the Government in February 2009 and was passed by the Parliament in June 2009.

The *Electricity Sector Development Plan 2005–2015* has been replaced by the new *Electricity Sector Development Plan until 2018* that was endorsed by the Government in February 2009.

Regarding the emission trade, *Estonia's National Allocation Plan* (NAP 1) that had been accepted in October 2004 by the European Commission and had been adopted by the Estonian Government in January 2005, has been replaced with the next *National Allocation Plan* (NAP 2) for the period 2008–2012. Nevertheless, legal action was initiated in the European Court of Justice (case T-236/07) against the EC over its decision to reduce the CO_2 emission gap for Estonia. In its judgment of 23 September 2009 the European Court of First Instance annulled the European Commission decision.

Also regarding the emissions into air, the *National Programme on the Reduction of Pollutant Emissions from Large Combustion Plants (for 1999–2003)*, which approximated the EU Directive 88/609/EEC, has been expired. As a result of the Programme, the emission of pollutants from large combustion plants was reduced substantially: particulates by 56%, SO_2 by 23% and the emission of NO_x by 10%.

The *National Programme for Phasing out Ozone Depleting Substances* approved in May 1999 by the Government has been completed and expired. Since 2002, the main driver in Estonia regarding ozone depleting substances has been the EC regulation No. 2037/2000.

The Estonian National Development Plan for the Implementation of the EU Structural Funds – Single Programming Document 2004–2006 that formed the basis for receiving EU regional structural assistance has expired and been replaced with a new similar document – the *National Strategic Reference Framework 2007–2013* that presents the most general strategic objectives and priorities for developing the policy areas and sectors that are eligible for EU structural assistance during the years 2007–2013. Considering the importance of assistance issues a relevant law – *2007–2013 Structural Assistance Act* – was passed by the Parliament in December 2006.

The *Energy Conservation Programme* has been replaced with the *National Energy Efficiency Programme (Plan) for 2007–2013* prepared by the Ministry of Economic Affairs and Communications and approved by the Government in November 2007.

The Transport Development Plan for 1999–2006 adopted by the Government in 1999 has expired and been replaced with the *Transport Development Plan for 2006–2013* that was approved by the Parliament in January 2007.

Regarding waste management, the *National Waste Management Plan*, approved in 2002 has been repealed and a new strategy document *National Waste Management Plan 2008–2013* was endorsed by the Government in May 2008.

To promote sustainable forest management the previous Forest Act was replaced by the Parliament with the complete new *Forest Act* that has been enforced since 1 January 2007.

V PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES, AND SUPPLEMENTARITY RELATING TO THE KYOTO PROTOCOL MEASURES

5.1. Introduction

The main objective of this chapter is to give an indication of future trends in GHG emissions and sequestration, given the current policies and measures implemented and accepted within the current Estonian climate policies. Projections are given for all greenhouse gases considered in the Kyoto Protocol and for the following sectors: energy (incl. transport), industry, agriculture and waste. They are estimated for the period of 2006 to 2020 and compared to the inventory data for 1990. These projections were compiled on the basis of 2006 data as long as the work was carried out in 2008 when only 2006 data were available.

Two scenarios are presented in this report. First, the "With Measures" (WM) scenario evaluates future greenhouse gas emission trends under current policies and measures. In the second scenario, a number of additional measures and their impacts are taken into consideration, forming the basis of the scenario "With Additional Measures" (WAM).

5.2. Scenarios

5.2.1. Basic considerations

The development of the main energy indicators until 2020 as forecast in the Draft National Long-term Development Plan for the Fuel and Energy Sector until 2020 is presented in Table 5.1.

	2006	2020
The share of oil shale in the Estonian energy balance	60%	<30%
The share of other energy carriers in the Estonian energy balance in 2006 (2020)	Oil products – 14% Natural gas – 16% Wood – 10%	Each <20%
Increase of the share of renewable energy in the final consumption	17.5%	25%
Increase of the share of cogeneration in the gross consumption	12%	20%
As a result of the applied measures, the country will save 9.8 PJ in 2016 (i.e. 9% of the annual average energy consumption of 2001-2005, arising from the Directive 2006/32/EU)	5 PJ (2007)1	9.8 PJ (2016)
Reduction of the network losses (losses relative to gross production)	Electricity -1.07% Heat - 66%2	Decreasing trend
Reduction of the amount of energy used for domestic consumption	114,693 TJ	Decreasing trend
The share of fuels based on the renewable sources among the transport fuels makes up 10% in 2020	0.15%	10%
The emissions of CO_2 of the energy sector are two times less in 2020 compared with 2007	15.7 Mt	7.85 Mt

Table 5.1 Main goals of the Estonian energy sector

5.2.2. With measures scenario for 2006–2020

5.2.2.1. Scenario formulation

Several studies, conducted with regard to the development of the Estonian energy supply, have shown that the level of GHG and especially the amount of CO_2 emission can not be reduced without applying special measures. For the elaboration of the required complex of measures, the plan of renewable sources utilization, outlined in the Estonian energy development projections, was applied. Minimum limits were set for the amount of electricity produced from renewable sources, also for the share of biofuels used in the transport sector. According to these outlines, the following minimum limits for the renewable energy sources utilization for the electricity production in Estonia were projected:

	2006	2010	2015	2020
Wind onshore-medium voltage	0.20	1.00	2.8	2.8
Wind onshore-low voltage	0.00	0.00	0.02	0.04
Wind offshore-medium voltage	0.00	0.00	0.30	4.00
Biomass gas / liquid	0	0.01	0.03	0.07
Biomass solid (wood)	0.00	0.20	1.50	3.40
Total	**0.20**	**1.21**	**5.35**	**10.35**

Table 5.2 Renewable energy sources [PJ/a] for electricity and heat production

Similarly, the minimum share of the bio-fuels used in the transport sector was introduced:

	2010	2015	2020
Min. total share of biofuels	0.08	0.10	0.12

Table 5.3 Minimum level of biofuels used in the transport sector

Tables 5.2 and 5.3 together form the essence of the scenario WM.

Also, this scenario includes building of an additional fluidized bed block in the time period up to 2020.

5.2.2.2. The starting points of the WM Scenario

5.2.2.2.1. Starting situation in Estonian energy sector in 2006

In 2006, the Estonian resources of primary energy amounted to 257 PJ, 208 PJ of which was used for the primary energy supply. About 115 PJ of the amount was used for final consumption, including 25 PJ in industry, 23 PJ in transport, 15 PJ in commercial and public services, and 47 PJ by households. The total GHG emission in 2006 was 19179.7 Gg, 16482 Gg of which was CO_2. In 2006, the main electricity producer was the thermal power plant Narva PP, using oil shale, which was also the main source of atmospheric pollution. Most of the equipment of this plant is made up of old boilers combusting oil shale powder, the lifetime of which is about to expire and all the old blocks should be closed down by 2015. However, it could be possible, if required, to keep using the old blocks which have undergone some modernization. Two of the plant blocks were rebuilt for the fluidized bed technology. These blocks have a better efficiency and emit smaller amounts of volatile particles and sulphur-containing gases; however, their CO_2 emission coefficient does not differ much from the earlier indicators. As a result, the capacity of oil shale based electricity generation is going to decrease in the coming years. At the same time, according to the development plan of the energy sector, the total gross consumption of electricity will grow to the level of 9 – 10 TWh by 2015. To cover this demand, there are plans to rebuild some more blocks on Narva Power Plant based on the fluidised bed technology, but this is not likely to cover the demand. The application of new feed-in tariffs on the level of 73.50 EUR/MWh has provoked the interest of private investors in the energy sector. Therefore, there is currently a remarkable activity of building and designing a new CHP plant using biomass and a lot of applications for the creation of wind farms. This trend makes it possible to project an essential increase in the use of renewable sources, and to reduce the future emission on GHG in the energy sector in Estonia, despite of the fact that the CHP plants using oil shale and implementing the efficient co-production process can use feed-in tariff like the plants using renewable sources.

5.2.2.2.2. Data used in the runs

The base-year data used in this Estonian energy supply development model is based on the data of 2006. The model runs for the period 2006-2020 at five year intervals.

5.2.2.2.3. Discount rates

The model uses the following discount rates per sector:

– Large power and steam generation: 8.2% in 2005 to 9% in 2015-2020
– Small power end steam generation companies: 9.5% in 2005 and 10.5% in 2015 - 2020
– Industry, services, agriculture: 12%
– Households: 17.5%

– Private transport cars: 17.5%
– Trucks, inland navigation: 12%
– Public transport: 8%
– Social discount rate is assumed to be 4-5 %.

5.2.2.2.4. Prices of fossil fuels

The prices used in all the scenarios are based on the constant Euros of 2005. The prices were converted into constant Euros of 2000 using the deflator 1.1075, and are as follows:

	2006	2010	2015	2020	2025	2030
Oil	6.892	6.892	7.322	7.727	7.879	7.942
Gas	4.578	5.248	5.489	5.817	5.969	6.020
Coal	1.797	1.733	1.808	1.859	1.872	1.884

Table 5.4 Prices of fossil fuels, €2000/GJ

5.2.2.2.5. Demographic assumptions and macroeconomic outlook

The population projection used by the model is according to Eurostat. The data for Estonia used in the NEEDS demand projection is determined with the following table of population growth rates:

	2006	2010	2015	2020	2025	2030
Population growth rates	-0.34%	-0.2%	-0.1%	-0.2%	-0.3%	-0.4%
Annual GDP growth rates	3.5%	3.0%	2.7%	2.7%	2.5%	2.3%

Table 5.5 Assumptions on population and GDP growth rates

5.2.2.3. Total consumption of energy

	Total Gross Inland Consumption, PJ				Proportion, %			
	2006	2010	2015	2020	2005	2010	2015	2020
Oil Shale	124.4	87.7	88.0	73.8	55.0	42.8	40.1	33.5
Peat	2.0	4.5	4.5	4.5	0.9	2.2	2.0	2.0
Fuel Oils	8.0	10.9	13.2	20.6	3.5	5.3	6.0	9.4
Transport Fuels	35.2	38.4	42.7	44.3	15.6	18.8	19.4	20.1
Natural Gas	33.9	32.4	34.2	34.8	15.0	15.8	15.6	15.8
Biomass	20.3	30.0	34.2	36.2	9.0	14.6	15.6	16.4
Others	2.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0
Wind	0.3	1.0	2.8	6.0	0.1	0.5	1.3	2.7
Hydro	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total consumption	**226.1**	**204.9**	**219.6**	**220.2**	**100**	**100**	**100**	**100**

Table 5.6 Total Gross Inland Consumption by sources in the WM Scenario in absolute and relative amounts in 2006–2020

As it follows from the table above, the total gross inland energy consumption in Estonia generally remains on the same level for the time period up to 2020, with minor deviations. However, the structure of the primary energy used undergoes some essential changes. These changes become apparent, above all, in the reduction of the use of oil shale as the main energy source, the share of which falls from 54.3% in 2006 to the level of 32.9% in 2020. This reduction of the share of oil shale is balanced with the growth of the use of biomass and wind, also with an increase in the use of natural gas. In fact, no other source of primary energy exceeds 20%, except transport fuels with their share of 20.2% in 2020.

5.2.2.4. Total consumption and production of electricity

Like the total energy consumption, the consumption of electricity in Estonia is not going to increase essentially by 2020 in relation to 2006. There is a remarkable increase of the electricity consumption in industry and a small increase of the consumption in the household sector, while the consumption of electricity in other sectors (incl. commercial, services and agriculture sectors) are decreasing slightly. An essential decrease in the consumption of electricity could be followed in using electricity for heating. That could be considered as a result of the measures applied for the better thermal insulation of houses, written into the base technologies of NEEDS models. However, the growth of the share of wind power from the level of 0.8% in 2006 up to the level of 16.5% in 2020 has to be considered of most significance.

	GWh				Proportion, %			
	2006	2010	2015	2020	2006	2010	2015	2020
Industry	2640.0	4911.8	5638.6	6335.0	25.8	47.7	50.3	53.4
Households	1674.4	1500.0	1586.2	1604.3	16.3	14.6	14.1	13.5
Heating	520.4	338.7	275.4	194.4	5.1	3.3	2.5	1.6
Services	2166.2	1861.1	1805.6	1722.2	21.1	18.1	16.1	14.5
Other sectors	2172.9	707.6	825.9	845.2	21.2	6.9	7.4	7.1
Losses	1077.5	987.9	1084.0	1156.7	10.5	9.6	9.7	9.8
Total Consumption	**10251.4**	**10307.1**	**11215.5**	**11857.8**	**100**	**100**	**100**	**100**

Table 5.7 Electricity consumption in the WM Scenario, 2006–2020

	GWh				Proportion, %			
	2006	2010	2015	2020	2006	2010	2015	2020
Conventional condensate power	8596.6	8388.5	8611.1	8072.0	88.3	82.1	78.1	70.0
CHP heating	1043.3	1525.7	1603.9	1533.2	10.7	14.9	14.5	13.3
Wind power	76.6	277.8	788.9	1900.0	0.8	2.7	7.2	16.5
Hydropower	14.1	22.2	22.2	22.2	0.1	0.2	0.2	0.2
Total production	9730.6	10214.1	11026.1	11527.4	100	100	100	100
Net import	-750	0	0	0	-7.71	0	0	0
Total supply (incl. own use by PP)	**8980.6**	**10214.1**	**11026.1**	**11527.4**	**92.29**	**100**	**100**	**100**

Table 5.8 The structure of the electricity supply in the WM Scenario, 2006–2020

5.2.2.5. Greenhouse gas emissions

5.2.2.5.1. Summary of total emissions

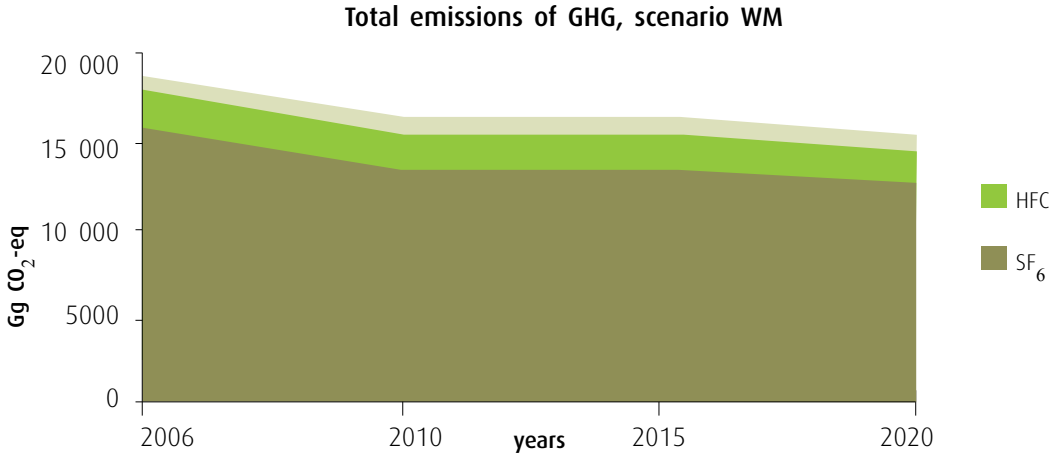

Figure 5.1 Total emissions of GHG in the WM Scenario in 2006–2020 (without LULUCF)

2006	CO_2	CH_4	N_2O	SF_6	HFCs	PFCs	Total
Energy	15,392	881	38	0	0	0	16,311
Transport	2,413	8	6	0	0	0	2,427
Industrial Processes	580	0	0	0,8	75	0	6,56
Agriculture	0	508	694	0	0	0	1,202
Waste	0	608	100	0	0	0	7,08
Total	**15,972**	**1,997**	**832**	**1**	**75**	**0**	**18,876**

2010	CO_2	CH_4	N_2O	SF_6	HFCs	PFCs	Total
Energy	12,512	879	41	0	0	0	13,432
Transport	2,378	7	24	0	0	0	2,409
Industrial Processes	537	0	0	0,85	80	0	618
Agriculture	0	522	748	0	0	0	1,269
Waste	0	547	94	0	0	0	641
Total	**13,049**	**1,948**	**883**	**1**	**80**	**0**	**15,960**

2015	CO_2	CH_4	N_2O	SF_6	HFCs	PCHs	Total
Energy	12,965	840	35	0	0	0	13,840
Transport	2,619	3	19	0	0	0	2,641
Industrial Processes	579	0	0	1	85	0	665
Agriculture	0	535	747	0	0	0	1,281
Waste	0	489	101	0	0	0	590
Total	**13,544**	**1,864**	**882**	**1**	**85**	**0**	**16,376**

2020	CO_2	CH_4	N_2O	SF_6	HFCs	PCHs	Total
Energy	12,215	840	24	0	0	0	13,079
Transport	2,710	3	10	0	0	0	2,723
Industrial Processes	634	0	0	0,95	90	0	597
Agriculture	0	556	747	0	0	0	1,902
Waste	0	403	107	0	0	0	509
Total	**12,850**	**1,798**	**877**	**1**	**90**	**0**	**15,615**

Table 5.9 Emissions by gas and by sector in WM-projection, Gg CO_2-eq (without LULUCF)

5.2.2.5.2. Energy-based carbon dioxide emissions

The main part of carbon dioxide emissions in Estonia comes from the large power plants combusting oil shale. Smaller power plants are adding their share which is, however, inessential. As it can be seen from the table and graph below, the reduction of the oil shale consumption in 2015-2020 involves an essential reduction of CO_2 emissions in the energy industry, which could be calculated as a decrease of 25%. This number exceeds the level set as a goal in the development plan. However, taking into account the increase of CO_2 emissions from transport and industry, the total amount of the GHG reduction is approximately 20%. Hence, it is evident that the measures applied in this scenario for CO_2 emission reduction had given the desired results.

	2006	2010	2015	2020
Energy Industries	15,392	12,512	12,965	12,215
Manufacturing Industries and Construction	539	368	418	439
Transport	2,413	2,378	2,619	2,710
Other Sectors	336	293	332	340

Table 5.10 Scenario WM, emission of CO_2, Gg

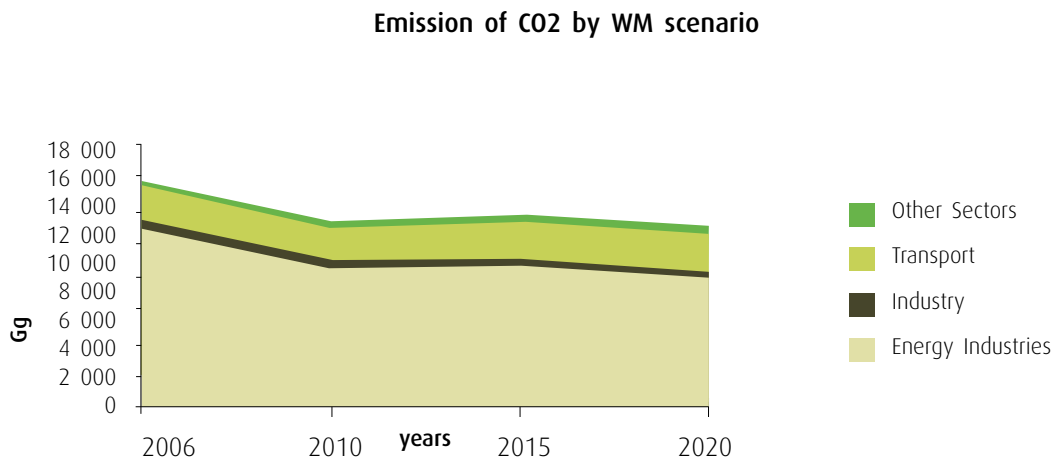

Figure 5.2 CO_2 emissions of energy production and use for each sector in the WM Scenario in 2006–2020

5.2.2.5.3. CO_2 emissions from the Industrial Processes sector

The main sources of the remaining CO_2 emission are the industry of mineral products and chemical industry. The emission of CO_2 in the mineral products industry comes from three processes – cement and lime production and ammonia production, where the cement and lime production has the share of 92%, leaving 8% for ammonia production. The source of CO_2 emission in Estonia in the chemical industry is only ammonia production. The emissions from the production of mineral products are showing a small decrease and emissions from the chemical industry a certain increase. However, the levels of CO_2 emission from all these sources do not exceed 4% of the total emission, and therefore they do not deserve special attention in the measures for the reduction of total GHG emissions.

	CO_2 emissions (Gg)			
	2006	**2010**	**2015**	**2020**
Cement production	414	420	411	415
Lime production	31	23	24	25
Chemical Industries	135	94	144	194
Total	**580**	**537**	**579**	**634**

Table 5.11 CO_2 emissions from other sources in the WM scenario in 2006 – 2020

5.2.2.5.4. Methane

The main methane emission into air comes from three sectors. These sectors are: energy, agriculture, and waste management. The main source of CH_4 emission in the energy sector is fugitive emission from fuel, where about one-third comes from oil shale mining and two-

third from oil and gas handling. From the last, the main share belongs to the various gas leakages in the system and by end users. The main source of CH_4 emission in agriculture is enteric fermentation, where 99% of CH_4 emission comes from cattle and about 1 % from other stock.

As shown in the table, CH_4 emission is clearly decreasing in the waste management, whereby the CH_4 emission from energy is slightly decreasing while in agriculture it is slightly growing. The change trend in the waste management determines the total decreasing trend of the total CH_4 emission.

	CO_2-eq (Gg)			
Methane (CH_4)	2006	2010	2015	2020
Energy	881	879	840	840
Agriculture	508	522	535	556
Waste	608	547	489	403
Total	**1,997**	**1,948**	**1,864**	**1,798**

Table 5.12 Methane emissions in the WM scenario in 2006–2020 (without LULUFC)

5.2.2.5.5. Nitrous oxide

There are three sectors giving nitrous oxide emission: energy, agriculture and waste management, whereby the main N_2O producer is agriculture accounting for about 83% of the total emission, leaving about 12% to the waste management and 4.5 % to the energy sector. In agriculture, most of N_2O emission is coming from direct and indirect N_2O emission from agricultural soil, where the share of direct emission is about two-third and indirect emission about one-third, leaving a small, but an increasing part of N_2O emission to pasture manure. Small amounts of nitrous oxide emission originate from the energy sector where the emission producers are electricity production, households and road transport, but their share, as mentioned already, is small.

In general, it could be concluded that the total emission of nitrous oxide exhibits a growing trend during the period under consideration.

	2006	2010	2015	2020
Energy	38	41	35	24
Agriculture	694	748	747	747
Waste management	100	94	101	107
Total	**832**	**883**	**882**	**877**

Table 5.13 Emissions of nitrous oxide in the WM Scenario in 2006–2020, Gg CO_2-eq

5.2.2.5.6. F-gases

In 2006, greenhouse gas emissions from F-gases amounted to 75.98 Gg CO_2 -eq, which is about 0.4% of the total greenhouse gas emissions in Estonia. In 2007, the corresponding number was about 0.66%. The absolute value of GHG emissions from F-gases will increase in the future, but the share of F-gases emissions in total GHG emissions will still be relatively small, i.e. less than 1%.

	CO_2-eq (Gg)				Index, 2006=100			
	2006	2010	2015	2020	2005	2010	2015	2020
F-gases	75.98	80.85	85.90	90.95	100	106	113	120

Table 5.14 Emissions of F-gases in the WM Scenario in 2006–2020

5.2.3. With additional measures scenario for 2006–2020

5.2.3.1. Description of the scenario "With Additional Measures"

By construction of the scenario WAM, the following additional requirements were added to the set of data, building up the scenario WM: building of additional offshore wind farms with an annual electricity production of 4 PJ. As a result, the user constraint for the scenario was set up as follows:

	2006	2010	2015	2020
Wind onshore-medium voltage	0.20	1.00	2.8	2.8
Wind onshore-low voltage	0.00	0.00	0.02	0.04
Wind offshore-medium voltage	0.00	0.00	0.30	8.00
Biomass gas / liquid	0	0.01	0.03	0.07
Biomass solid (wood)	0.00	0.20	1.50	3.40
Total	**0.20**	**1.21**	**5.35**	**14.31**

Table 5.15 Energy from renewable [PJ/a] by the WAM scenario

The same conditions as for scenario WM were held for the renewable use in the transport sector. Also, this scenario expects building of the second additional fluidized bed block in Narva Power Plant.

The starting points of the WAM are the following:

Energy

	Primary energy, PJ				Proportion, %			
	2006	2010	2015	2020	2006	2010	2015	2020
Oil Shale	124.44	87.86	84.11	49.98	55.0	43.0	38.8	24.3
Peat	1.97	4.5	4.5	4.5	0.9	2.2	2.1	2.2
Fuel Oils	8.01	12.66	11.61	21.2	3.5	6.2	5.4	10.3
Transport Fuels	35.16	38.34	42.68	44.3	15.6	18.7	19.7	21.5
Natural Gas	33.9	32.21	35.7	38.87	15.0	15.7	16.5	18.9
Biomass	20.26	27.94	35.21	35.84	9.0	13.7	16.2	17.4
Others	2.04	0	0	0	0.9	0.0	0.0	0.0
Wind	0.27	1	2.84	10.84	0.1	0.5	1.3	5.3
Hydro	0.05	0.05	0.05	0.05	0.0	0.0	0.0	0.0
Total consumption	**226**	**205**	**217**	**206**	**100**	**100**	**100**	**100**

Table 5.16 Consumption of primary energy source by sources in the WAM Scenario in absolute and relative amounts in 2006-2020

	2006	2010	2015	2020
WM scenario	9,732	10,197	11,009	11,510
WAM scenario	9,732	10,255	10,807	10,950

Table 5.17 Electricity consumption in the WM and WAM Scenarios in 2006–2020, GWh

	GWh				Proportion, %			
	2006	2010	2015	2020	2006	2010	2015	2020
Conventional condensate power	8,597	8,388	8,611	8,072	88,3	82,1	78,1	70,0
CHP heating	1,043	1,526	1,604	1,533	10,7	14,9	14,5	13,3
Wind power	77	278	789	1900	0,8	2,7	7,2	16,5
Hydropower	14	22	22	22	0,1	0,2	0,2	0,2
Total production	9,731	10,214	11,026	11,527	100	100	100	100
Net import	-750	0	0	0	-7,71	0	0	0
Total supply (incl. own use by PP)	**8981**	**10197**	**11009**	**11510**	**92,3**	**100**	**100**	**100**

Table 5.18 Supply of electricity by the WAM Scenario in 2006–2020

5.2.3.1.2. Emissions from the Industrial Processes sector

Considering the emissions from other sources in the WAM scenario, compared with those in the WM scenario, it could be concluded that the emissions from the industrial sector do not change essentially with the change of the scenario. The same emission trends and values that could be followed within the WM scenario could be followed within the WAM scenario as well. In general, the changes in the amount of CO_2 coming from other sources do not influence the development of energy supply in Estonia.

	CO_2 emissions (Gg)			
	2006	2010	2015	2020
Mineral Products	445	443	435	440
Chemical Industries	135	89	139	187
Total	**580**	**532**	**574**	**627**

Table 5.19 CO_2 emissions from other sources in the WAM scenario in 2006 – 2020

5.2.3.2. Summary of emissions

2006	CO_2	CH_4	N_2O	SF_6	HFCs	PFCs	Total
Energy	15,392	881	38	0	0	0	16,311
Industrial Processes	580	0	0	0,8	75,18	0	656
Agriculture	0	508	694	0	0	0	1202
Waste	0	608	100	0	0	0	708
Total	**15,972**	**1,997**	**832**	**1**	**75**	**0**	**18,876**

2010	CO_2	CH_4	N_2O	SF_6	HFCs	PFCs	Total
Energy	12,652	780	42	0	0	0	13,474
Industrial Processes	532	0	0	1	78	0	611
Agriculture	0	501	748	0	0	0	1,248
Waste	0	547	94	0	0	0	641
Total	**13,184**	**1,828**	**78**	**1**	**78**	**0**	**15,974**

2015	CO_2	CH_4	N_2O	SF_6	HFCs	PCHs	Total
Energy	12,564	704	36	0	0	0	13,303
Industrial Processes	574	0	0	1	83	0	658
Agriculture	0	493	746	0	0	0	1239
Waste	0	489	101	0	0	0	590
Total	**13,138**	**1,685**	**883**	**1**	**83**	**0**	**15,790**

2020	CO_2	CH_4	N_2O	SF_6	HFCs	PCHs	Total
Energy	9,837	677	24	0	0	0	10,538
Industrial Processes	627	0	0	1	97	0	725
Agriculture	0	493	746	0	0	0	1,239
Waste	0	403	107	0	0	0	509
Total	**10,465**	**1,572**	**877**	**1**	**97**	**0**	**13,012**

Table 5.20 Emissions by gas and by sector in the WAM scenario, Gg CO_2-eq (without LULUFC)

5.2.4. Comparison of the WM and WAM Scenarios

The comparison of the total inland energy consumption within both scenarios leads to the conclusion that installing additional generating capacities in offshore wind farms, closing old oil shale bocks and building additional fluidized bed blocks in Narva Power Plant has involved an essential decrease of the consumption of the primary energy from the level of 220 PJ by scenario WM down to 206 PJ by scenario WAM. That is mainly due to changes in the structure of the generation and essential decrease of the generation from oil shale. The consumption of oil shale drops from the level of 74 PJ in the WM to the level of 50 PJ in the WAM. Use of the biomass is showing a small decrease from 36.2 PJ to 35.9 PJ, whereby the use of wind energy is increasing from 6 PJ in the WM up to 10.8 PL in the WAM. The reduction of the total electricity consumption from WM to WAM could be explained with the disuse of auxiliary power consumption of old oil shale blocks.

	2006	2010		2020	
		WM	WAM	WM	WAM
Oil Shale	124.4	86.4	86.1	72.7	48.7
Coal and Coke	1.3	1.3	1.8	1.0	1.3
Natural Gas	33.9	32.3	32.2	36.2	38.9
Fuel Oils	8.0	10.9	12.7	20.6	21.2
Motor Fuels	35.2	38.4	38.3	44.3	44.3
Peat	2.0	4.5	4.5	4.5	4.5
Wood-based fuels	20.3	30.0	27.9	36.2	35.8
Hydropower and wind power	0.3	1.0	1.1	6.0	10.9
Total	**229**	**205**	**205**	**220**	**206**

Table 5.21 Total Gross Inland Consumption in the WM and WAM Scenarios in 2010 and 2020 (PJ) and the actual consumption in 2006

	2006	2010		2020	
		WM	WAM	WM	WAM
Carbon dioxide	15,972	13,049	13,184	12,850	10,465
Methane	1,997	1,948	1,828	1,798	1,572
Nitrous oxide	832	883	884	877	887
F-gases	76	81	79	91	98
Total GHG emissions	**18,877**	**15,960**	**15,974**	**15,615**	**13,012**

Table 5.22 Greenhouse gas emissions in the WM and WAM Scenarios in 2010 and 2020 (Gg CO_2-eq) and the actual emissions in 2006

The total reduction of GHG emission of 2605 Gg in 2020 while applying the WAM scenario instead of the WM scenario is essential and enables to conclude that the application of all the measures of the WAM scenario is real and profitable, and should be practically implemented.

All in all, it could be concluded that it is possible to use the NEEDS model for GHG projections, although it must to be said that the NEEDS model itself is still not flexible enough and needs further improvement for its wider applications.

5.2.5. Considerations of sensitivity

5.2.5.1. Rough comparison of GHG emissions of both scenarios

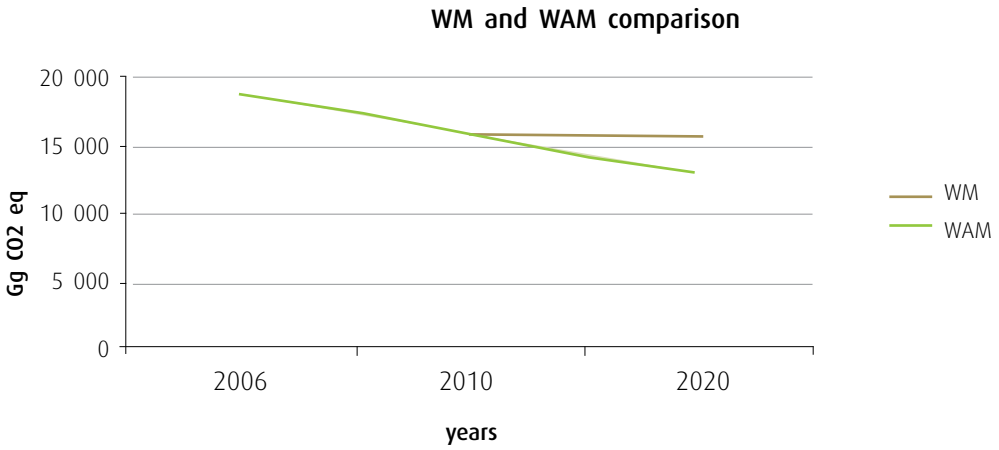

Figure 5.3 Greenhouse gas emissions in the WM and WAM scenarios

The comparison of the emission paths of the WM and WAM scenarios does not yield much information about the sensitivity of the applied measures inasmuch as different measures for the reduction of greenhouse gases are applied. The application of WAM measures leads to a total reduction of GHG of 2739 Gg by 2020 in comparison with the scenario WM. Still, this approach does not give any numerical value for the sensitivity evaluation, hence, other methods for sensitivity evaluation could be applied.

Sensitivity consideration	2006	2010	2020
WM	18876	15960	15615
WAM	18876	15974	13012

Table 5.23 Greenhouse gas emissions in the WM and WAM emission paths.

5.2.5.2. Another approach to the sensitivity analysis methodology

The methodology developed for the given case is rather an attempt at groping the possible ways of determining the sensitivity of NEEDS/TIMES energy development models.

The proposed methodology used could be expressed as follows:

At the given state of the development of the NEEDS/TIMES model of the PanEU energy supply development model, one of the possible ways for the sensitivity analysis of a country model is the following.

To proceed with the scenario "With Measures", the scenario-specific minimum limits are set up for the amount of electricity generated by different renewable energy sources.

For instance, for the wind offshore electricity generation, the minimum limit for 2020 is set at 4.0 PJ. If this limit is raised for 2020 by 1 PJ and will have for the new scenario, that could be called, for instance, Exp-1, the last column of the file UC_ELC will be following:

	2020
Wind onshore-medium voltage	1.00
Wind onshore-medium voltage, new	1.80
Wind onshore-low voltage	0.04
Wind offshore-medium voltage	5.00
Biomass gas / liquid	0.07
Biomass solid (wood)	3.40
Total	11.31

Table 5.24 Energy from renewable [PJ/a]

With this new user constraint model, the EE model for the scenario EXP-1 is run and the results of earlier solutions are compared with those obtained for the scenario "With Measures". The comparison of the differences in the electricity production and the CO_2 emission in 2020 should give the sensibility factor for the EE model.

5.2.5.3. Sensitivity analysis results

For comparison, the summary tables for electricity production and emission of CO_2 for both scenarios WM an EXP-1 are as follows:

Scenario		2020
	CHP	5.9
	ELE	35.27
EE-Exp-1	Total	41.17
	CHP	5.9
	ELE	35.27
EE-WM	Total	41.17

Table 5.25 Electricity production, scenario "WM", PJ

Scenario		2020
EE-Exp-1	$AGRCO_2$	120.18
	$COMCO_2$	245.30
	$ELCCO_2N$	9026.82
	$INDCO_2N$	932.26
	$INDCO_2P$	254.01
	$RSDCO_2$	191.97
	$SUPCO_2$	139.59
	$TRACO_2$	2595.68
EE-Exp-1	**Total**	**13504.81**
EE-WM	$AGRCO_2$	120.18
	$COMCO_2$	245.50
	$ELCCO_2N$	9235.86
	$INDCO_2N$	945.56
	$INDCO_2P$	254.01
	$RSDCO_2$	191.97
	$SUPCO_2$	139.59
	$TRACO_2$	2595.68
EE-WM	**Total**	**13728.17**

Table 5.26 Emissions of CO_2 for scenario WM and Exp-1

The comparison of both tables given above enables to make the following conclusions:

Electricity production by the scenario EE_Exp-1 in the public power plants is 41.17 PJ in 2020 by scenario WM and 41.17 PJ in public power plants in 2020 by scenario EXP-1. Thereby the emission of CO_2 from the electricity and heat producing processes was 13505.81 Gg in 2020 by the EXP-1 scenario and 13728.17 Gg by scenario WM for the same year.

Hence, the increase of the energy production from the renewable sources has resulted in a decrease of the CO_2 emission of 223.0 Gg or thousand tons.

5.2.6. Projections of the total aggregated GHG emissions

Projections of the total aggregated emissions (converted to CO_2 –eq using GWP) for the three scenarios of WM, WAM and WOM (Without Measures) in the period 2005-2020 are summarized in Table 5.27 and Figure 5.4. Figure 5.4 illustrates the level of the aggregated emissions corresponding to the national reduction target under the Kyoto Protocol (2008-2012) and post-Kyoto target (2012-2020). The courses in the Figure show that in the case

of a balanced economic development of Estonia, the Kyoto Protocol reduction target and a new EU energy policy target (20% reduction of the 1990 GHG emissions by 2020) is far away for all the considered scenarios, even without implementing any specific mitigation measures.

	1990	1995	2000	2005	2006	2010	2015	2020
WM	41,593	20,803	18,246	19,313	18,876	15,960	16,376	15,615
WAM	41,593	20,803	18,246	19,313	18,876	15,974	15,790	13,012
WOM	41,593	20,803	18,246	19,313	18,876	17,915	19,187	19,041

Table 5.27 Projections of the total aggregated GHG emissions, Gg CO_2-eq

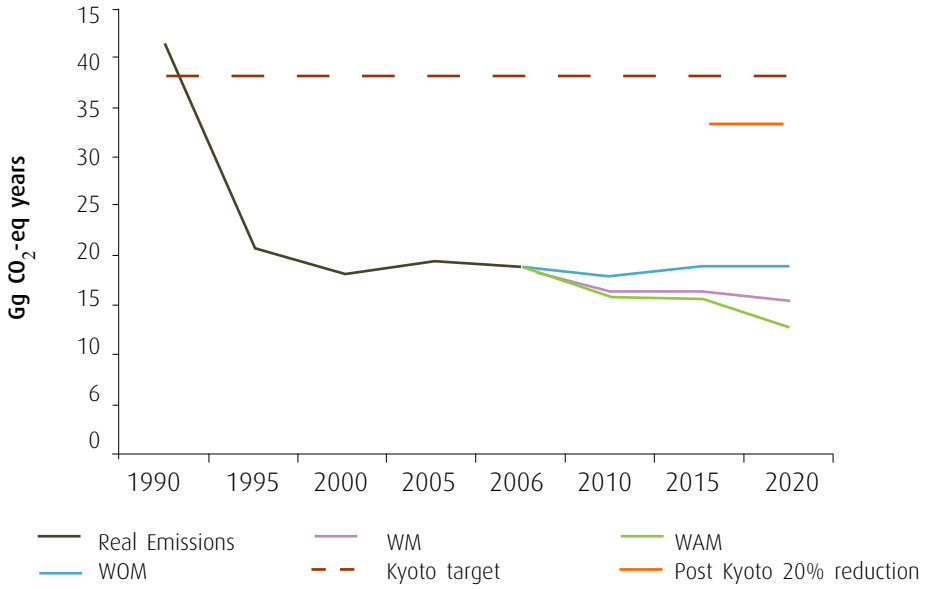

Figure 5.4 Historic and projected emissions of GHG, in Gg CO_2-eq

5.3. Supplementarity relating to mechanisms under Article 6, 12 and 17, of the Kyoto Protocol

Estonia does not have a problem with the 8% reduction commitment under the Kyoto protocol as it is currently 50% below the base-year emissions. Hence, there is no significant research and effort put into domestic action in order to meet the Kyoto target.

According to Estonia's Joint Implementation Guidelines, the projects already implemented or projects presented in a national strategy or a development scheme/programme can not be implemented as Joint Implementation projects.

5.4. Methodology

Unlike the previous GHG projections, these projections are based on the use of the energy supply development model **NEEDS** (or NEEDS/TIMES). This energy development model is elaborated in the framework of the Sixth Framework Program within the project "New Energy Externalities Development for Sustainability" (NEEDS). The development was carried out as an Integrated Project under the EU 6th Framework Programme addresses Priority 6.1: Sustainable Energy Systems and, more specifically, Sub-priority 6.1.3.2.5: Socio-economic tools and concepts for energy strategy. The team participating in the PanEU energy model elaboration included 66 partners from 26 countries and presented a mix of universities, research institutions, industries and NGOs. The main objective of the elaboration of the NEEDS was to evaluate the full costs and benefits (i.e. direct + external) of energy policies and of future energy systems, both at the level of individual countries and for the enlarged EU as a whole. This huge amount of work, related to the development of the model of a large region and a number of countries inside it, had to provide a tool for the projection of and planning of the energy supply development in the EU as a whole as well in each member country.

The tool selected for this modelling is the Integrated MARKAL-EFOM System (TIMES). This tool is being developed in collaboration with the Energy Technology Systems Analysis Programme (ETSAP), which is one of some 40 Implementing Agreements of the International Energy Agency. A long-term time horizon (2050, by 5-year step) is used to support the definition of long-term strategies, taking into account different standards of energy devices and technologies development.

The main source for the base-year of all countries of the model is the Eurostat database. The section "Energy and Environment" of this database provides all the energy flows for the base- year (2006), as well as the installed capacities for power plants and import/export

figures. Methodological consistency with other important global energy modelling efforts (US-EIA) is maintained using the VEDA database system for the NEEDS/TIMES national and Pan-European models.

5.4.6. Description of the NEEDS model

NEEDS (or NEEDS/TIMES) country's energy supply development model consists of two parts. One part of the model contains

- Data common for all the countries belonging to the PanEU region;
- Data characterising the development of all sectors and sub-sectors for every country of the PanEU model;
- Data characterising the optimisation time domain.

The second part of the country's model represents the data of a certain country and consists of models of five economy sectors.

5.4.1.1. System part of the model

The system part of the model consists initially of two folders and one file.

One of these folders is called SubRES_TMPL. This folder contains two files: the SUBRES_B-NewTechs and SUBRES_B-NewTechs_Trans. The first of them represents a collection of data of all possible new technologies for all sectors of economy.

For the energy sector, the sheet ELC contains 45 possible technologies for electricity production, including combined cycles gas turbines, lignite combusting power plants with steam turbines and CO_2 sequestering, nuclear power plants, fuel cells generators, etc. For each technology, there are given a total of 35 parameters, including the variation of investment costs for this technology during the time period, also permanent and variable costs and emission coefficients for these technologies. 30 different technologies are recommended for public CHP plants, 25 technologies for industrial auto-producers, and 18 for electricity and heat production in the commercial sector, 7 different technologies for public heat production and 4 for CO_2 storage.

The sheet TRA contains new technologies for transport vehicles. The table begins with small cars using gasoline, diesel fuel, methanol, ethanol, dimethylether, bio-diesel, and FT diesel, gaseous and liquid H2. Following are presented large cars, intercity and urban buses, heavy-duty trucks, and motorbikes. For each transport technology, there are given the values of efficiency and investment costs and their changes in time horizon. Also, data on the fuel infrastructure and rail transport fuels are given on this sheet.

The sheet IND contains about 300 different technologies for industry, including 18 new technologies for pulp and paper industry and about 120 for other industries. For the technologies, there are given energy sources, efficiencies, investment and permanent costs.

The sheet RCA contains data on the technologies for residential, commercial and agricultural sectors. The technologies of space heating, water heating and space cooling in the commercial sector are addressed. The same technologies are presented for the residential sector, for multi-apartment and rural conditions. Different heat pumps are included.

Solar collectors with diesel backup etc are covered. Economic data of all technologies are given.

The last sheet in this EXCEL file - sheet SUP- gives a collection of possible technologies for primary and secondary energy conversion. It includes the technologies of gasification of black liquor to DME, fermentation of crops to ethanol, H2 production biomass gasification and import of bio-fuels.

The file SUBRES_B-NewTechs_Trans contains 15 sheets with various coefficients of the availability and efficiency for solar, wind, residential, transport and industrial technologies for all member states, including the EE region. The last sheets are connected with CO_2 storage and trade.

The second folder − Suppxls contains 23 EXCEL files, including the file Scen_DemPrj_General that presents the demand changes in all the sectors and sub-sectors of all member countries of the PanEU region. This file could be considered the main driver for the time development of the whole PanEU energy supply system during the period of 2000 up to 2050, including the development of the Estonian energy supply system development. The file also contains the emission coefficients for all GHG for all countries are given. In addition to the system parameters and given parameters of the regions, this folder contains all files, representing constraints, set by the model user. There are 10 files, which enable to set limits to various system variables. For instance, the folder Scen_CO_2 enables to limit the amount of CO_2 emitted by the electricity and heat generation, Scen_UC_CLIC enables to limit the use of fluorescent and halogen lightning, Scen_UC_ELC enables to set the upper and lower limits for different electricity generation technologies, use of renewable sources and nuclear energy included. Scen_UC_TRA enables to set limits for various technologies (i.e. for the use of different fuels) in the transport sector. The latter two files are those that, together of the file Scen_CO_2, will be used for the modelling of different scenarios in the EE model as long as we do not have the facility to model different policies.

In the model run, the program system adds two additional folders – one folder with log files and another folder with the system database. This database is open for system programmers only and model users do not have any access to this part of data.

5.4.1.2. Country model

The second part of the model, the country model, consists of 5 sector files:

- File EE_ELC, representing the Estonian base-year data for electricity and heat generation system i.e. ELC sector;
- File EE _IND, containing the base-year data of the main sub-branches of Estonian industry (IND sector);
- File EE_RCA, presenting the base-year (2005) data of the residential, commercial and agricultural sectors of economy (RSD, COM and AGR sectors);
- File EE_SUP, where the data of primary energy resources and supply, and export-import facilities and constraints for the EE region are presented (SUP sector);
- File EE_TRA – containing all the base-year data for the Estonian road and rail transport.

File EE_ELC is an ERXCEL file that consists of 11 sheets, the first of them being the balance sheet, representing the electricity and heat balance of the Estonian power system.

It begins with the base-year energy flows from the Eurostat, followed by the base-year data aggregated by sector fuel. Next, there are the tables with ELC technology capacity split by fuel and CHP technology capacity by fuel follows. The user must balance the production capacities with the base-year utilisation factors with the data from Eurostat and from the model.

The next sheet in the file is the EPLT sheet. The sheet contains data on the capacity of public electric power plants with its all-characterizing parameters. In this regard, it has to be mentioned that in the time horizon, the life cycle of the energy equipment is presented, proceeding from the age of the equipment in the base year, also the change of the efficiency and availability factors of the equipment in time periods

The sheet of public power plants is followed by data on CHP plants, arranged by the same principles as the EPLT sheet. Thereafter, hydro- and wind power generation and nuclear power plants are presented (3 sheets). One sheet presents all commodities related to the electricity and heat generation, including the corresponding emissions. Commodities notations, descriptions, units and limits are given. The sheet with the caption “ELC fuels” contains the base-year infrastructure for electricity fuels, also a new infrastructure. The stock for 2050 is given for the base-year fuels, whereas the investment costs are given for the new fuels. On the following sheets, there are emission and other coefficients and a list of electricity and heat generating processes.

The file EE_IND consists of 17 lists, the first of them giving the energy balance of industry

branch of economy. This sheet presents the Eurostat data on the energy consumption of all main industry sub-branches and balancing of these data with the final energy consumption in non-ferrous metal, chemical, pulp-and-paper and other industries. The next separate sheets present data on the main sub-branches of the industry. The closing sheets cover non-energy consumption, emission coefficients in the industry and related processes.

The file EE_RCA contains 22 sheets and consists of three main parts, representing data on the residential, commercial and agricultural branches of economy. The RSD part of the model is based on the number of three types of dwellings – rural, urban and multi-apartment dwellings. The energy parameters of the commercial sector are based on the total number of square meters and their division into large and small enterprises. The AGR sector is represented just as one equivalent process. Separate sheets are given for fuels of each of the three sectors, one for the emissions of these sectors and one for the used processes.

The file EE_SUP consists of 11 sheets and contains data about primary energy production, transformation to secondary energies, export and import of energy carriers and electricity. The primary energy production includes mining of oil shale, the main local energy carrier for Estonia. The trade sheet distinguishes the import and export from and to Russia, Rest-Of-the-World (ROW), Europe and OPEC. It is possible to add different exporters and importers.

The file EE_TRA presents data of all kind of transport in Estonia. The file consists of 12 sheets, and considers energy consumption by cars, buses, motorbikes and rail transport, based on the number of corresponding vehicles and the average values of their use.

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VI VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

6.1. Introduction

The impacts of climate change in Estonia are relatively small compared to the southern and northern regions of Europe. Therefore no significant consequences are expected for biodiversity or public health. Some species may disappear and some new species will probably emerge, but these changes are quite negligible.

The rise in temperature and precipitation will have a positive rather than negative effect on Estonian economy. For example, it will probably be favourable for agriculture, especially grassland husbandry. The total growing season will lengthen and a greater number of harvests will become possible. In the case of higher temperatures and higher rainfall, the growth and development of herbaceous plants will quicken and harvesting times will shift to an earlier period. Livestock will be better provided with fodder in summer and winter.

The main hazards and economic losses in Estonia will result from the rise of sea level which will cause flooding in coastal areas, the erosion of sandy beaches and the destruction of harbour constructions.

6.2. Estonia's climate – observed changes

6.2.1. Changes in temperature

According to the Intergovernmental Panel on Climate Change (IPCC) the territory of Estonia lies within the region where the most significant increase in air temperature has been observed over the past few decades. The annual mean air temperature in Estonia increased by 1.0-1.7 °C during the second half of the 20th century. Seasonality plays an important part in climate warming in Estonia. A statistically significant increase in the monthly mean temperature is present only during the period from January to May, with the greatest increase in March (up to 4 °C). For the rest of the year, practically no change in the annual mean air temperature has been identified.

6.2.2. Changes in precipitation

Precipitation is the most variable climatic characteristic in Estonia. Its extreme values cause severe droughts and floods which have a significant influence on human activity. Since 1966 precipitation series in Estonia have been homogeneous. They indicate an increase during the cold half-year and also in June. A significant increase in precipitation has occurred in winter period (29%).

6.2.3. Changes in snow cover

The duration of snow cover and sea ice decreased significantly during the second half of the 20th century. Over this period, the date by which sea ice appears has been very consistent, but the date by which it disappears at the end of winter has become earlier. The end of winter and the start of spring occur much earlier than before (by 19–39 days).

Snow cover is an indicator of climate changes. Reduced snow cover and surface albedo in late winter and early spring, caused by increased temperature, strongly intensifies the absorption of solar radiation on the surface and thereby leads to an additional increase in air temperature near the surface. Snow cover duration, its maximum depth, water equivalent, surface albedo, and air temperature in winter-spring all over Estonia depend partly on the extent of ice cover on the Baltic Sea.

The earlier melting of the snow cover causes changes in the hydrological regime. For instance, rivers reach their point of maximum runoff earlier and the magnitude of such runoff is generally smaller. The water content of the soil is comparatively smaller and drought conditions appear earlier. Drier climatic conditions in spring and in the first half of summer are projected for Estonia in the future.

6.2.4. Changes in wind

Estonia is situated on the eastern coast of the Baltic Sea that is a region with intensive cyclonic activity; therefore Estonia has a relatively high mean wind speed. The Baltic Sea itself is a very important factor affecting wind climate, it has an especially strong influence on the wind regime in coastal areas.

Over the last century the mean wind speed increased by 0.5-0.8 m/s. The increase of mean wind speed is characteristic mainly of the cold season (November to February). No significant change in wind speed is observed during the warm period (May–July).

The distribution of wind directions was analysed at the Vilsandi station (the westernmost station in Estonia located on the coast of the Baltic Sea proper) during 1966–2005 and the results indicate quite substantial changes in the frequency of wind directions. Generally, south-westerly and westerly winds have increased, whereas north-easterly, easterly and south-easterly winds have decreased. The winds of maximum frequency have changed from south-east to south-west.

Semi-realistic simulations using a 2D hydrodynamic model demonstrate that a relative modest (2 m/s) increase in mean wind speed can yield a mean sea level increase of 2–5 cm in the study area. Changes of similar magnitude probably occurred already between 1950 and 1990, and several climate modelling studies anticipate further changes in the wind regime.

6.2.5. Extreme weather events

According to the IPCC an extreme weather event is an event that is rare within its statistical reference distribution in a particular area. In Europe the most common extreme weather events are heat or cold waves, floods, windstorms, droughts, fires and snowstorms. The occurrence of extremely high or low precipitation (leading to flood or drought), storms and floods have been studied in more detail in Estonia.

A study for determining the extreme wet and dry days during the past 50 years confirmed that the inter-annual variability of the number of extreme wet, extreme dry and total extreme days shows an apparent increasing trend in Estonia. The increase of the annual number of extreme wet and dry days put together clearly indicates the rising trend of extreme precipitation events in Estonia during the period of 1957–2006.

The ASTRA winter storm study concludes that flooding and storms (especially during winter season) are already a major threat in the Baltic Sea Region. The impact of storms is enhanced when extreme weather events follow each other in a time span shorter than the recovery time of the given ecosystem. Furthermore, the severity of storms is increasing with prolonged ice free periods due to the mild winter climate. Storm winds and the changes in the atmosphere pressure cause sea level fluctuations on the coast.

The impact of the sea level rise is considered to be the most influential factor for flood damage. When several unfavourable conditions (wind speed and direction, general water level and long waves in the Baltic Sea) coincide, a short-time sea level rise of 1–2 meters may occur and several places may be inundated. The areas most influenced by this are the coastal zones of shallow bays in Western Estonia with natural landscapes and dispersed settlements.

6.3. Expected impacts of climate change

6.3.1. Coastal areas

Estonian tidal measurements over the period 1842–2005 suggest a mean sea level rise (adjusted to account for land uplift) of 1.5–2.1 mm/yr over the last century. The trend in Pärnu County (2.3–2.7 mm/yr) is greater than the estimated mean global sea level rise. The excessive rise in both the mean and the maximum sea level can be accounted for by the local sea level response to the changing regional wind regime and the intensification of cyclones. The main threats connected with sea level rise are the flooding of coastal areas, the erosion of sandy beaches and the destruction of harbour constructions. Also a number of valuable natural ecosystems will be in danger. These include both marine and terrestrial systems containing rare plant communities and suitable breeding places for birds.

The increase in wind speed leads to enhanced water exchange through straits, as well as to the strengthening of the basin-scale circulation. Near coasts a relatively small wind speed

increase presumably enhances alongshore currents, and at certain sections along the coast, it may produce an up to twofold increase in the bottom stresses.

The relationship between storminess and shoreline changes in different areas and particularly on Harilaid Peninsula (the North West coast of the island Saaremaa) is relatively strong. An analysis of shoreline changes shows that shore processes have intensified over the last 20 years, the majority of the changes occurring during stormy periods. Shoreline changes have been 4–10 times greater in recent decades than before. The intensification of shore processes is well correlated with the increased annual storminess and the higher sea levels but also with the absence of ice cover near the coast in recent decades. This combination induces intense erosion and transport of sediments above the mean sea level and the mean shoreline, leading to substantial changes in coastal morphology that persist for years or even decades.

Changes in shoreline position and contours are greater at the areas that are well exposed to the open Baltic Sea and to the dominating stormy wind sectors. In general, changes in shoreline position and contours are also greater in areas with more rapid land uplift. The least changes in shoreline position and contours occur on active coasts in North Eastern and South Western Estonia.

6.3.1.1. Storm of January 9, 2005

A cyclone called Gudrun in the Nordic countries developed over the North Atlantic and travelled over the British Isles, Scandinavia, and Finland on January 7–9, 2005. As a result of the high initial levels of the Baltic Sea, the fast moving cyclone with a favourable trajectory and strong south westerly and westerly winds created a record high storm surge (275 cm) in Pärnu County, as well as in many other locations along the West Estonian coast. The January storm included clearly visible changes in the shore development and the dynamics of beach sediments over almost all of Estonia. The precondition for the profound changes resulting from this storm was a combination of the absence of protective ice cover in the sea, relatively high sea level for a long period before the storm, and a very intensive surge taking place over the background of an already elevated sea level. Strong storm waves combined with the high sea level caused substantial changes in the coastal geomorphology of the depositional shores of Saaremaa Island, and near Pärnu City and Tallinn City. The January 2005 storm caused significantly larger changes to the depositional shores in West Estonia than the cumulative effects of ordinary storms over the preceding 10–15-year period. Gudrun induced clearly visible changes in the development of shores and the dynamics of beach sediments in various regions of Estonia.

Storm impacts and economic consequences of the storm

The monetary impact of the storm on human settlements and properties was assessed with materials furnished by the Ministry of Finance in order to mobilise the European Union

Solidarity Fund (EUSF) to compensate for the damages. About 8 km^2 of Pärnu City was flooded by the storm. The total damage caused to homes in the country amounted to nearly 9.2 million EUR. In all, 400 people were evacuated in Pärnu City and 103 in Haapsalu City, and 1 person perished.

The total direct damage caused by the storm was 47,868,096 EUR, of which 28,223,651 EUR was attributed to the private sector and 19,644,445 EUR to the public sector. The damage caused to Estonia was more than 0.6% of Estonia's GNI, namely 0.635%. More detailed information about costs of damages is presented in the table below.

	Total damage (million EUR)
Households	11.08
Vehicles	2.99
Private sector	28.22
Enterprises (financial damages)	7.66
Farmers	0.24
Private harbours	1.12
Fishing industry	0.28

Table 6.1. Estimated costs of storm damages.

The rainstorm paralysed life and caused power outages to about a quarter of the substations of the national electricity company, Eesti Energia AS. Many fishing harbours, boats and equipment were damaged. Road traffic suffered mainly from fallen trees, some roads were flooded. The Audru polder dam in Pärnu County was breached by storm waves and the polder was heavily flooded.

Wells were filled with surface water and needed purification. There were sewage problems as the pumping stations were out of order. Some coastal areas had problems with drinking water because of contamination due to power cuts.

The storm also had an impact on agriculture. Domestic animals suffered because of power outages, cows were not milked, as equipment did not work with backup generators. Also milk spoiled due to the lack of refrigeration. The farmers lost fodder because of the flood: some farmers were forced to send their cattle to abattoirs, as they had nothing to feed them.

The strong winds also caused damage to the forests. The forest covered area in Estonia is 2.2 million ha (51.5% of Estonia's land territory), of which 40% is state owned. Uprooted trees represented 70-80% of tree damage; fallen trees caused about 90% of the power outages. Approximately 17,000 trees fell on wires in the affected counties.

A total of 515,000 solid cubic meters of forest was lost in the state forest and 600,000 solid cubic meters in private forests. The proportion of damages caused to state forests between

commercial forests and protection forests is approximately 75%–25%. Approximately 70% of the damaged forests are conifers and 30% broadleaves. All the forest areas that have been taken into account were healthy prior to the storm.

Compensation of losses

In August 2005, the European Commission made a proposal to the EUSF for financial support for Estonia to recover the losses resulting from the January 2005 storm. Estonia received 1.29 million EUR from the EUSF and international support was additionally received from Norway, Hungary, the Red Cross and UNICEF. Compensations were paid also on national level and help was given to people on local level. In addition, Pärnu City Government took the bill to cover storm damages for citizens (support was given to 208 families).

Lessons learned

On the order of the Prime Minister, the Minister of Finance set up with his directive of January 10th 2005 a Committee for assessing the storm damages. The Chairman of the Committee was the Secretary General of the Ministry of Finance, and the members were secretary-generals of the involved ministries and county governors of the three counties that suffered the most.

The conclusions of the Committee's assessment document were the following:

- Some ministries and counties have to update their crisis plans and there is a need for specific legislation to strengthen the crisis regulation;
- There is a need to improve communication between administrations;
- There is need for special equipment to keep alive the most important structures, for example electricity in hospitals and the telecommunication network.

Over the recent years the recommendations from the assessment document have mostly been implemented.

The storm forecast was given in time. For the first time in the post-Soviet history of Estonia, the government used its power given by law to force all TV channels and radio stations to inform people of the government announcement in time and without interpretation. A special website www.kriis.ee (Crisis Web) was opened where all government announcements were uploaded, including warnings and other information.

6.3.2. Rivers and lakes

During the period 1961–2004 the winter seasonal air temperature increased by 3.2 °C on average, precipitation increased over 45 mm and streamflow by 19 mm. The higher temperatures during the cold period have had an important effect on the winter and spring runoff. It confirms the highest correlation coefficient (up to 0.7) between the air temperature, precipitation and streamflow parameters for the winter season.

Increased air temperature has caused a decrease in the maximum discharge of spring floods and their earlier beginning. Before the 1960s the average beginning time of flood was the end of March or the beginning of April, whereas after the 1960s the floods have begun in February and for the last decade even in January. If the tendencies continue, Estonia can expect earlier and lower spring floods, smoothing the boundaries between the seasonality of river flow. More frequent flooding during winter may have an impact on the infrastructure, because the current structure was designed for past climate conditions with stable winters and higher spring floods.

The increased precipitation in the water balance of Lake Peipsi confirms the general increasing tendency in precipitation that is observed in recent years in Estonia. An analysis of the water temperature of Lake Peipsi shows its increase; it is probably caused by the increase in air temperature. The increase in water temperature of the lake in turn affects the water quality by supporting an earlier and longer eutrophication period. This may be the reason for the continuation of the eutrophication problem and the increase of cyan bacterial blooms in the lake despite the reduction of nutrients emissions in recent years.

A decrease in the contribution to the annual runoff in the spring season by 4%–10% and an increase in the contribution to the annual runoff in the winter season by 24%–34% will have different impacts on water resources management in the future. On the one hand, the decrease in spring runoff is good for designing and constructing road bridges and culverts whose cost will decrease. A more evenly distributed river flow throughout the year will lead to a profitable situation for the hydropower industry. It is also good for water level regulation against floods and droughts. The increased flow in winter will improve the water quality of rivers and is better for fish farming management. On the other hand, the earlier and shortened spring and the longer low flow period after spring may deteriorate water quality and have a negative impact on aquatic habitats.

A comparison of climate change impacts on different water regimes and water resources elements is presented in Table 6.2.

Change	Positive influence	Negative influence
Increased winter runoff	Better ecological situation in water bodies; decrease in spring floods	Unstable, shorter and thinner ice cover that makes using winter roads more difficult
Decreased and earlier runoff in spring	Decrease in spring floods; decreased washout of sediments from catchment area	Longer minimum runoff period in summer; diminishing water capacity in soil
Increased minimum runoff in summer	Favourable ecological condition for water bodies; more ways to use water bodies	Increased leaching of nutrients from fields
Increased runoff in autumn	Increased water supply in lakes for winter period	Increased overmoisture during harvesting period in autumn
More even runoff from agricultural land	Decrease in the leaching of fertilizes and overall diffuse pollution	
Balancing of water level in the lakes throughout the year	Decreased flooded areas around rivers and lakes	Decreased water level in the middle of the summer in small lakes
Changes in the storage of the lakes	Increased general and active capacity during winter period	Decreased capacity of small lakes during the second part of the summer

Table 6.2 Changes caused by climate change to water bodies.
Source: Järvet, A. Kliimamuutuste mõju Peipsi ja Viru alamvesikonna jõgede äravoolule

6.3.3. Groundwater

As a result of climate change, groundwater recharge will increase by 5–75%, depending on the hydrogeological conditions of catchments. Groundwater recharge will be the most intensive in the heights of Upper Estonia, whereas toward the lowlands the incremental infiltration rate will be less intensive. The safe yield of wells tapping the upper aquifers will be augmented up to 20% on average in Upper Estonia. It will make the public water supply cheaper.

The thickness of the aeration zone, which varies mostly from 1 to 3 meters in Estonia, will be reduced by half on average and the total area of wetlands will expand significantly due to the increase of infiltration. Thus, the parts of Estonia suffering from excess moisture will become even wetter in the future. To guarantee the productivity of agriculture and forestry, very extensive amelioration of wetlands should be carried out in the coming decades.

Many towns and villages in North Estonia, along the coast of the Gulf of Finland, get their drinking water from deep aquifers which belong to the zone of passive water exchange. The pumping conditions of deep groundwater will not be affected significantly by climate change.

The future dangers in the utilisation of groundwater may rather be caused by negative changes in groundwater quality than by the decrease in quantity. At the current water consumption rate, the reserves of the Estonian groundwater aquifers will suffice for hundreds of years.

6.3.4. Water management

The impacts of climate change on water management are relatively small in Estonia and there is no need to implement specific measures solely because of climate change. Factors such as the rising of sea level will be solved in connection with water management plans under Water Framework Directive, regional planning and construction requirements.

The results of the analysis of water supply and demand do not indicate any impact of climate change on the public water use in Estonia, although the country does not have any drought protection measures. The groundwater resources guarantee a sufficient supply of good quality domestic water in all regions of the country. Water consumption in towns and other settlements is independent of the quantity and quality fluctuations of rivers.

6.3.5. Forestry

Almost half of the land area of Estonia is covered with boreal forests, which play a remarkable role in the country's economy and ecology. There has been a continuous increase in forest area (about 2.5 times), volume (about 3 times), and the average age of stands (about 1.3 times) in Estonia during the past half-century. The dominant tree species in Estonia are pine, spruce and birch.

Up to this decade, no Estonian forests appear to have been damaged directly by minimum temperatures in winter or other weather conditions. Relatively cool weather during the vegetation period and high mortality rates in winter have not provided favourable reproduction conditions for needle and leaf pests.

Further climate warming will cause some changes; first of all, with regard to dendrofagous insects. The most numerous and dangerous trunk pest in Estonia has always been the spruce bark beetle. Mortality due to low winter temperatures has regulated its numbers. Lately, however, this pest has survived better during the milder winters. Weather conditions during its flying period in late April and early May are also important. Even a short period of dry and warm weather is then a good precondition for its successful development.

In recent decades, the area of spruce stands damaged by spruce bark beetles has been increasing. This has been caused directly by warm and dry weather and indirectly by drought stress on trees. Damage by spruce bark beetles occurs mainly in Eastern Estonia. Spruce stands grow there in site types, where soil humidity depends directly on the amount of precipitation. In western Estonia, spruce roots have good capillary contact with groundwater, and thus the negative influence of drought on trees is alleviated.

Root rot with its cosmopolitan distribution can be regarded as the most dangerous fungal disease also in Estonian forests. Up to the middle of the last century, the disease affected mainly spruce groves, although some cases of infection in pine, juniper, and some broad-leaved trees

have also been recorded. Spruce stands are currently even more damaged, but pine stands are also suffering. The raising annual temperature in Estonia results in more favourable environmental conditions for the spreading of root rot. A bigger number of damaged areas and hence a more severe economic loss are predicted for coniferous stands.

As Estonia's climate is rather cool and mostly with sufficient precipitation, the amount of land area damaged by forest fires has remained relatively stable. The damaged stands have been cleaned in time, and so the possible multiplication of forest pests after fire has been avoided. The danger of forest fires will increase with increasing droughts, and there has been a remarkable increase of them during the recent years. As 60% of forest fires happen in May and June, the increasing spring-summer droughts will obviously increase the danger of forest fires.

The increase in temperature prolongs the growing season and enhances the decomposition of soil organic matter, increasing the supply of nitrogen, all of which enhance forest growth, timber yields and carbon sequestration. Improved forest productivity will create opportunities for increased utilisation of forest resources. Higher winter temperatures will shorten the period with frozen soils and snow cover, thereby negatively impacting forest management operations. Reduced availability of timber due to the inaccessibility of forest resources on wet soils outside the frost period will pose a threat to the forest industry.

Research has confirmed that pine and spruce grow well even in habitats with 5 °C higher temperature. Therefore the forests in Estonia will not disappear because of climate change, but some changes in the composition of species may occur.

6.3.6. Agriculture

With the average temperature rising, especially in winter and early spring, the agricultural production is becoming increasingly vulnerable to pests and diseases. There is a greater possibility of the migration of diseases from southern areas.

The yields of cultivated meadows are positively influenced by the rise of temperature and the increase in precipitation. Estimates show that the rise of mean annual temperature by 1°C can increase the average dry matter yield of perennial fodder crops by up to 0.17 tonnes per hectare. In comparison to mowed meadows, grazed grasslands are more sensitive to climate warming accompanied with drought periods because of the high importance of stock-farming.

In general, the rise of average annual temperature is also likely to be favourable for grassland husbandry in Estonia in the future. The total growing season will lengthen and a higher number of cuttings will be available from grasslands. In recent years it has been possible to have 3 cuttings instead of 2. In the case of higher temperatures and higher precipitation the growth and development of herbaceous plants will quicken and the proper cutting time

will also shift to an earlier period. Livestock will be better provided with fodder in summer and winter.

During the growing period the agricultural variety's need for water will increase, and there will be a danger of soil drought, particularly during the period from May to July. Soils with lighter texture will suffer the most.

The rise of average temperature prolongs the total growing season and lengthens the sowing and autumn harvesting periods. A greater amount of the warmth needed for plant growth and development will accumulate during the vegetation period. The development of agricultural varieties will become quicker and the growing period will shorten. Researches show that the optimum sowing time will shift on average to a 4–11 days earlier period and in order to get the maximum yield the whole cultivation period ought to be prolonged by 10–30 days on average. This will help using fields more effectively and scatter the work load of farmers.

With lengthening growing season it will be possible to introduce new crop species to Estonia's agriculture. It will be possible to grow species more common in Central Europe.

During the past few decades there have been more years with very good harvest, but due to the more extreme weather also the number of years with extremely scarce harvest has increased. This means that the production rate will be more unstable between the years. Climatic and soil conditions vary greatly in the different regions of Estonia and that means that when the harvest is bad in one region it might be better in others. Altogether it can be said that the existence of different regions in the country will smoothen the effect of extremes.

In conclusion, it is estimated that due to climate change, Estonian agriculture will be more efficient and competitive in the future.

6.3.7. Peatlands

About 25% of the Estonian territory is covered with coastal and inland wetlands. About 70% of the Estonian mires have been drained for different purposes during the past 100 years, increasing their vulnerability to changes in climatic conditions. In the regions of Central and Eastern Europe where snow traditionally contributes significantly to the annual precipitation rate the share of rainfalls has increased steadily due to warmer winters in the recent decades and has resulted in increased runoff and more frequent inundations.

Seasonal changes - the formation, duration and disappearance of snow and ice cover - have a strong influence on nutrient supply and fluxes and the associated biological processes (including peat production) in wetlands. Recent studies suggest that nutrient-poor peatlands may be able to accumulate more carbon in warmer climatic conditions, and nutrient-rich peatlands may become potential additional sources of atmospheric carbon.

6.3.8. Human health

No studies on the impact of climate change on human health have been conducted in Estonia. A lot of research has been done in other Northern and Eastern European countries and the results of these analyses can also be applied to Estonia. No significant impacts on the human health can be foreseen but there are some tendencies worth mentioning.

Climate change can affect human health directly through the physiological effect of hot and cold or indirectly through the time spent outdoors, food, diseases like tick-borne encephalitis or consequences like floods.

The rise of average temperature during winter and spring has a positive effect for Estonians – the cold-related mortality during winter may decrease. People working outdoors will have a slightly better performance as the temperature is higher. Longer vegetation period and increased precipitation may have a positive influence on agriculture and food industry, also on private gardening and the time spent outdoors.

Floods may cause water contamination due to overflow in sewage pipelines that can lead to the spreading of diseases. Higher temperatures in the summer influence people's clothing choices and how much time they spent outdoors. That can increase the exposure to ultraviolet light, thereby increasing the cases of sunburn and skin cancer. Higher temperature may also cause an increase in heat-related mortality. Research in Sweden has shown correlation between mild temperature rise and the increased incidence of tick-borne encephalitis. Due to effective vaccination against tick-borne encephalitis the incidence of the disease has decreased 3-fold between the years 2000 and 2009 in Estonia. The incidence of borrelia, however, has risen significantly. Studies have shown that the rise in annual temperature results in a higher density of ticks which is an important factor in transmitting the above mentioned diseases.

Natural disasters and coping with their consequences affect people psychologically, especially children. The frequency of extreme weather events has been linked to global warming. As a result, the occurrence of mental diseases among the population may increase.

6.3.9. Tourism

Changes in the climate will also have an effect on tourism in Estonia. Winter tourism (skiing as entertainment and as sport) will encounter difficulties with lack of snow. Estonia has old skiing traditions and in recent years Estonian ski-runners have obtained a good reputation. As a result, skiing is popular in Estonia, and interest in organising international top-level competitions has grown. Poor snow conditions may put these competitions at risk.

High sea level, lack of ice and heavy storms damage sandy beaches, and the accelerating blooming of sometimes poisonous blue algae could be a serious problem for beach tourism. At the same time warmer climate will have a positive effect on tourism in summer. So

far Estonian tourism is characterised by cultural and rural tourism but in the future warmer climate could attract more seaside tourists.

Deutsche Bank Research has shown that Estonia will experience positive climatic effects on tourism. Among the Eastern European countries that will experience positive climatic effects by 2030, Estonia is one of the countries most dependent on tourism. Figure 6.1 shows the positive effect climate change has on tourism in Estonia in relation to the dependency on tourism compared to other countries.

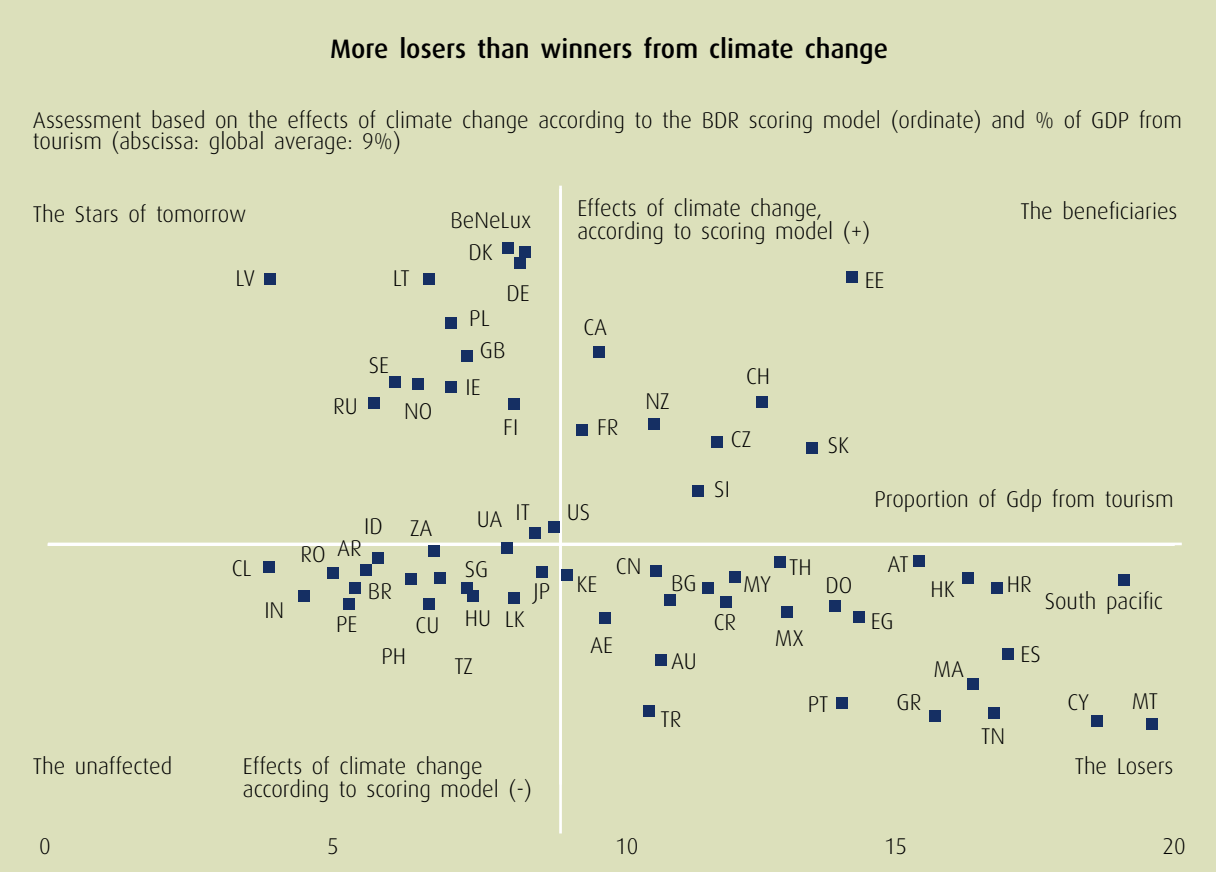

Figure 6.1. Effects of climate change on tourism in different countries
Source: Deutsche Bank Research

6.4. Adaptation measures

6.4.1. National level activities

Estonia does not have a national adaptation strategy. In recent years, the main project for gaining information on the adaptation to climate change was the ASTRA project discussed in more detail in Chapter 9.

In 2010 the Ministry of the Environment is planning to coordinate the compilation of a national adaptation strategy. Plans include the collecting, analysing and prioritising of relevant

data, the development of guidance for adaptation, also involving different state institutions in the process. According to the Ministry, adaptation has to be part of regional and local development plans.

Crisis management in Estonia, including the legal principles and division of responsibilities between government agencies, is regulated by Emergency Law that came into force on 24 July 2009. According to Emergency Law there is a need to draw up risk assessments and crisis management plans in case of storms and floods. These plans are prepared in cooperation between different institutions which assures a better communication between them. This way it is guaranteed that everybody has a common understanding of how to act in case of emergency. Also crisis management committees have been formed in different regions of Estonia.

It is very hard to predict extreme weather events and therefore the actions of the Estonian Ministry of the Interior and the Rescue Centres are concentrated on mitigating the consequences and improving adeptness in this field. The Rescue Centres have developed their crisis communication skills; for example, a nation-wide operative radio communication system was implemented in summer 2009 to facilitate information exchange between agencies. Risk assessment and crisis management plans have been updated for different counties. Training exercises in order to solve emergencies that are triggered by extreme weather events have been organised for all regions of Estonia, and a lot of new equipment for eliminating the consequences of storm damages and floods has been acquired. The Rescue Centres are cooperating with the Estonian Meteorological and Hydrological Institute and the Marine Systems Institute at Tallinn University of Technology to get the updated weather forecasts and sea level projections.

Also some websites have been set up in Estonia in order to provide necessary information to the interested parties:

- A national level website www.kriis.ee provides information about bigger accidents and emergencies. The website also contains behaviour instructions for different emergencies and the related legislation documents.
- A live online Sea Level Information System that informs people of the sea level in different regions of Estonia is available at http://on-line.msi.ttu.ee/kaart.php?en.

6.4.2. Local level activities

On the local level many cities have taken action regarding adaptation to climate change and implemented different measures after the storm in 2005. The storm gave a clear indication that there is a need to improve the readiness of regions in case of emergency, and many cities are working out different measures in order to be prepared. Cities that were most influenced by the storm (Tallinn, Pärnu, Haapsalu) are also by far the most active in implementing the adaptation measures.

In order to plan different measures for minimising the risks it is of utmost importance that the institutions reacting to the emergencies be well trained for this kind of situation. Modern equipment and good coordination between governmental institutions, local governments and nongovernmental organisations are also very important.

Cities are participating in the regional crisis committees. They have performed risk analyses that include extreme weather events like storms, hurricanes and heavy rains. Local detailed plans include new conditions (flooding boundaries, flood construction levels, etc). In case of flood risk in certain areas, problems are brought to the attention of developers, and together with the compilers of the detailed plan possible solutions are elaborated and risks minimised.

To raise the preparedness for extreme weather events, several rescue trainings and exercises have been performed in collaboration with the Estonian Rescue Service. Cities have increased the resources for emergency situations; a variety of safety and technical equipment has been acquired.

Since 2008, 24-hour monitoring has been started in Tallinn City to guarantee the preparedness for extreme weather events. Weather forecasts, sea level in the town, the direction and speed of the wind and precipitation that could cause floods are monitored. Water companies check the condition of sewage pipes and grid-wells on a regular basis to ensure the carry-off of precipitation water. The resources and equipment of Tallinna Vesi AS (water supply and wastewater service in the city) have been improved to increase the preparedness for possible floods and heavy rains.

Pärnu City participated in the ASTRA project that addressed the threats arising from climate change in the Baltic Sea Region, such as extreme temperatures, droughts, forest fires, storm surges, winter storms and floods. An autonomous warning system was acquired which is used for informing citizens of possible threats in case of flooding and for giving instructions to people in the danger zones. The city's website has a map identifying flooding areas so the citizens can check the ground level compared to the sea level in different parts of the city.

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VII FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY, INCLUDING INFORMATION UNDER ARTICLES 10 AND 11 OF KYOTO PROTOCOL

Estonia is not an Annex II party therefore the provisions of Article 4.3, 4.4 and 4.5 are not applicable.

VIII RESEARCH AND SYSTEMATIC OBSERVATION

8.1. General policy on research and systematic observation

Between 2003 and 2004, the European Commission included in its regular reports on science and technology indicators ten countries in Central and Eastern Europe that have since joined the European Union. Data from the 2008–09 report "Beyond the Bloc" show that research intensity — the percentage of gross domestic product spent on research and development (R&D) — is in all ten countries below the European average of around 1.8% (for Slovenia – 1.6%; Czech Republic – 1.5%; Estonia – 1.1%; Hungary – 1.0%; others countries under 1.0%). But there are strong differences within the region. Notable improvements, mainly driven by the business sector, have been made in the Czech Republic, Estonia and Hungary.

Scientific research projects in Estonia are financed from different financial sources. The instruments of the Estonian Research and Development funding under the Ministry of Education and Research system are:

- Targeted financing (TF);
- Baseline funding;
- Research grant funding (RGF);
- National research and development programmes;
- Funding of research and development infrastructures.

Targeted financing is determined by the Minister of Education and Research, following the recommendations of the Estonian Research Council. The aim is to ensure a competitive basic structure for scientific research, open to all fields and all research groups – both basic and applied research is funded. The Ministry of Education and Research (www.hm.ee) and the Estonian Science Foundation (www.etis.ee) have financed climate change related research projects on atmospheric circulation processes, sea and terrestrial climate observing systems, ionisation, analyses of satellite images, climate modelling, climate monitoring, etc (Table 8.1).

Year	Research grant funding	Targeted financing	Total*
2009	0.37	2.28	**2.96**
2008	0.38	2.28	**2.81**
2007	0.24	1.55	**1.93**
2006	0.22	1.36	**1.73**

* All climate change research projects financed under the Ministry of Education and Research

Table 8.1. Climate change related research projects from 2006 to 2009 (million EUR), financed by the Estonian Science Foundation and the Ministry of Education and Research.

Source: Ministry of Education and Research

Table 8.1. Climate change related research projects from 2006 to 2009 (million EUR), financed by the Estonian Science Foundation and the Ministry of Education and Research).

The Environmental Investment Centre (EIC) (http://www.kik.ee) processes the received applications, monitors the implementation of projects and verifies the expenses and realization of the projects. The environmental programme is implemented pursuant to the Environmental Fees Act with the funds received in the state budget. The EIC organizes the financing of the projects and monitors the purposeful use of the money.

The environmental programme is implemented through eight programmes:

- water management programme;
- waste management programme;
- environment management programme;
- nature conservation programme;
- forestry programme;
- fishery programme;
- environmental awareness programme;
- regional programme (15 county-based programmes).

All programmes are divided into sub-programmes. The Environmental Investment Centre financed only the ambient air protection sub-programme in the years 2006 (47 projects), 2007 (63 projects) and 2008 (33 projects): with 27.0; 45.4 and 50.0 million Estonian kroons, respectively.

As a member of the European Union, Estonia participates in EU regional policy, being eligible for EU structural assistance under the Convergence Objective. The Operational Programme for the Development of the Living Environment 2007–2013 guides the use of the European Regional Development Fund (ERDF) and the Cohesion Fund (CF) in the areas of environmental protection, energy, local and regional development, education and health and welfare infrastructure development.

During the period of 2007–2013, EIC serves as the implementing agency of the environmental measures financed by the European Regional Development Fund (ERDF) and the European Social Fund (ESF), mediating a total of 2.55 billion kroons in the years 2007–2013, includ-

ing 2.5 billion kroons from the ERDF and 50 million kroons from the ESF.

Estonia´s contribution to the Fifth Framework Programme was 5,855,476 euros (91,614,777 kroons) in total, of which 848,361 euros (13,273,456 kroons) came from the PHARE Programme. A total of 809 project proposals were submitted with the participation of Estonian organisations, of which 195 proved successful.

All calls in the Sixth Framework Programme (FP6) are announced on the website of Cordis and on the website of the European Union Innovation Centre at the Archimedes Foundation. Archimedes Foundation serves as the national contact for the Sixth Framework Programme in Estonia (Table 8.2). Additional information concerning the participation in FP6 programmes can be obtained from the NCPs for different areas. Contact information is available at the website of the European Union Innovation Centre.

Programmes	Projects submitted with Estonian participation	Successful projects with Estonian participation	Financed projects
Life sciences, genomics and biotechnology for health (LifeSciHealth)	128	45	**
Aeronautics and space (Aerospace)	10	4	1
Sustainable development, global change and ecosys-tems (Sustdev) – Environment	89	42	20
Sustainable development, global change and ecosystems (Sustdev) - Energy	44	20	10
Sustainable development, global change and ecosystems (Sustdev) - Transport	14	6	1
International cooperation activities – INCO	33	21	7
Coordination activities	27	**	15
New and emerging science and technology (NEST)	24	2	1
Research and innovation (Innovation)	26	8	8
Science and society	79	37	13

*Successful project denotes a project over threshold ** Data were not available yet.
Table 8.2. Estonia in the Sixth Framework Programme (as of 1 January 2007) (related to climate change) (https://www.etis.ee/portal/Portaal/rsk.aspx?lang=en).

The Ministry of the Environment financed two climate change related research projects (2007–2008): "Trends in reducing greenhouse gas emissions and analysis of adaptation to climate change" and "Assessment of the technological, geological and toxicological possibilities of mineral binding and storage of CO_2", 0.07 million EUR altogether.

The Council of the Estonian Science Foundation has made its decision concerning the Mobilitas Programme and decided to award grants to four projects connected with climate change (Table 8.3).

Project title	Duration of the project (years)	Financing (million Estonian kroons)
Dynamic Landscape Analyses in Southern Estonia (DYLAN_Estonia): Spatial Dynamics of Vegetation and Land Cover through Time	5	6.4
Biodiversity changes across the Ordovician and Silurian environmental crises	3	1.6
Sacred Others in a Changing Landscape – Environmental Change and Animal Practice in the Norwegian Arctic	3	1.5
The regulation of mesophyll conductance for CO2 under climatic variables in relation to photosynthesis and respiration	3	1.6

* *Source: Estonian Science Foundation*
Table 8.3. Estonia in the Mobilitas Programme, 2009 (related to climate change)

In the context of climate change, the Ministry of Agriculture has from 2004 on financed the project "Analysis of climatic conditions and agrometeorological prognoses for agricultural producers". The project covered the years 2003–2007 and 2009–2012.

The goal of the project was to:

- carry on with meteorological and agrometeorological monitoring at agricultural experimental stations, research institutions and other establishments;
- compile and systematise data and continue with the existing time series;
- provide an objective assessment of the weather of the current year as well as the weather of a longer time period from the point of view of crop farming;
- provide the Ministry of Agriculture, the Commission for Monitoring the Implementation of National Development Plan, the Commission for Assessment of Natural Damage, agricultural research institutes, advisers, local governments, farmers and other interested parties with necessary information;
- distribute agrometeorological data, including the agrometeorological prognoses made on the basis of the gathered data.

The total amount spent on the analysis of climatic conditions and agrometeorological prognoses for agricultural producers in 2004–2009 was 40000 EUR.

8.2. Research

Estonian climate-related research encompasses the whole range demanded in reporting to the United Nations Framework Convention on Climate Change (FCCC). Estonia ratified the UN FCCC in 1994 and the Kyoto Protocol in 2002.

Estonian Meteorological and Hydrological Institute (EMHI), Tartu Observatory and the Institute of Geography at the University of Tartu, Estonian University of Life Sciences, the Institute of Ecology at Tallinn University, the Marine Institute at the University of Tartu, the Marine Systems Institute at Tallinn University of Technology, Centre for Nonlinear Studies, Institute of Cybernetics at Tallinn University of Technology, SEI Tallinn (Stockholm Environmental Institute Tallinn Centre) have been conducting related studies on climate change.

Estonian Environment Information Centre (EEIC) collects, processes, analyses and publishes information about Estonian nature, the state of the environment, and the influencing factors. EEIC has a number of bureaus connected with climate and climate change research – Information Bureau is tasked with disseminating environmental information; Climate and Ozone Bureau is tasked with coordinating GHG reporting (inventory, projections, policies and measures) administrating the national greenhouse gases emissions trading registry, managing joint implementation projects related to Estonia, administrating the database of ozone depleting substances consumption and treatment; Environment Monitoring Bureau is tasked with administrating National Environment Monitoring Program; Ambient Air Bureau is tasked with maintaining a register of air emissions, compiling reports on air quality and air emissions; Environmental Register Bureau is tasked with establishing, developing and maintaining the environmental register; and Nature Bureau is tasked with managing duties related to the protection of biological diversity and ecosystems.

8.3. Systematic observation

Prioritization of the environment in the society increases the demand for environmental information, also raising expectations to its quality and availability. **Estonian Meteorological and Hydrological Institute** is a governmental service under the Ministry of the Environment. EMHI's responsibilities include all the activities typically carried out by a national meteorological and hydrological service. The Estonian meteorological and hydrological system, comprising 99 monitoring stations, includes an aerological observation programme; an actinometric observation programme; an inland water observation programme; a lake research programme; a swamp research programme; a coastal sea observation programme; and an observation programme for ionizing radiation.

Estonian Environment Information Centre is a state agency founded in 1993 and administered by the Ministry of the Environment. The complete list of EEIC duties is as follows: to collect, analyze and provide environmental data; to publish information about state of environment;

to compile and issue environmental reviews; to participate in the state environmental monitoring programme; to transform environmental data into geo-referenced data (GIS) and process spatial data; to maintain environmental information systems, e.g. information system of environmental permits; to contribute to the elaboration of environmental legislation; to provide consultations, expertise and assessments related to environmental issues; to serve as a national focal point (NFP) for European Environment Agency and UNEP/Info-terra network; to exchange and report environmental data to EEA, EUROSTAT, European Commission, UNEP and other international institutions.

Estonian State Monitoring Programme: The Environmental Monitoring Act entered into force in 1999. The Act provides for the organization of environmental monitoring, the procedure for processing and storing the obtained data, and the relations between the persons carrying out environmental monitoring and the owners or possessors of immovables. Environmental monitoring is defined as the continuous observation of the state of the environment and the factors affecting it, with the main objective of predicting the state of the environment and obtaining data for programmes and plans and for the preparation of development plans.

International Co-operation: **EMEP** (European Monitoring and Evaluation Programme) is a scientifically based and policy-driven programme under the Convention on Long-range Transboundary Air Pollution for international co-operation to solve transboundary air pollution problems. The (EMEP) programme provides scientific support to the conventions on atmospheric monitoring and modelling; emission inventories and emission projections; and integrated assessment modelling. Two Estonian air monitoring stations, Lahemaa and Vilsandi station, belong to the EMEP monitoring system. In order to develop the necessary international cooperation in the research on and the monitoring of pollutant effects, the Working Group on Effects (WGE) was established under the Convention on Long-range Transboundary Air Pollution in 1980 and held its first meeting in 1981. The Convention involves countries in the UNECE region and has its secretariat with the UNECE. Estonian researchers participated at the work of the following International Co-operation Programmes (ICPs): ***ICP Integrated Monitoring*** - the Programme seeks to carry out bio-monitoring to detect natural changes, in particular to assess the effects of air pollutants and climate change; to monitor the state of ecosystems (catchments/plots) and provide an explanation of changes in terms of causative environmental factors, in order to provide a scientific basis for emission controls; to develop and validate models for the simulation of ecosystem responses and use them in order to estimate responses to actual or predicted changes in pollution stress, and in concert with survey data to make regional assessments; ***ICP Modelling and Mapping*** - the objectives of the ICP Modelling and Mapping are to assess damage to forests, crops, natural vegetation, soils, surface and groundwater, and materials by determining critical levels and loads for the response of these systems, with particular attention to the direct effects of air concentrations of sulphur dioxides (SO_2), nitrogen dioxides (NO_2) and ozone (O_3), and the indirect effects of (long-term) deposition of sulphur and nitrogen compounds; to map geographical areas in order to determine the scope and extent of pollutant depositions and concentrations which exceed critical loads and levels; and to establish the appropriate methods as a basis for

assessing potential damage; ***ICP Forests*** - the objectives of ICP Forests are to monitor the effects of anthropogenic (air pollution, in particular) and natural stress factors on the condition and development of forest ecosystems in Europe, and to contribute to a better understanding of cause-effect relationships in forest ecosystem functioning in various parts of Europe; ***ICP Waters*** - the objectives for ICP Waters are to assess, on a regional basis, the degree and geographical extent of acidification of surface waters (the data collected should provide information on dose/response relationships under different conditions, and correlate changes in acidic deposition with the physical, chemical and biological status of lakes and streams); ***ICP Materials*** – ICP Materials has two objectives: to perform a quantitative evaluation of the effect of sulphur and nitrogen compounds and other major pollutants, including the effects of low concentrations of these pollutants on the atmospheric corrosion of important materials, and to assess the trends of corrosion and pollution; ***ICP Vegetation*** - the objectives of ICP Vegetation are to facilitate the production of European maps showing where critical levels for ozone are exceeded; to evaluate the effects of air pollutants and other stresses on crops and non-wood plants by monitoring the onset of injury and reductions in the yield/biomass of sensitive species; to identify realistic dose-response functions, incorporating modifying (level II) factors for a range of economically important crops and for crops endangered by pollution; to validate and substantiate the critical levels of ozone for crops and non-wood plants, including the incorporation of level II factors; to assist in assessing the economic loss due to ozone pollution; to conduct literature reviews and specific experiments on the accumulation of the atmospheric deposition of heavy metals.

8.3.1. Atmospheric climate observing systems, including those measuring atmospheric constituents

Estonian Meteorological and Hydrological Institute's *(EMHI)* responsibilities include all the activities typically carried out by a national meteorological and hydrological service – handling the meteorological issues connected to the protection of the environment; making weather forecasts; collecting, treating and storing the results of meteorological and hydrological measurements; conducting a climatological survey of Estonia; making the results of its work available; providing special services for public and private interests on a commercial basis; and co-operating with foreign as well as international meteorological institutions, especially with World Meteorological Organisation (WMO). EMHI is a governmental service under the Ministry of the Environment. Contact: http://www.emhi.ee/i?nlan=eng. EMHI provides free services regarding the weather of the day before, four day forecast, sea weather forecast, probabilistic precipitation forecasts, storm warnings, measured weather in Estonian stations, and measured weather in world cities.

In 2002 a co-operation project was initiated with the approval of the international HIRLAM-project between Estonian Meteorological and Hydrological Institute (EMHI), Finnish Meteorological Institute (FMI) and the University of Tartu (UT) with the main purpose to develop a very high resolution non-hydrostatic numerical weather prediction model. The most important task is to

supply international and Estonian organisations and projects (GCOS (Global Climate Observing Programme), GPCC (Global Precipitation Climatology Centre); ECSN (Europe Climate Support Network); ETH (Swiss Federal Institute of Technology); the Ministry of the Environment of Estonia, among others) with Estonian climate data, also to compile climate overviews for Estonian public services and government institutions. For that purpose our specialists also continue to build and service climate websites. A book on the weather risks in Estonia has been published. Estonia is associated with the ECMWF, EUMETSAT, EUMETNET NORDRAD and HIRLAM; EMHI participates in the work of WMO World Climate Research Programme (WCRP), TECO 2006 (Technical Conference on Meteorological and Environmental Instruments and Methods of Observation), and the working groups of BSRN (Baseline Surface Radiation Network) of GEWEX.

Tartu Observatory*:* On March 1, 2008 the European Commission's (EC) Seventh Framework Programme (FP) REGPOT project EstSpacE (Expose the Capacity of Estonian Space Research and Technology through High Quality Partnership in Europe) was commenced. The leader of this three-year project is EC's Nordic Network NordAquaRemS (**http://nordaquarems.org/**). Another project of EC's Sixth Framework Programme is Hyperspectral Remote Sensing in Europe. Tartu Observatory contributes to the European satellite programme EUMETSAT, which provides cost-effective operational satellite data, services and products in response to the needs of its users. Experts from the European Space Agency recognized Tartu Observatory as an essential partner in the future European state co-operation agreement which Estonia and ESA could conclude in the near future. Tartu Observatory has participated in the European Database for Ultraviolet Radiation Climatology and Evaluation (EDUCE) and also participates in the COST (European Cooperation in the field of Scientific and Technical Research) 726 action: long-term changes and climatology of UV radiation over Europe (2004–2009). Multi-annual changes in atmospheric column transparency based on measurements of direct solar radiation allow us to assess various tendencies in climatic changes. Variability of the atmospheric integral (broadband) transparency coefficient, calculated according to the Bouguer-Lambert law and transformed to a solar elevation of 30°, is used for two Russian locations, Pavlovsk and Moscow, one Ukrainian location, Feodosiya, and three Estonian locations, Tartu, Tõravere, and Tiirikoja, covering altogether a 102-year period, 1906–2007.

University of Tartu, Department of Geography: Sixth Framework Programme project DAMOCLES – Developing Arctic Modelling and Observing Capabilities for Long-term Environmental Studies, 2005–2010. Other international projects: "Dynamics of greenhouse gas emission from wetlands and riparian buffer zones as hot spots in agricultural landscapes," 2007–2008, and "Emission of nitrous oxide and methane from Estonian agricultural landscapes – variation among various ecosystems and possible mitigation strategies," 2007–2010. Target-financed projects funded by the Ministry of Education and Research, Republic of Estonia: SF0182534s03 "Landscape material cycling in changing climatic and socio-economic conditions: analysis, modelling and optimization using eco-technological measures," 2003–2007; SF0180127s08 "Material cycling of landscapes in changing climate and land

use conditions and eco-technological control thereof," 2008–2013; SF0180049s09 "Landscape changes in Estonia related to global climate warming and human activity," 2009–2014.

University of Tartu, Institute of Physics, laboratory of atmospheric physics: Non-hydrostatic HIRLAM is elaborated and implemented as weather forecast software in the Estonian weather service (EMHI). Horizontal resolution is 3 km, vertical resolution 60 layers. The forecast covers Estonia and its immediate surrounding areas. Forecast is available at the website of EMHI. During 2008–2010 computations of climatologic database BaltAn65+ are carried out for the Baltic region, years 1965–2005. This database is analogous to ERA 40, but in the local area with a spatial resolution of 11 km horizontally and 60 layers vertically. Computations are carried out with HIRLAM 7.2 model (standard hydrostatic version). The database is to be completed in January 2010. The occurrence of cyclones deeper than 1000 hPa in the Baltic Sea region during 1948–2000 was studied on the basis of the database of cyclones of the Northern Hemisphere. It was found that the frequency of such cyclones was increasing until 1970s and started to decrease afterwards. The cyclones in the Baltic Sea region last longer and move faster, compared to the cyclones in the whole Atlantic-European area. About 40% of the cyclones affecting the Baltic Sea region are formed within the region. Dependence of the frequency of extreme precipitation events on the synoptic situation during 1961–2005 was also studied. It was found that 88% of the days with precipitation over 50 mm in at least one of the meteorological stations in Estonia were related to the propagation of different depressions or frontal zones. Regarding cyclone trajectories, the southern cyclones (during 53 days) and local cyclones (during 35 days) were dominant in causing the extreme rain events. In an extensive study on the variability of atmospheric column transparency during 1906–2007 in Europe between latitudes 44–60°, some regular dimming and brightening trends were discovered, most notably a dimming period that lasted for almost 40 years, starting from ca 1945 and lasting until the beginning of 1980s. There are several reasons for the very good transparency of atmosphere in Europe afterwards, at the end of the 20th and at the beginning of the 21st century: 1) no volcanic activity at that time; 2) the efficient purification methods for industrial technologies; 3) the economic collapse after the political changes in Eastern Europe and a decrease in energy-intensive production. Also, it was found that the amount of low clouds in Estonia increased throughout three decades, until the beginning of the 1990s alongside the increasing NAO index, referring to the alteration of the atmospheric circulation pattern forming the climate in Europe. In an investigation based on increment drilling, a strong dependence was discovered among the trends in the atmospheric transparency and the radial growth rates of Pinus sylvestris at the bog areas of the Baltic region – acceleration of growth during the dimming, and deceleration of growth during the brightening of the atmosphere. As raised bog is an ecosystem entirely dependent on nutrients from the air, the larger amount of deposited nutrients when atmosphere was rich in mineral particles might obviously be a reason for such trends.

University of Tartu, Institute of Physics, laboratory of environmental physics: The research group of environmental physics measures the mobility distribution of atmospheric ions in Tahkuse air quality monitoring station, using the spectrometer EAS developed in the Univer-

sity of Tartu. This research makes it possible to specify the aerosol formation process in the atmosphere and the role of air ionisation and pollutant gases in that process. Based on an upgraded nucleation theory, algorithms have been developed that enable taking into account the ion-induced nucleation in numerical models of the atmosphere. In a long perspective, the results of this research are important for estimating the effect of aerosols to the climate. The data collected at Tahkuse and Tartu mainly for scientific research is archived and available on demand for interested researchers. Data from 2003–2006 is archived in the databases FINESTION 2003–2006 and ATMEL2007A.

Estonian University of Life Sciences: Department of Environmental Protection is carrying out a target foundation project financed by the Estonian Ministry of Education and Research "Biotic and abiotic markers for the evaluation of complex anthropogenic influences on habitats and landscapes". The increase in the yearly growth of trees seems to be related more to atmospheric deposition than climate changes, and is more related to the atmospheric pollution by power plants in North-East Estonia.

Other target-financed projects financed by the Ministry of Education and Science, Republic of Estonia: SF0362480s03 **"**Impact of climatic change on shallow lake ecosystems"; SF0170011s08 "Will climate change alter the relative importance of catchment and in-lake processes in the carbon balance of shallow lakes?"

Stockholm Environmental Institute Tallinn Centre (SEI): SEI is an independent international research institute. They have been engaged in environment and development related issues at local, national, regional and global policy levels for more than a quarter of a century.SEI has established a reputation for rigorous and objective scientific analysis in the field of environment and development. The goal of SEI is to bring about change for sustainable development by bridging science and policy. SEI researchers are gathered into six thematic teams that tackle overarching issues like climate change, energy systems, vulnerability and governance, as well as specific problems such as water resources and air pollution.

SEI is participating in two projects under the Sixth Framework Programme (FP6) NEEDS (New Energy Externalities Developments for Sustainability 2004–2009): and ALARM.

SEI was also involved in INTERREG BSR financed project "Baltic Climate"that is described in chapter 9.7.

Other project in which SEI was involved is INTERREG BSR financed project *"Baltic Climate*" - Baltic Challenges and Chances for local and regional development generated by Climate Change (2008–2012): http://www.seit.ee/index.php?m=9&program=4&project=57&l=1

8.3.2. Ocean climate observing systems

Tallinn University of Technology, Marine Systems Institute. Research topic: Baltic Sea water and material exchange processes in changing climatic conditions. Dynamical and opti-

cal processes in coastal sea areas. For example: probable locations of wind farms in the open sea in relation to the most favourable meteorological, hydrographical, ice and environmental conditions. The special significance of the research is that (a) it is one of the first public marine research projects in Estonia aimed at the development of offshore wind parks. At the same time this complex marine research (b) will provide highly valuable data of the coastal sea from the sea bed up to the atmosphere, comprising (c) geology, bathymetry, hydrodynamics, marine physics, biology and optics, currents, waves and winds – all at once. Those complex investigations could not be carried out in a large geographical scale, but the investigation data of the polygons can be extrapolated to larger areas.

University of Tartu, Marine Institute*:* European Coastal Shelf Sea Operational Observing and Forecasting System (ECOOP). The overall goal of ECOOP is to consolidate, integrate and further develop the existing European coastal and regional seas operational observing and forecasting systems into an integrated pan-European system targeted at detecting environmental and climate changes, predicting their evolution, producing timely and quality assured forecasts, providing marine information services (including data, information products, knowledge and scientific advice) and to facilitate decision-supporting needs.

Tallinn University of Technology, Institute of Cybernetics (Wave Engineering*)*: The following studies were carried out:

Climatology (incl. long-term changes and seasonal variations) of wave conditions in the eastern Baltic Sea. The studies are based on the available wave data from the entire northern Baltic Sea region. There is a new pool of information from the recently digitized records of visual wave observations at the coastal hydro-meteorological stations in Estonia (Vilsandi, Pakri, Narva-Jõesuu) during 1954–2008 and in Lithuania. The most interesting feature is a rapid increase of the annual mean wave height in the northern Baltic Proper in the 1980s, its very large values in mid-1990s and its rapid decrease since about 1997. These variations occurred simultaneously on both the eastern and western coasts of the Baltic Proper on the background of gradually increasing average wind speed. Moreover, these variations have apparently been generated by the ageostrophic components of the air flow. The digitized wave data are currently undergoing an additional quality-check and will be available to the public after its completion.

Wave climate modelling in the Baltic Sea basin. A high-resolution numerical study of seasonal, spatial and long-term properties and changes of surface wave climatology in the entire Baltic Sea is currently in progress for the years 1970–2008. The numerical model is forced by geostrophic winds adjusted to the sea level. The results are expected to be published in 2010; currently preliminary results and model verification studies are available. The modelled wave data have been used (a) in estimating the local wave climate and potential changes in wave-induced sediment transport for several semi-sheltered Estonian beaches, and (b) in estimating the share of anthropogenic waves in the total wave activity as well as the role of ship waves as energy pollution in Tallinn Bay.

Extremes in the wave conditions of the Baltic Sea. The studies are mostly based on numerical simulations with the use of operational wave models and verified against a few in situ

recordings of wave fields in extreme storms. It is demonstrated that the significant wave height may reach 9.5 m in the central Baltic Proper even under the existing climatic conditions and that extremely long waves, with periods up to 12 s, may dominate during some storms in the Gulf of Finland.

Reflections of climate change in the studies of physical oceanography of the Gulf of Finland, mostly on the level of overviews of research publications.

Climatology of both upper-layer and surface winds over Estonia. It is shown that the long-term changes of the upper-layer air flow include abrupt shifts in early spring rather than trends of periodic variations over North-East Europe. Also, there is substantial seasonal variability of the daily course of the mean wind speed in coastal wind observation sites in Estonia.

8.3.3. Terrestrial climate observing systems

Centre of Forest Protection and Silviculture*:* The International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests operating under the UNECE *Convention on Long-range Transboundary Air Pollution*. Estonian Focal Point is Centre of Forest Protection and Silviculture. ICP Forests monitors the forest condition in Europe, in co-operation with the European Union using two different monitoring intensity levels. The first grid (called Level I) is based on around 6000 observation plots on a systematic transnational grid of 16 x 16 km throughout Europe. The intensive monitoring level comprises around 800 Level II plots in selected forest ecosystems in Europe. Currently 41 countries participate in the ICP Forests. A LIFE+ co-financed project for the "Further Development and Implementation of an EU-level Forest Monitoring System" (FutMon) comprises 38 institutions in 24 EU countries. The project aims at the creation of a pan-European long-term forest monitoring system which can serve as a basis for the provision of policy relevant information on forests in the European Union as required under international obligations and key action 8 of the Forest Action Plan (COM 2006 final). More specifically, the objectives of the project are the scientific analysis of data and the provision of respective reports focusing on forest conditions and forest soil conditions in relation to air pollution, climate change, carbon sequestration, and biodiversity.

8.4. Support for developing countries

Aid to developing countries in connection with the above-mentioned systems: the laboratory of environmental physics, Institute of Physics, University of Tartu hosted a scientist from the Indian Institute of Tropical Meteorology for 12 months (25.05.2006–19.05.2007). The visit was funded by the research collaboration programme "Better Opportunities for Young

Scientist in Chosen Area of Science and Technology (BOYSCAST)" of Indian Republic. His research topics during his stay in Tartu were long-range air pollution transport and measurement of air ions and aerosol in Tahkuse, Estonia. During his stay the scientist from India was acquainted with measurement methods and data systems for the research of air ions and aerosol. From the autumn of 2009 the mobility spectrometer of nanometre particles and air ions, co-developed by the University of Tartu and AS AIREL, is in use in the field base of the Indian Institute of Tropical Meteorology (Pune, India).

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IX EDUCATION, TRAINING AND PUBLIC AWARENESS

9.1. Public awareness of climate change

According to the survey on Europeans' attitudes towards climate change that was carried out in January and February 2009, only 49% of Estonians see climate change as a serious problem (Figure 9.1). That is the lowest percentage among European Union (EU) member states. Estonia is the only country in EU where the majority of citizens consider climate change as an unstoppable process. According to Estonians the emissions of CO_2 have marginal impact on climate change. According to 37% of Estonian citizens, the seriousness of the climate change phenomenon has been exaggerated; this percentage has reached a relatively high level from 30% in spring 2008.

Education and public awareness programmes play a significant role in Estonia´s response to climate change. There is a growing trend, particularly in the area of formal education, to blend climate change issues into the subject of 'sustainability'. Environmental education could be more effective if systemic and long lasting attitudinal and behavioural change were achieved.

Estonians' attitude towards sustainable lifestyle has changed during the past decade. People used to build large energy-consuming houses and use vehicles with poor fuel economy without regard for sustainability. In recent years the trend has changed, one factor being the economic recession. People are thinking about saving energy already in the planning phase of building a house. It is very common to use heat pumps (air-to-air heat pumps, air-to-water heat pumps, ground-source heat pumps, etc), solar panels and energy-efficient heating systems. New houses are built with better insulation and old buildings are being renovated to improve their energy efficiency. Fuel efficiency is an important indicator when buying a new car, also hybrid and electric cars are becoming more popular.

On local level, the so-called green transport is being popularised in Tallinn City – there is free parking for electric and hybrid cars and a free public recharging spot for electric cars. Capacity building in other regions is exemplified by the Rõuge energy park, established in 2001. The park, located in Rõuge Parish in South-East Estonia, is a good example of promoting the use of renewable energy and innovative solutions of energy production as well as of providing information about energy saving. The energy park is unique in combining old and new technologies. On the energy trail of the park visitors can see how it is possible to get energy from water, sun and wind, as well as from the ground.

The general discussion of environmental issues, including the dissemination of information to the public through the media and the Internet, has increased in the recent years. Most people get their information from the media, especially from television. There are TV shows, such as *Environmental News* and *Ozone* on air every week. The issue of climate change also appears in the daily newspapers in the form of topical articles. There are a number of environmental magazines dealing with the environment and climate change, for example *Estonian Nature*, *Environmental Technology*, *Horizon* etc.

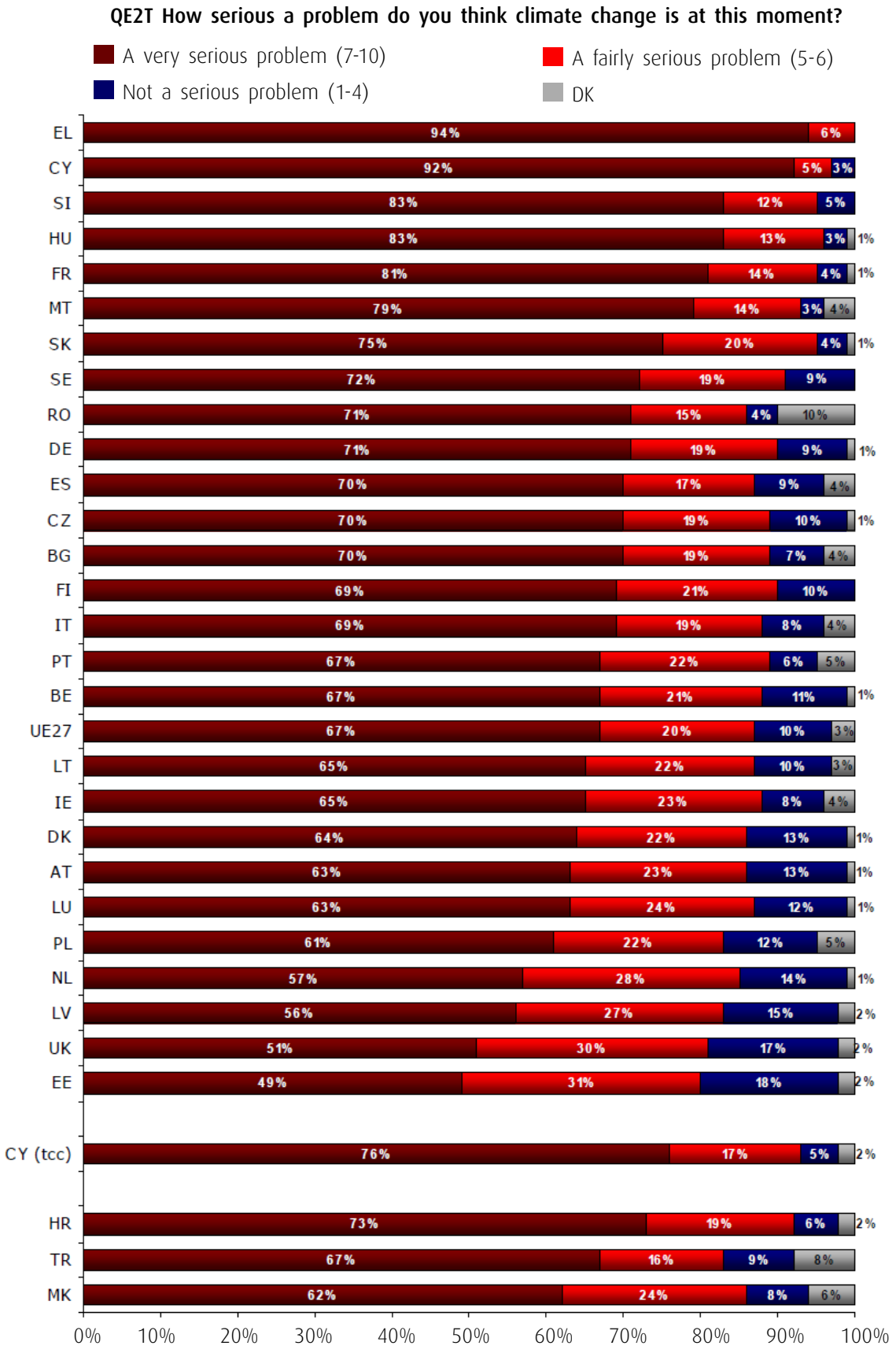

Figure 9.1. Seriousness of climate change according to different countries

Source: Europeans' attitudes towards climate change, 2009

The Ministry of the Environment has been making an effort to introduce the subject of climate change into various environmental seminars for different stakeholders. Additionally, different ministries, universities, local communities and information centres have been organising conferences and seminars on climate change. The presentations have covered climate change both in the world at large and in Estonia. Also a few exhibitions have been organised to raise the public awareness of climate change.

9.2. Public access to environmental information

The access to environmental information in Estonia is regulated mainly by the Public Information Act. During the past decade Estonia has started using different information technology solutions in order to provide the public with a better access to environmental information. The special electronic system eJustice for coordinating draft legislation is available at http://eoigus.just.ee/, used by civil servants elaborating and coordinating draft legislation. All information in eJustice is available to the public, including (in some cases digitally signed) draft legislation, draft elaboration timetable, time limits for coordination, search engine, etc. Citizens can express their opinion about the content of drafts and make proposals to the Government in the ParticipationWeb at https://www.osale.ee/.

Most of the environmental information in Estonia is published by the Estonian Environment Information Centre (EEIC), a state agency founded in 1993 and administered by the Ministry of the Environment (MoE). The EEIC collects, analyses and distributes environmental information to both decision-makers and the public. Information on the environmental data is electronically available in the Environmental Registry at http://register.keskkonnainfo.ee/, regulated by the Environmental Registry Act.

The website of EEIC www.keskkonnainfo.ee is a source of environmental data consisting of indicators, analyses and reports. Different reports on air quality, environmental monitoring, nature conservation, water quality and the state of the environment are available on the website. It is also the main source of information on climate policy and its implementation, giving an overview of the issue of climate change and the implementation of the UNFCCC and its Kyoto protocol with reports like National Communications and National Greenhouse Gas (GHG) Inventories. The website has a list of legal acts related to climate change in Estonia, as well as information on Joint Implementation projects and the implementation of EU Emission Trading Scheme (EU ETS). The site is used for the official publication of climate change policy related information, including all relevant reports and guidance for participating in EU ETS with information on the Emission Trading Registry.

The MoE uses its website www.envir.ee to publish environmental information. However, no information on climate change is included.

Websites like www.bioneer.ee and www.greengate.ee have specialised in publishing environmental information from other media. Both contribute to raising the public awareness and to publishing environmental information.

9.3. Activities by the Estonian Government

It is the responsibility of the MoE to coordinate climate change policy and its implementation. The Ministry of Economic Affairs and Communication is responsible for energy policy and has been involved in implementing EU ETS and Joint Implementation in Estonia. The Ministry of Foreign Affairs and the Ministry of Finance participate in international projects regarding climate change. The main implementing agency for climate change policy is EEIC.

Estonian Research Institute of Agriculture, a state research institute under the jurisdiction of the Ministry of Agriculture, is actively involved in different studies that, among other things, assess the impact of climate change on agriculture.

The institutions involved in the compilation of GHG inventory are listed in the description of National Inventory System in chapter 3.4.

The MoE as the overall coordinator of climate change policy has altogether 2.5 specialists working on climate change related issues in the Air Quality and Radioactivity Bureau under the Environmental Management and Technology Department. The implementing body of climate change policy is the Climate and Ozone Bureau in EEIC with 4 specialists. The main tasks of the Climate and Ozone Bureau include administrating the Emission Trading Registry, coordinating GHG reporting (inventory, projections, policies and measures), implementing EU ETS, coordinating Joint Implementation, and administrating the registry for Ozone Depleting Substances. It is clear that the MoE does not have enough personnel for coordinating and implementing climate change policy. One of the latest developments designed to improve Estonia's performance in climate policy is the plan to establish an Energy and Climate Agency.

In summer 2009 the Ministry of Economic Affairs and Communications was ordered by the Parliament of Estonia to establish an Energy and Climate Agency. The Agency is going to be part of The Credit and Export Guarantee Fund KredEx. The activities of the Energy and Climate Agency will be oriented in two main directions: analysing the trends of energy and climate, and applying the measures of sustainable development.

The purpose of the analysis is to support the development of energy and climate policy, improve the overview in the statistical reporting of climate areas, and analyse the necessary global, national and local trends, as well as the influence of different developments on energy and climate areas. As a result, the country's energy and climate policy is expected to improve. The budget of the Energy and Climate Agency until the end of year 2010 is more than 80 million EEK in total.

The Estonian Ministry of Education and Research has been subsidising climate-related science and development, the amount of the subsidy having increased on several occasions over the past few years.

9.4. Educational system

The educational system in Estonia is administered by the Ministry of Education and Research. The Ministry prepares educational policy, coordinates its implementation and is responsible for educational matters at all educational levels. Education is organised mainly within the public sector and there are only a few private schools that still receive some public funding. The Estonian Ministry of Education and Research is supervising the drafting of the 2009–2013 development plan for education on sustainable development. Although this development plan does not address the issues of climate change separately, it recommends treating climate change, its reasons, consequences and adaptation as part of the education on sustainable development.

The educational system is divided into four levels. Pre-school is the first educational level and is intended for children under the compulsory age for education. Basic education can be acquired in primary schools (grades 1−4), basic schools (grades 1−9) and upper secondary schools (grades 10–12).

Environmental studies at school are part of many subjects, especially of science (elementary and basic school), geography, biology, chemistry and physics. The national curriculum includes a cross-curricular theme "Environment and Sustainable Development" which enables the teaching of subjects such as sustainable development, climate change, biodiversity, sustainable energy and water usage, waste separation, etc. Many schools have shown special initiative in integrating environmental education into the school curriculum and have established opportunities for outdoor learning near schools. The students have the opportunity to visit nature education centres and perform their studies in a natural environment. More than 50 nature and forest centres are offering educational programmes country-wide. Information about the extra-curricular programmes is available at the environmental education portal www.keskkonnaharidus.ee. The share of climate change related issues in general education could be increased and further developed. The challenge is to raise the awareness of teachers and provide better-quality learning materials on issues related to climate change.

Participation of schools in projects

Climate change education in primary and secondary schools is possible through public awareness campaigns and projects organised by different organisations. Several school projects supported by The Ministry of Education and Research are being carried out in Estonia:

- The Embassy of Denmark in Tallinn in cooperation with Eesti Energia AS and the Faculty of Power Engineering at Tallinn University of Technology announced the competition **Energy Saving School** in January 2009. Lower and upper secondary school

students were invited to monitor their energy use and to find opportunities for saving energy in schools. More than 60 schools were involved in the project. Teams of 5 students and 1 teacher analysed energy use in the school building and school's daily life, planned the activities for saving energy, held a campaign directed at students and teachers, and monitored the actual energy saving by carrying out measurements and doing research in the course of the project.

- Starting from 1996, 44 schools have been participating in the international **Global Learning and Observations to Benefit the Environment (GLOBE) Programme** which is a worldwide community of students, teachers, scientists, and citizens working together to better understand, sustain, and improve the Earth's environment on a local, regional, and global scale. Students participating in the programme observe and measure certain climate properties of the nature near their school and submit their results to an online database. The data on air temperatures and clouds collected by Estonian schools between 1997 and 2004 was declared to be of sufficient quality and was entered in the National Oceanic and Atmospheric database for climatic data. Since 1997, Estonian schoolchildren have sent more than 600,000 measured values to the GLOBE database, concerning the atmosphere, hydrology, biostatistics and phenology. Since 1996, students have prepared hundreds of research papers, and 700 to 1000 children are involved in the programme each year.

- 19 Estonian schools participate in the **Baltic Sea Project**. It is the first regional project within UNESCO Associated Schools Project to combine environmental education on a specific environmental issue, the Baltic Sea and intercultural learning. The objectives of the project are to increase students' awareness of the environmental problems of the Baltic Sea area and to give them an understanding of the scientific, social and cultural aspects of the interdependence between man and nature, to develop the ability of the students to study changes in the environment, and to encourage students to participate in developing a sustainable future.

- 12 Estonian schools participate in the **NASA CloudSat education network** where schoolchildren observe and measure clouds and precipitation during the overpass of the CloudSat satellite. The students provide CloudSat scientists with additional data related to the scientific goals of the mission and in return benefit from interaction with mission scientists, special web and hard copy activities, web chats etc.

- Since 1993, younger schoolchildren have been participating in the **Hello Spring** project which was initiated in Estonia but later became international in scope. Children participating in the project observe nature's first signs of spring (buds appearing and growing, plants blooming, migratory birds arriving) and enter their data into a database. More than 6000 kindergarten and primary school children participated in the observation activities in 2009. The project is financed by the Tiger Leap Foundation and the Environmental Investment Centre.

Higher education

Estonian universities do not offer the possibility to study climate change as a separate major, but many universities provide Bachelor or Master level programmes in environmental studies which incorporate climate change issues. Many secondary and vocational schools offer courses in environmental studies or place a special emphasis on environmental issues in their curriculum.

Based on the national schooling requirements, the Ministry of Education and Research orders studies from programmes related to environmental issues from universities. In 2008, 985 higher education students studied in environment-related curricula. These programmes address different environmental issues but the proportion of climate change studies is negligible. The universities teaching environmental subjects (including climate change issues) are Tallinn University of Technology, University of Tartu (including Türi College), University of Life Sciences, Tallinn University, Maritime Academy and Eurouniversity.

9.5. NGOs

The Estonian community has become more aware of the significance of climate change as a separate issue. A broad range of non-governmental organisations (NGOs) are actively involved in the capacity building of climate change issues through research, lobbying, education and training, and media activities.

- **Estonian Green Movement-FoE (EGM)** is one of the most influential environmental non-profit NGOs in Estonia, protecting the environmental needs of Estonia's inhabitants. In its activities the EGM is backed by a nationwide active network of some 1000 individual members. EGM has adopted the mission of reacting to the regional environmental problems brought about by political and social changes, and protecting Estonian natural resources on grass root, national and international levels. Its activities are carried out in the framework of two programmes (environmental awareness and environmental policy) addressing the following issues: consumption, energy and atmosphere (including climate change), forestry, transport and water.

- Estonian Students Society for Environment Protection Sorex is a voluntary non-profit NGO for young people of at least 16 years of age. Currently the organisation comprises mainly 20-26 year old students from Estonian universities. The main aims of Sorex are to raise the public awareness of ecological issues, to arouse interest in nature, to instil an environmentally friendly and sustainable way of thinking in young people, and also to organise events aimed at the protection of the environment and the improvement of knowledge. In 2008 Sorex published a brochure on four topics - water, waste, climate and sustainable development. The booklet was meant for distribution in schools alongside with lessons addressing these topics. The main goal of the booklet was to raise young people's awareness of these issues.

- **Stockholm Environment Institute Tallinn Centre (SEI-Tallinn)** is a non-profit NGO, founded by SEI and registered under the Estonian law in 1992. Through its Climate and Energy Programme SEI-Tallinn has been participating actively in numerous local, national and international projects regarding climate change for more than a decade. The institute has been involved in implementing UNFCCC and its Kyoto protocol in Estonia, acting as a consultant for Joint Implementation for the MoE and project developers, participating in climate change related projects in Baltic Sea Region. Furthermore, SEI-Tallinn has been compiling the National Allocation Plans under EU ETS for the periods 2005–2007 and 2008–2012. The main ongoing project in SEI-Tallinn regarding climate change at the moment is the INTERREG project "Baltic Climate" in cooperation with local municipalities, directed at enabling the municipalities to deal with the issue of climate change in a cooperative, integrative and sustainable way. The project started in October 2008 and will end in 2012.

- **Estonian Fund for Nature** is a non-profit organisation. Its objective is the preservation of natural diversity in Estonia and in the world in cooperation with individuals, companies, organisations and state institutions. Since 1991, the voluntary civic association, in cooperation with many people and organisations, has been leading various wildlife conservation projects.

- **The Archimedes Foundation** participates actively in building a knowledge-based Europe by helping open up education and training systems to Estonia through European cooperation programmes and by creating conditions for participation trough accreditation and evaluation of higher education. Through annual project competitions, efforts are being made to promote the sustainable management of the environment and its resources, to improve our knowledge of the interaction between the climate, biosphere, ecosystem and the human factor, and to create new technologies, means and services for addressing global environmental issues in an integrated way. The goals of the call for proposals in 2010 are related to the natural risk factors associated with climate change and the development of risks evaluation and alleviation methods. Priority is given to the development of prediction and warning systems for droughts related to climate change, and to the development of methods for adjusting to the dangers related to climate change.

9.6. Public information campaigns

Various campaigns and activities related to climate change are carried out in Estonia:

- **European Mobility Week** is celebrated yearly to raise public awareness of the need to take action against the air pollution and climate change caused by the increase in the number of cars in the urban environment. EGM has been the organiser of the Mobility Week activities since 2006. The aim of the campaign is to introduce the ad-

vantages of public transportation to the citizens. In the framework of the campaign various lectures are given on the alternative travel options. The campaign encourages individuals to think about how they can change their travel habits by using different means of transportation.

- Every year on 22 September Estonia celebrates the **Car-free Day** during which the public transportation is free of charge for all citizens of Tallinn City.

- The **Park and Drive** programme enables citizens to leave their cars in the special free parking lots in the suburbs and continue their way to the city centre of Tallinn by public transportation. The programme operates throughout the year. The main reasons for using the Park and Drive system are the cheaper price and the acceptable quality of the public transportation, as well as the smooth transfer from the suburbs.

- **Environment Day** was organised in cooperation between the Student Society for Environmental Protection and the European Commission (EC) within the project **Change** in 2007 during the Tallinn Youth Week. The objective of the project was to raise public awareness of environmental issues, including climate change. A special Environment Day was organised by the EU Information and Culture Centre in order to address various environmental issues: waste, climate change, air, and water. The project proved very successful in attracting the interest of different stakeholders.

- **Snowmen Campaign against the Climate Change** is an international campaign that has been organised in various places across Estonia (near schools, on squares etc). Hundreds of snowmen are built to fight the global warming, to show that climate change is threatening them as well as most other inhabitants of planet Earth. In Estonia, the campaign has been organized by EGM since 2006. Many other groups and concerned individuals have participated as well. The campaign has been very successful and has generated a lot of public and media interest during the past few years.

9.7. Participation in international activities

ASTRA project

In 2005–2007 Estonia participated in the project "Developing Policies & Adaptation Strategies to Climate Change in the Baltic Sea Region" (ASTRA) funded by the INTERREG IIIB Programme (Baltic Sea) of the EC. The Estonian partners in the project were the Institute of Ecology at Tallinn University, the Geological Survey of Estonia and Pärnu City. The main objective of the project was to assess the regional impact of the ongoing global climate change in the Baltic Sea region and to develop strategies and policies for regional adaptation to climate change.

The project used scientific knowledge from climate modelling and climate impact research, as well as geomorphologic and geological investigations to assess the impact of climate change on both natural and socio-economic systems. This provided a basis for the governments for handling threats arising from climate change in the Baltic Sea Region, such as extreme temperatures, droughts, forest fires, storm surges, winter storms and floods. As a first step, a major winter storm on 8–9 January 2005 and the subsequent events, as well as the related national, regional and local effects and responses, were studied as examples of the various challenges climate change poses to the region.

Adaptation strategies for regional planning purposes were developed. For example, the impact of climate change and the vulnerability of regions were studied in several regional and local case studies focusing on single effects as well as socio-economic sectors. Entry points and integration to existing planning processes and methods were identified. Special attention was paid to risk awareness, addressed by means of intensive dissemination exercises, such as regional conferences and workshops. Finally, policy recommendations for climate change adaptation were delivered for different spatial scales from local to national and Baltic Sea Region levels.

Baltic Climate Project

The INTERREG project Baltic Challenges and Chances for local and regional development generated by Climate Change (Baltic Climate) started in 2008. The project with an overall budget of 4.4 million EUR will end in 2012. It is targeted at small and medium sized cities and rural areas in all of the Baltic Sea Region countries including Estonia, especially at decision makers and those who prepare decisions on a local and regional level.

The project will identify how the climate change phenomenon also presents opportunities/chances and not only obstacles for the development of regions if they account for climate change related information in their long-term planning. Activities under the project:

- Developing and providing support materials enabling the assessment of the impact of climate change at the local level in the Baltic Sea Region;
- Describing and designing alternative urban and rural models of adjusting to climate change and developing a comprehensive approach which “localises” climate change related information and integrates several aspects of climate change at the local level and in the Baltic Sea Region;
- Implementing cross-sectoral cases on the subjects of transport, housing, energy and agriculture;
- "Capitalising” climate change by evaluating the changes in the operating environment and the effects on the "target area's" industry and commerce resulting from climate change in order to help regions’ business and economic life adapt to and benefit from climate change;
- Developing an Information and Communications Technology Toolkit in order to provide the identified target groups (decision makers and those who prepare decisions) on local and regional levels in all Baltic Sea Region countries with an easy-to-use, process-oriented guide on how to account for the impact of climate change in the relevant decision making processes. The toolkit will reflect the thematic focuses of target areas: e.g. energy, transport, housing, agriculture, with an emphasis on integrated planning processes, as well as local and regional planning and development.

The leading partner of the project

is Germany. Estonian participants are SEI-Tallinn, Harju County Government, non-profit organisation Harju Public Transport Centre, Saku Rural Municipality Government, Rapla County Government, Kehtna Rural Municipality Government and Kohila Rural Municipality Government.

Information under Articles 10e and 10f of the Kyoto Protocol

Estonia does not have any programmes or activities to cooperate in and promote the development and implementation of education and training programmes at international level.

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ANNEX I.

SUMMARY TABLES ON EMISSION TRENDS

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)
(Sheet 1 of 3)

Inventory 2007
Submission 2009 v1.2
ESTONIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	$HFCs^{(1)}$		$PFCs^{(1)}$		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**11 187,81**	**82,17**	**3,41**	**NA,NO**	**144,73**	**NA,NO**	**0,06**	**NA,NO**	**0,00**	**38,90**	**148,46**	**29,56**	**101,92**
1. Energy	**18 337,84**	**30,64**	**0,34**							**38,76**	**143,94**	**24,40**	**100,50**
A. Fuel Combustion — Reference Approach [2]	18 487,29												
A. Fuel Combustion — Sectoral Approach [2]	18 337,84	5,82	0,34							38,72	143,91	24,14	100,11
1. Energy Industries	14 458,35	0,30	0,04							19,50	12,44	7,92	91,35
2. Manufacturing Industries and Construction	995,10	0,07	0,01							2,14	2,47	0,37	5,97
3. Transport	2 536,92	0,54	0,23							15,12	45,53	6,08	0,64
4. Other Sectors	347,46	4,92	0,07							1,96	83,47	9,77	2,15
5. Other	NA,NO	NA,NO	NA,NO							NA	NA	NA	NA
B. Fugitive Emissions from Fuels	NA,NO	24,82	NA,NO							0,04	0,03	0,26	0,39
1. Solid Fuels	NO	NA,NO	NO							NO	NO	NO	NO
2. Oil and Natural Gas	NA,NO	24,82	NA,NO							0,04	0,03	0,26	0,39
2. Industrial Processes	**755,41**	**NA,NE,NO**	**NA,NE,NO**	**NA,NO**	**144,73**	**NA,NO**	**0,06**	**NA,NO**	**0,00**	**0,10**	**1,95**	**5,15**	**1,43**
A. Mineral Products	630,91	NA,NE	NA,NE							NA,NE	NA,NE	NA,NE	0,33
B. Chemical Industry	124,49	NA,NO	NA,NO	NA	NA	NA	NA	NA	NA	NA,NO	1,59	0,95	0,01
C. Metal Production	NA,NE,NO	NA,NE,NO	NA				NA,NO		NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
D. Other Production [3]	NO									0,10	0,36	4,21	1,09
E. Production of Halocarbons and SF_6					NA,NO		NA,NO		NO				
F. Consumption of Halocarbons and SF_6				NA,NO	144,73	NO	0,06	NA,NO	0,00				
G. Other	NA	NA	NA	NO	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note: **A** = Actual emissions based on Tier 2 approach of the IPCC Guidelines.
P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

Note: All footnotes for this table are given at the end of the table on sheet 3.

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)
(Sheet 2 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs [1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**NA**		**NA**							**NA**	**NA**	**NA**	**NA**
4. Agriculture		**23,76**	**2,69**							**0,05**	**2,57**	**NA,NE,NO**	**NE**
A. Enteric Fermentation		20,70											
B. Manure Management		2,85	0,39									NE,NO	
C. Rice Cultivation		NO										NE,NO	
D. Agricultural Soils[4]		NE,NO	2,30									NE,NO	
E. Prescribed Burning of Savannas		NO	NO							NO	NO	NO	
F. Field Burning of Agricultural Residues		0,21	0,00							0,05	2,57	NE,NO	
G. Other		NA	NA							NA	NA	NA	NE
5. Land Use, Land-Use Change and Forestry	[5] **-7 905,43**	**0,06**	**0,00**							**NE,NO**	**NE,NO**	**NE,NO**	**NO**
A. Forest Land	[5] -6 884,68	0,06	0,00							NE	NE	NE	
B. Cropland	[5] 606,00	NE	NE							NE	NE	NE	
C. Grassland	[5] -1 041,26	NE	NE							NE	NE	NE	
D. Wetlands	[5] -14,67	NE	0,00							NE	NE	NE	
E. Settlements	[5] NE	NE	NE							NE	NE	NE	
F. Other Land	[5] -570,82	NE	NE							NE	NE	NE	
G. Other	[5] IE	IE	NE							NO	NO	NO	NO
6. Waste	**NA,NE,NO**	**27,71**	**0,37**							**NA,NE**	**NA,NE**	**NA,NE**	**NE,NO**
A. Solid Waste Disposal on Land	[6] NA,NE,NO	24,59								NA,NE	NA,NE	NA,NE	
B. Waste-water Handling		IE,NA,NO	0,12							NA,NE	NA,NE	NA,NE	
C. Waste Incineration	[6] NA	NA,NE	0,01							NE	NE	NE	NE
D. Other	NE	3,12	0,23							NE	NE	NE	NO
7. Other ***(please specify)*** [7]	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Other non-specified	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note: All footnotes for this table are given at the end of the table on sheet 3.

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)
(Sheet 3 of 3)

Inventory 2007
Submission 2009 v1.2
ESTONIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
Memo Items: [8]													
International Bunkers	**924,87**	**0,05**	**0,01**							**15,90**	**10,25**	**2,06**	**4,62**
Aviation	148,37	0,00	0,00							0,61	0,05	0,02	0,05
Marine	776,50	0,05	0,01							15,29	10,19	2,04	4,57
Multilateral Operations	**NO**	**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**2 467,60**												

[1] The emissions of HFCs and PFCs are to be expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.

[2] For verification purposes, countries are asked to report the results of their calculations using the Reference approach and to explain any differences with the Sectoral approach in the documentation box to Table 1.A.(c). For estimating national total emissions, the results from the Sectoral approach should be used, where possible.

[3] Other Production includes Pulp and Paper and Food and Drink Production.

[4] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[5] For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[6] CO_2 from source categories Solid Waste Disposal on Land and Waste Incineration should only be included if it stems from non-biogenic or inorganic waste streams. Only emissions from Waste Incineration Without Energy Recovery are to be reported in the Waste sector, whereas emissions from Incineration With Energy Recovery are to be reported in the Energy sector.

[7] If reporting any country-specific source category under sector "7. Other", detailed explanations should be provided in Chapter 9: Other (CRF sector 7) of the NIR.

[8] Countries are asked to report emissions from international aviation and marine bunkers and multilateral operations, as well as CO_2 emissions from biomass, under Memo Items. These emissions should not be included in the national total emissions from the energy sector. Amounts of biomass used as fuel are included in the national energy consumption but the corresponding CO_2 emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net CO_2 emissions are accounted for as a loss of biomass stocks in the Land Use, Land-use Change and Forestry sector.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2007
Submission 2009 v1.2
ESTONIA

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]	**11 187,81**	**1 725,59**	**1 056,47**	**144,73**	**0,06**	**0,97**	**14 115,63**
1. Energy	**18 337,84**	**643,43**	**106,02**				**19 087,28**
A. Fuel Combustion (Sectoral Approach)	18 337,84	122,29	106,02				18 566,14
1. Energy Industries	14 458,35	6,25	12,49				14 477,09
2. Manufacturing Industries and Construction	995,10	1,53	2,60				999,24
3. Transport	2 536,92	11,28	69,78				2 617,98
4. Other Sectors	347,46	103,22	21,15				471,83
5. Other	NA,NO	NA,NO	NA,NO				NA,NO
B. Fugitive Emissions from Fuels	NA,NO	521,14	NA,NO				521,14
1. Solid Fuels	NO	NA,NO	NO				NA,NO
2. Oil and Natural Gas	NA,NO	521,14	NA,NO				521,14
2. Industrial Processes	**755,41**	**NA,NE,NO**	**NA,NE,NO**	**144,73**	**0,06**	**0,97**	**901,17**
A. Mineral Products	630,91	NA,NE	NA,NE				630,91
B. Chemical Industry	124,49	NA,NO	NA,NO	NA	NA	NA	124,49
C. Metal Production	NA,NE,NO	NA,NE,NO	NA	NA	NA,NO	NA,NO	NA,NE,NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [2]				144,73	0,06	0,97	145,76
G. Other	NA	NA	NA	NA,NO	NA	NA	NA,NO
3. Solvent and Other Product Use	**NA**		**NA**				**NA**
4. Agriculture		**498,98**	**834,11**				**1 333,09**
A. Enteric Fermentation		434,71					434,71
B. Manure Management		59,78	119,71				179,48
C. Rice Cultivation		NO					NO
D. Agricultural Soils[3]		NE,NO	713,54				713,54
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		4,49	0,86				5,35
G. Other		NA	NA				NA
5. Land Use, Land-Use Change and Forestry[1]	**-7 905,43**	**1,28**	**1,10**				**-7 903,05**
A. Forest Land	-6 884,68	1,28	0,13				-6 883,27
B. Cropland	606,00	NE	NE				606,00
C. Grassland	-1 041,26	NE	NE				-1 041,26
D. Wetlands	-14,67	NE	0,97				-13,69
E. Settlements	NE	NE	NE				NE
F. Other Land	-570,82	NE	NE				-570,82
G. Other	IE	IE	NE				IE,NE
6. Waste	**NA,NE,NO**	**581,90**	**115,24**				**697,14**
A. Solid Waste Disposal on Land	NA,NE,NO	516,39					516,39
B. Waste-water Handling		IE,NA,NO	38,57				38,57
C. Waste Incineration	NA	NA,NE	4,15				4,15
D. Other	NE	65,50	72,52				138,03
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Memo Items: [4]							
International Bunkers	924,87	1,09	3,38				929,34
Aviation	148,37	0,02	1,48				149,88
Marine	776,50	1,07	1,90				779,47
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**2 467,60**						**2 467,60**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	22 018,68
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	14 115,63

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

TABLE 10 EMISSION TRENDS
CO_2
(Part 1 of 2)

Inventory 2007
Submission 2009 v1.2
ESTONIA

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	**36 337,90**	**33 747,57**	**23 880,43**	**19 213,99**	**19 836,00**	**17 597,29**	**18 539,14**	**17 975,32**	**16 278,67**	**15 158,77**
A. Fuel Combustion (Sectoral Approach)	36 337,90	33 747,57	23 880,43	19 213,99	19 836,00	17 597,29	18 539,14	17 975,32	16 278,67	15 158,77
1. Energy Industries	29 448,30	27 267,95	20 240,88	15 977,62	16 438,61	14 903,37	15 627,05	15 134,35	13 433,99	12 778,41
2. Manufacturing Industries and Construction	2 025,61	1 836,74	1 142,01	583,57	946,83	648,10	758,24	678,24	663,93	364,84
3. Transport	3 345,35	3 211,18	1 810,75	2 088,02	2 062,36	1 615,06	1 684,32	1 785,58	1 841,57	1 664,01
4. Other Sectors	1 518,64	1 431,70	686,78	564,78	388,20	430,76	469,52	377,14	339,17	351,51
5. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
B. Fugitive Emissions from Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Industrial Processes	**945,59**	**925,73**	**538,11**	**304,58**	**546,53**	**568,54**	**586,42**	**633,80**	**670,32**	**596,39**
A. Mineral Products	628,43	633,86	387,65	244,62	344,22	361,08	375,17	411,43	428,80	379,38
B. Chemical Industry	317,16	291,87	150,45	59,96	202,31	207,47	211,25	222,37	241,52	217,01
C. Metal Production	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
D. Other Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
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]	**-6 373,92**	**-6 289,71**	**-8 164,43**	**-8 305,05**	**-7 033,52**	**-7 116,11**	**-7 455,64**	**-5 679,07**	**-5 229,31**	**-1 296,35**
A. Forest Land	-8 037,50	-7 784,88	-9 542,73	-9 234,93	-6 974,09	-6 897,16	-7 028,37	-5 125,72	-4 848,63	-890,98
B. Cropland	1 605,84	1 439,42	1 328,31	869,28	518,73	497,84	491,79	476,50	501,37	668,48
C. Grassland	66,54	66,74	60,99	71,59	-96,41	-388,09	-796,55	-1 018,85	-645,91	-538,48
D. Wetlands	-8,80	-11,00	-11,00	-11,00	-11,00	-11,00	-11,00	-11,00	-11,00	-11,00
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NE	NE	NE	NE	-470,75	-317,70	-111,50	NE,NO	-225,13	-524,37
G. Other	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
6. Waste	**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**
A. Solid Waste Disposal on Land	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. Waste-water Handling										
C. Waste Incineration	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
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	**30 909,56**	**28 383,59**	**16 254,10**	**11 213,52**	**13 349,01**	**11 049,72**	**11 669,91**	**12 930,04**	**11 719,68**	**14 458,81**
Total CO_2 emissions excluding net CO_2 from LULUCF	**37 283,48**	**34 673,31**	**24 418,53**	**19 518,57**	**20 382,53**	**18 165,83**	**19 125,56**	**18 609,12**	**16 948,99**	**15 755,16**
Memo Items:										
International Bunkers	**679,84**	**704,58**	**427,00**	**528,60**	**444,43**	**326,94**	**336,28**	**382,22**	**381,44**	**416,92**
Aviation	105,44	108,33	35,51	52,92	43,31	49,22	45,86	60,53	39,73	52,42
Marine	574,40	596,25	391,49	475,68	401,12	277,72	290,42	321,69	341,71	364,50
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	892,34	875,60	837,30	786,31	1 277,52	2 131,39	2 475,04	2 587,31	2 209,09	2 188,03

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
CO_2
(Part 2 of 2)

Inventory 2007
Submission 2009 v1.2
ESTONIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**14 972,51**	**15 253,25**	**15 015,38**	**16 711,12**	**16 875,11**	**16 302,42**	**15 761,50**	**18 337,84**	**-49,54**
A. Fuel Combustion (Sectoral Approach)	14 972,51	15 253,25	15 015,38	16 711,12	16 875,11	16 302,42	15 761,50	18 337,84	-49,54
1. Energy Industries	12 506,30	12 296,18	12 048,38	13 767,17	13 860,37	13 161,78	12 480,43	14 458,35	-50,90
2. Manufacturing Industries and Construction	474,67	580,99	416,78	436,55	471,46	540,96	539,41	995,10	-50,87
3. Transport	1 643,46	1 934,99	2 081,11	2 092,31	2 148,92	2 204,54	2 405,33	2 536,92	-24,17
4. Other Sectors	348,07	441,09	469,12	415,09	394,35	395,15	336,34	347,46	-77,12
5. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
B. Fugitive Emissions from Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NO	NO	NO	NO	NO	0,00
2. Oil and Natural Gas	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
2. Industrial Processes	**583,12**	**605,08**	**417,13**	**456,62**	**567,46**	**545,44**	**579,63**	**755,41**	**-20,11**
A. Mineral Products	395,29	402,49	388,73	363,80	396,04	401,90	444,84	630,91	0,40
B. Chemical Industry	187,83	202,59	28,40	92,82	171,42	143,54	134,79	124,49	-60,75
C. Metal Production	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0,00
D. Other Production	NO	NO	NO	NO	NO	NO	NO	NO	0,00
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
3. Solvent and Other Product Use	NA	NA	NA	NA	NA	NA	NA	NA	0,00
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]	**-1 463,42**	**-4 200,62**	**-3 850,80**	**-5 579,76**	**-8 765,61**	**-7 561,92**	**-8 946,11**	**-7 905,43**	**24,03**
A. Forest Land	-698,18	-2 707,75	-2 288,39	-4 487,34	-7 102,25	-7 252,67	-8 106,38	-6 884,68	-14,34
B. Cropland	457,63	314,92	500,19	788,30	299,60	1 296,88	910,48	606,00	-62,26
C. Grassland	-394,60	-998,66	-1 433,06	-1 191,80	-1 145,21	-757,74	-900,86	-1 041,26	-1 664,90
D. Wetlands	-14,67	-14,67	-14,67	-14,67	-14,67	-14,67	-14,67	-14,67	66,67
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	0,00
F. Other Land	-813,61	-794,46	-614,88	-674,26	-803,08	-833,72	-834,68	-570,82	100,00
G. Other	IE	IE	IE	IE	IE	IE	IE	IE	0,00
6. Waste	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**0,00**
A. Solid Waste Disposal on Land	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0,00
B. Waste-water Handling									
C. Waste Incineration	NA	NA	NA	NA	NA	NA	NA	NA	0,00
D. Other	NE	NE	NE	NE	NE	NE	NE	NE	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total CO_2 emissions including net CO_2 from LULUCF	**14 092,21**	**11 657,71**	**11 581,71**	**11 587,98**	**8 676,96**	**9 285,94**	**7 395,02**	**11 187,81**	**-63,80**
Total CO_2 emissions excluding net CO_2 from LULUCF	**15 555,63**	**15 858,33**	**15 432,51**	**17 167,74**	**17 442,56**	**16 847,86**	**16 341,13**	**19 093,24**	**-48,79**
Memo Items:									
International Bunkers	**389,23**	**362,77**	**426,74**	**409,34**	**556,12**	**519,66**	**763,92**	**924,87**	**36,04**
Aviation	58,60	48,14	53,97	54,66	84,38	142,65	94,26	148,37	40,72
Marine	330,63	314,63	372,77	354,69	471,74	377,01	669,66	776,50	35,19
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass	2 253,45	2 327,08	2 324,04	2 545,95	2 684,10	2 609,20	2 161,92	2 467,60	176,53

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
CH_4
(Part 1 of 2)

Inventory 2007
Submission 2009 v1.2
ESTONIA

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	42,12	41,78	25,13	13,70	19,26	23,85	26,64	26,12	23,63	22,98
A. Fuel Combustion (Sectoral Approach)	4,35	4,11	3,16	2,92	3,70	5,95	6,83	6,83	5,41	5,25
1. Energy Industries	0,35	0,34	0,22	0,21	0,25	0,28	0,32	0,31	0,31	0,30
2. Manufacturing Industries and Construction	0,08	0,08	0,05	0,02	0,03	0,02	0,03	0,03	0,02	0,02
3. Transport	0,90	0,86	0,43	0,48	0,55	0,49	0,56	0,59	0,55	0,53
4. Other Sectors	3,02	2,83	2,47	2,22	2,86	5,16	5,92	5,90	4,53	4,40
5. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
B. Fugitive Emissions from Fuels	37,77	37,67	21,97	10,78	15,56	17,90	19,81	19,30	18,22	17,73
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	37,77	37,67	21,97	10,78	15,56	17,90	19,81	19,30	18,22	17,73
2. Industrial Processes	**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**
A. Mineral Products	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
B. Chemical Industry	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C. Metal Production	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
D. Other Production										
E. Production of Halocarbons and SF6										
F. Consumption of Halocarbons and SF6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use										
4. Agriculture	**59,11**	**55,80**	**47,53**	**37,18**	**33,67**	**29,97**	**28,18**	**27,61**	**27,21**	**23,48**
A. Enteric Fermentation	51,92	49,09	42,34	32,98	29,68	26,27	25,05	24,43	24,05	20,70
B. Manure Management	6,94	6,46	5,02	3,99	3,86	3,55	2,96	3,00	3,01	2,67
C. Rice Cultivation	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
D. Agricultural Soils	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	0,25	0,24	0,17	0,21	0,14	0,14	0,17	0,18	0,15	0,11
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**0,23**	**0,00**	**0,22**	**0,04**	**0,14**	**0,07**	**0,08**	**0,12**	**0,09**	**0,10**
A. Forest Land	0,23	0,00	0,22	0,04	0,14	0,07	0,08	0,12	0,09	0,10
B. Cropland	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Grassland	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. Wetlands	NE	NE	NE	NE	NE	NE	NE	NE	NE	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	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
6. Waste	**28,60**	**28,06**	**27,63**	**28,18**	**27,98**	**25,99**	**26,08**	**29,07**	**30,95**	**31,09**
A. Solid Waste Disposal on Land	28,57	28,03	27,60	28,15	27,95	25,95	25,96	28,81	30,92	31,05
B. Waste-water Handling	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
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	0,03	0,03	0,03	0,03	0,03	0,04	0,13	0,26	0,03	0,04
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	**130,05**	**125,64**	**100,52**	**79,10**	**81,05**	**79,88**	**80,97**	**82,92**	**81,89**	**77,65**
Total CH_4 emissions excluding CH_4 from LULUCF	**129,83**	**125,63**	**100,30**	**79,06**	**80,91**	**79,81**	**80,90**	**82,80**	**81,79**	**77,56**
Memo Items:										
International Bunkers	0,04	0,04	0,03	0,03	0,03	0,02	0,02	0,02	0,02	0,02
Aviation	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Marine	0,04	0,04	0,03	0,03	0,03	0,02	0,02	0,02	0,02	0,02
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
CH_4
(Part 2 of 2)

Inventory 2007
Submission 2009 v1.2
ESTONIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	25,57	27,14	23,52	25,62	29,33	29,46	29,61	30,64	-27,25
A. Fuel Combustion (Sectoral Approach)	5,23	5,27	5,18	5,40	5,44	4,86	4,70	5,82	33,97
1. Energy Industries	0,30	0,33	0,34	0,33	0,35	0,39	0,31	0,30	-14,57
2. Manufacturing Industries and Construction	0,03	0,04	0,03	0,07	0,08	0,08	0,04	0,07	-13,23
3. Transport	0,50	0,60	0,53	0,49	0,47	0,47	0,52	0,54	-40,15
4. Other Sectors	4,41	4,30	4,29	4,50	4,54	3,93	3,82	4,92	62,96
5. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
B. Fugitive Emissions from Fuels	20,34	21,87	18,33	20,23	23,88	24,60	24,92	24,82	-34,30
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
2. Oil and Natural Gas	20,34	21,87	18,33	20,23	23,88	24,60	24,92	24,82	-34,30
2. Industrial Processes	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**0,00**
A. Mineral Products	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
B. Chemical Industry	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C. Metal Production	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0,00
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	0,00
3. Solvent and Other Product Use									
4. Agriculture	**23,26**	**24,51**	**23,18**	**23,45**	**23,67**	**23,90**	**23,95**	**23,76**	**-59,80**
A. Enteric Fermentation	20,39	21,49	20,29	20,55	20,76	20,95	21,05	20,70	-60,13
B. Manure Management	2,69	2,87	2,77	2,77	2,77	2,76	2,75	2,85	-58,96
C. Rice Cultivation	NA,NO	NA,NO	NA,NO	NO	NO	NO	NO	NO	0,00
D. Agricultural Soils	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	0,00
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	0,00
F. Field Burning of Agricultural Residues	0,18	0,14	0,13	0,13	0,14	0,18	0,15	0,21	-15,63
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
5. Land Use, Land-Use Change and Forestry	**0,15**	**0,05**	**0,29**	**0,04**	**0,08**	**0,02**	**0,48**	**0,06**	**-73,15**
A. Forest Land	0,15	0,05	0,29	0,04	0,08	0,02	0,48	0,06	-73,15
B. Cropland	NE	NE	NE	NE	NE	NE	NE	NE	0,00
C. Grassland	NE	NE	NE	NE	NE	NE	NE	NE	0,00
D. Wetlands	NE	NE	NE	NE	NE	NE	NE	NE	0,00
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	0,00
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	0,00
G. Other	IE	IE	IE	IE	IE	IE	IE	IE	0,00
6. Waste	**32,78**	**32,52**	**30,98**	**30,63**	**30,48**	**28,61**	**28,49**	**27,71**	**-3,10**
A. Solid Waste Disposal on Land	32,67	32,38	30,59	29,44	28,86	26,69	25,81	24,59	-13,92
B. Waste-water Handling	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	0,00
C. Waste Incineration	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
D. Other	0,11	0,14	0,40	1,19	1,61	1,92	2,68	3,12	10 822,91
7. Other ***(as specified in Summary 1.A)***	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total CH_4 emissions including CH_4 from LULUCF	**81,76**	**84,21**	**77,97**	**79,74**	**83,55**	**81,99**	**82,53**	**82,17**	**-36,82**
Total CH_4 emissions excluding CH_4 from LULUCF	**81,61**	**84,16**	**77,68**	**79,70**	**83,48**	**81,97**	**82,05**	**82,11**	**-36,75**
Memo Items:									
International Bunkers	0,02	0,02	0,03	0,02	0,03	0,03	0,04	0,05	34,92
Aviation	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	40,71
Marine	0,02	0,02	0,02	0,02	0,03	0,03	0,04	0,05	34,81
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass									

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
N_2O
(Part 1 of 2)

Inventory 2007
Submission 2009 v1.2
ESTONIA

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	**0,20**	**0,19**	**0,12**	**0,12**	**0,15**	**0,18**	**0,20**	**0,21**	**0,20**	**0,19**
A. Fuel Combustion (Sectoral Approach)	0,20	0,19	0,12	0,12	0,15	0,18	0,20	0,21	0,20	0,19
1. Energy Industries	0,06	0,06	0,04	0,04	0,04	0,04	0,05	0,05	0,05	0,04
2. Manufacturing Industries and Construction	0,01	0,01	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00
3. Transport	0,08	0,08	0,04	0,05	0,06	0,07	0,07	0,08	0,09	0,08
4. Other Sectors	0,05	0,05	0,04	0,03	0,04	0,07	0,08	0,08	0,06	0,06
5. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
B. Fugitive Emissions from Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Industrial Processes	**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**
A. Mineral Products	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
B. Chemical Industry	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
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	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4. Agriculture	**5,78**	**5,57**	**4,81**	**3,43**	**3,09**	**2,70**	**2,46**	**2,62**	**2,69**	**2,38**
A. Enteric Fermentation										
B. Manure Management	0,97	0,90	0,74	0,60	0,55	0,49	0,44	0,45	0,44	0,39
C. Rice Cultivation										
D. Agricultural Soils	4,81	4,67	4,06	2,83	2,54	2,21	2,02	2,17	2,24	1,99
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Forest Land	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Cropland	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Grassland	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. Wetlands	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
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	**0,23**	**0,23**	**0,24**	**0,24**	**0,24**	**0,32**	**0,34**	**0,17**	**0,14**	**0,19**
A. Solid Waste Disposal on Land										
B. Waste-water Handling	0,13	0,13	0,13	0,12	0,12	0,12	0,12	0,12	0,12	0,11
C. Waste Incineration	0,10	0,10	0,10	0,11	0,11	0,19	0,21	0,03	0,03	0,07
D. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,02	0,00	0,00
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	**6,22**	**6,00**	**5,17**	**3,79**	**3,47**	**3,21**	**3,00**	**3,00**	**3,03**	**2,76**
Total N_2O emissions excluding N_2O from LULUCF	**6,21**	**6,00**	**5,17**	**3,79**	**3,47**	**3,20**	**3,00**	**2,99**	**3,02**	**2,76**
Memo Items:										
International Bunkers	**0,01**	**0,01**	**0,00**	**0,01**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
Aviation	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	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										

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
N_2O
(Part 2 of 2)

Inventory 2007
Submission 2009 v1.2
ESTONIA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**0,19**	**0,23**	**0,25**	**0,27**	**0,29**	**0,31**	**0,32**	**0,34**	**68,60**
A. Fuel Combustion (Sectoral Approach)	0,19	0,23	0,25	0,27	0,29	0,31	0,32	0,34	68,60
1. Energy Industries	0,04	0,05	0,05	0,05	0,05	0,05	0,04	0,04	-35,69
2. Manufacturing Industries and Construction	0,00	0,00	0,00	0,01	0,01	0,01	0,00	0,01	-23,76
3. Transport	0,09	0,12	0,14	0,15	0,17	0,19	0,22	0,23	181,49
4. Other Sectors	0,06	0,06	0,06	0,06	0,06	0,06	0,05	0,07	38,57
5. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
B. Fugitive Emissions from Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NO	NO	NO	NO	NO	0,00
2. Oil and Natural Gas	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
2. Industrial Processes	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**0,00**
A. Mineral Products	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
B. Chemical Industry	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	0,00
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	0,00
3. Solvent and Other Product Use	NA	NA	NA	NA	NA	NA	NA	NA	0,00
4. Agriculture	**2,61**	**2,43**	**2,22**	**2,47**	**2,50**	**2,43**	**2,49**	**2,69**	**-53,44**
A. Enteric Fermentation									
B. Manure Management	0,38	0,40	0,38	0,38	0,39	0,39	0,39	0,39	-60,02
C. Rice Cultivation									
D. Agricultural Soils	2,22	2,02	1,84	2,09	2,11	2,04	2,10	2,30	-52,13
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	0,00
F. Field Burning of Agricultural Residues	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-32,57
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
5. Land Use, Land-Use Change and Forestry	**0,00**	**0,00**	**0,01**	**0,00**	**0,00**	**0,00**	**0,01**	**0,00**	**3,37**
A. Forest Land	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-73,15
B. Cropland	NE	NE	NE	NE	NE	NE	NE	NE	0,00
C. Grassland	NE	NE	NE	NE	NE	NE	NE	NE	0,00
D. Wetlands	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	66,67
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	0,00
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	0,00
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	0,00
6. Waste	**0,54**	**0,19**	**0,51**	**0,27**	**0,56**	**0,32**	**0,34**	**0,37**	**61,53**
A. Solid Waste Disposal on Land									
B. Waste-water Handling	0,11	0,11	0,11	0,11	0,13	0,12	0,12	0,12	-4,08
C. Waste Incineration	0,42	0,07	0,36	0,07	0,31	0,05	0,01	0,01	-86,39
D. Other	0,01	0,01	0,03	0,09	0,12	0,14	0,20	0,23	10 822,91
7. Other ***(as specified in Summary 1.A)***	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total N_2O emissions including N_2O from LULUCF	**3,35**	**2,86**	**2,98**	**3,01**	**3,35**	**3,06**	**3,15**	**3,41**	**-45,17**
Total N_2O emissions excluding N_2O from LULUCF	**3,34**	**2,85**	**2,97**	**3,01**	**3,35**	**3,06**	**3,14**	**3,40**	**-45,19**
Memo Items:									
International Bunkers	**0,00**	**0,00**	**0,00**	**0,00**	**0,01**	**0,01**	**0,01**	**0,01**	**37,40**
Aviation	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	40,87
Marine	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,01	34,80
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass									

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF_6
(Part 1 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990) (Gg)	1991 (Gg)	1992 (Gg)	1993 (Gg)	1994 (Gg)	1995 (Gg)	1996 (Gg)	1997 (Gg)	1998 (Gg)	1999 (Gg)
Emissions of HFCs[3] - ($Gg CO_2$ equivalent)	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**25,70**	**30,94**	**36,75**	**47,52**	**57,01**
HFC-23	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-32	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,00	0,00
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-125	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,00	0,00
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,02	0,02	0,02	0,02	0,03
HFC-152a	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143a	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,00	0,00
HFC-227ea	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-236fa	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed HFCs[4] - ($Gg CO_2$ equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of PFCs[3] - ($Gg CO_2$ equivalent)	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**
CF_4	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_2F_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_3F_8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
c-C_4F_8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_5F_{12}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_6F_{14}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed PFCs[4] - ($Gg CO_2$ equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of SF6[3] - ($Gg CO_2$ equivalent)	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**3,22**	**3,51**	**3,00**	**2,98**	**3,01**
SF_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,00	0,00

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF_6
(Part 2 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
Emissions of HFCs[3] - ($Gg CO_2$ equivalent)	**70,79**	**86,21**	**87,24**	**93,04**	**105,71**	**118,70**	**139,53**	**144,73**	**100,00**
HFC-23	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00	100,00
HFC-32	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-125	0,00	0,00	0,01	0,01	0,01	0,01	0,01	0,01	100,00
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-134a	0,03	0,04	0,04	0,04	0,05	0,05	0,06	0,06	100,00
HFC-152a	0,00	0,00	0,00	0,00	0,01	0,01	0,01	0,02	100,00
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-143a	0,00	0,00	0,01	0,01	0,01	0,01	0,01	0,01	100,00
HFC-227ea	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
HFC-236fa	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Unspecified mix of listed HFCs[4] - ($Gg CO_2$ equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Emissions of PFCs[3] - ($Gg CO_2$ equivalent)	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,07**	**0,06**	**100,00**
CF_4	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C_2F_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C_3F_8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	100,00
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
c-C_4F_8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C_5F_{12}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C_6F_{14}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Unspecified mix of listed PFCs[4] - ($Gg CO_2$ equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Emissions of SF6[3] - ($Gg CO_2$ equivalent)	**2,73**	**1,74**	**1,43**	**1,31**	**1,08**	**1,08**	**1,15**	**0,97**	**100,00**
SF_6	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS SUMMARY (Part 1 of 2)

Inventory 2007
Submission 2009 v1.2
ESTONIA

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	30 909,56	28 383,59	16 254,10	11 213,52	13 349,01	11 049,72	11 669,91	12 930,04	11 719,68	14 458,81
CO_2 emissions excluding net CO_2 from LULUCF	37 283,48	34 673,31	24 418,53	19 518,57	20 382,53	18 165,83	19 125,56	18 609,12	16 948,99	15 755,16
CH_4 emissions including CH_4 from LULUCF	2 731,11	2 638,38	2 110,92	1 661,10	1 702,09	1 677,41	1 700,46	1 741,26	1 719,59	1 630,72
CH_4 emissions excluding CH_4 from LULUCF	2 726,35	2 638,32	2 106,23	1 660,27	1 699,16	1 675,95	1 698,88	1 738,75	1 717,69	1 628,70
N_2O emissions including N_2O from LULUCF	1 926,67	1 859,64	1 602,80	1 174,25	1 076,26	993,80	931,23	928,79	938,38	856,92
N_2O emissions excluding N_2O from LULUCF	1 925,60	1 858,91	1 601,59	1 173,43	1 075,24	992,92	930,34	927,80	937,46	855,98
HFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	25,70	30,94	36,75	47,52	57,01
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	3,22	3,51	3,00	2,98	3,01
Total (including LULUCF)	**35 567,34**	**32 881,62**	**19 967,83**	**14 048,87**	**16 127,37**	**13 749,85**	**14 336,05**	**15 639,84**	**14 428,15**	**17 006,48**
Total (excluding LULUCF)	**41 935,43**	**39 170,54**	**28 126,35**	**22 352,27**	**23 156,93**	**20 863,62**	**21 789,22**	**21 315,41**	**19 654,65**	**18 299,87**

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	37 285,23	34 683,65	24 446,25	19 539,31	20 285,57	18 154,77	19 160,57	18 587,79	16 835,85	15 700,37
2. Industrial Processes	945,59	925,73	538,11	304,58	546,53	597,46	620,86	673,54	720,83	656,41
3. Solvent and Other Product Use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4. Agriculture	3 032,75	2 899,67	2 488,81	1 843,64	1 664,04	1 467,78	1 355,70	1 391,56	1 403,87	1 231,96
5. Land Use, Land-Use Change and Forestry[5]	-6 368,09	-6 288,92	-8 158,52	-8 303,40	-7 029,56	-7 113,77	-7 453,17	-5 675,57	-5 226,50	-1 293,39
6. Waste	671,87	661,48	653,19	664,75	660,79	643,60	652,09	662,52	694,10	711,12
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)[5]	**35 567,34**	**32 881,62**	**19 967,83**	**14 048,87**	**16 127,37**	**13 749,85**	**14 336,05**	**15 639,84**	**14 428,15**	**17 006,48**

[1] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the COP. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[2] Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[3] Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as CO_2 equivalent emissions.

[4] In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is Gg of CO_2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.

[5] Includes net CO_2, CH_4 and N_2O from LULUCF.

TABLE 10 EMISSION TRENDS SUMMARY (Part 2 of 2)

Inventory 2007
Submission 2009 v1.2
ESTONIA

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	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	14 092,21	11 657,71	11 581,71	11 587,98	8 676,96	9 285,94	7 395,02	11 187,81	-63,80
CO_2 emissions excluding net CO_2 from LULUCF	15 555,63	15 858,33	15 432,51	17 167,74	17 442,56	16 847,86	16 341,13	19 093,24	-48,79
CH_4 emissions including CH_4 from LULUCF	1 716,89	1 768,51	1 637,40	1 674,59	1 754,60	1 721,76	1 733,10	1 725,59	-36,82
CH_4 emissions excluding CH_4 from LULUCF	1 713,77	1 767,46	1 631,33	1 673,71	1 752,99	1 721,35	1 723,09	1 724,31	-36,75
N_2O emissions including N_2O from LULUCF	1 037,45	885,60	923,82	932,85	1 039,25	949,32	976,73	1 056,47	-45,17
N_2O emissions excluding N_2O from LULUCF	1 036,16	884,52	922,23	931,79	1 038,11	948,31	974,74	1 055,36	-45,19
HFCs	70,79	86,21	87,24	93,04	105,71	118,70	139,53	144,73	100,00
PFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,07	0,06	100,00
SF_6	2,73	1,74	1,43	1,31	1,08	1,08	1,15	0,97	100,00
Total (including LULUCF)	**16 920,08**	**14 399,77**	**14 231,60**	**14 289,78**	**11 577,60**	**12 076,80**	**10 245,60**	**14 115,63**	**-60,31**
Total (excluding LULUCF)	**18 379,09**	**18 598,26**	**18 074,74**	**19 867,59**	**20 340,45**	**19 637,29**	**19 179,71**	**22 018,68**	**-47,49**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	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	15 569,73	15 895,39	15 585,54	17 331,84	17 579,80	17 016,16	16 482,27	19 087,28	-48,81
2. Industrial Processes	656,65	693,03	505,80	550,97	674,24	665,21	720,39	901,17	-4,70
3. Solvent and Other Product Use	NA	NA	NA	NA	NA	NA	NA	NA	0,00
4. Agriculture	1 297,99	1 267,47	1 175,91	1 258,72	1 273,53	1 255,28	1 274,40	1 333,09	-56,04
5. Land Use, Land-Use Change and Forestry[5]	-1 459,02	-4 198,49	-3 843,14	-5 577,81	-8 762,86	-7 560,49	-8 934,11	-7 903,05	24,10
6. Waste	854,73	742,37	807,49	726,06	812,88	700,65	702,66	697,14	3,76
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
Total (including LULUCF)[5]	**16 920,08**	**14 399,77**	**14 231,60**	**14 289,78**	**11 577,60**	**12 076,80**	**10 245,60**	**14 115,63**	**-60,31**

[1] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the COP. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[2] Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[3] Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as CO_2 equivalent emissions.

[4] In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is Gg of CO_2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.

[5] Includes net CO_2, CH_4 and N_2O from LULUCF.

Documentation box:
• Parties should provide detailed explanations on emissions trends in Chapter 2: Trends in Greenhouse Gas Emissions and, as appropriate, in the corresponding Chapters 3 - 9 of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and further details are needed to understand the content of this table.
• Use the documentation box to provide explanations if potential emissions are reported.

ANNEX II.

SUMMARY OF REPORTING OF THE SUPPLEMENTARY INFORMATION UNDER ARTICLE 7, PARAGRAPH 2,OF THE KYOTO PROTOCOL IN THE NC5

Annex II. Summary of reporting of the Supplementary information under Article 7, paragraph 2, of the Kyoto Protocol in the NC5

Information reported under Article 7, paragraph 2	NC5 section
National systems in accordance with Article 5, paragraph 1	3.4
National registries	3.5
Supplementarity relating to the mechanisms pursuant to Articles 6, 12 and 17	5.3
Policies and measures in accordance with Article 2	4.2; 4.3
Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures	4.1
Information under Article 10 Art 10a Art 10b Art 10c Art 10d Art 10e	 4.3.1.1 4.3. 4.2.4 8.3 9.2