MINISTRY OF ENVIRONMENTAL PROTECTION
AND REGIONAL DEVELOPMENT

THE THIRD NATIONAL COMMUNICATION OF THE REPUBLIC OF LATVIA UNDER UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

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The following chemical symbols, formulas and abbreviations are used:

C	carbon
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
HFC	hydro fluorocarbons
N	nitrogen
NH_3	ammonia
NMGOS	non-methane volatile organic compounds
N_2O	nitrous oxide
NO_x	nitrogen oxides
PFC	per fluorocarbons
SF_6	sulphur hex fluoride

SO_2	sulphur dioxide

The following units of measurements are used:

Gg	gig gram (10^9 gram)
GJ	gig joule (10^9 joule)
ha	hectare (10^4 m^2)
km	kilometre (10^3 m)
kWh	kilowatt-hour (10^3 vat hours)
m	meter
MW	mega vat
MWh	mega vat hour
nm^3	normal cubic meter
PJ	pet joule (10^{15} joules)
t	ton (10^3 kg)
toe	ton oil equivalent
tce	ton coal equivalent
USD	US dollar
LVL	Latvian lat

The following energy conversion is used:

	GJ	**MWh**	**toe**	**tce**	**Gcal**
GJ	1	0,28	0,024	0,034	0,24
MWh	3,6	1	0,086	0,122	0,86
toe	41,9	11,6	1	1,422	10
tce	29,3	8,2	0,703	1	7,03
Gcal	4,19	1,1	0,1	0,142	1

The following abbreviations are used:

A/S – Stock Company
acquis communautaire – Set of EU Legislative Acts
AIJ – Activities Implemented Jointly
BALTEX – Baltic Sea Experiment
BKG – Business Consulting Group
BTS – Baltic Therapeutically Service
CCB – Coalition Clean Baltic
CEE – Central and Eastern Europe
CEN – European Committee for Standardization
CFB – Compact Fluorescent Bulbs
CHP – Combined Heat and Power
CIS – Commonwealth of Independent States
CLICOM – CLImate COMputing
CM – Cabinet of Ministers
CP – Cleaner Production
CRF – Common Reporting Format
CSB – Central Statistical Bureau of Latvia
CTI – Climate Technology Iniciative
DATI – Danish Agency of Trend and Industry
DH – District Heating
DPC – Danish Power Consult
DTI – Danish Technological Institute
EAES – Environmentally Adapted Energy Systems
EBRD – European Bank for Reconstruction and Development
ED – Energy Departament
EEA – European Environmental Agency
EEF – Energy and Electro technical Faculty
EIF – Environmental Investment Fund
ELI – Efficient Lightning Iniciative
EMAS – Environmental Management and Auditing Scheme
EMS – Environmental Management system
EPAP – Environmental Protection Action Plan
EPPP – Environmental Protection Policy Plan
ERC – Energy Supply Regulation Council
ESCO – Energy Service Company
ETSAP – Energy Technology Systems Analysis Progrmme
EU – European Union
FSC – Forest Stewardship Council
GAP – Good Agricultural Practice
GDP – Gross Domestic Product
GEF – Global Environment Facility
GEWEX – Global Energy and Water Cycle Experiment
GHG – Greenhouse Gases
GWP – Global warming potencial
HDI – Human Development Index
HPS – Hydroelectric Power Station
ICP – International Co-operation Programm

IEA – International Energy Agency
IFC – International Finance Corporation
IPCC – Intergovernmental Panel on Climate Change
ISO – International Organization for Standardization
ISPA – Instrument for Structural Policies for Pre-accession
JI – Joint Implementation
JSC – Joint Stock Company
LAS – Academy of Science of Latvia
LDA – Latvian Development Agency
LEA – Latvian Environment Agency
LFA – Less-powered area
LPPC – Latvian Pollution Prevention Center
LR – Republic of Latvia
LRC – Latvian Research Council
LU – University of Latvia
LUA – Latvia University of Agriculture
MA – Ministry of Agriculture
MARKAL – Market Allocation
ME – Ministry of Economy
MEPRD – Ministry of Environmental Protection and Regional Development
NGO – Non-Governmental Organisation
NOVEM – Netherlands Agency for Energy and Environment
OECD – Organisation for Economic Co-operation and Development
OPET – Organisation of Promotion of Energy Technologies
PCF – Prototype Carbon Fund
PEFC – Pan-European Forest Certification
PHARE – Poland and Hungary Action for the Restructuring of the Economy
PIP – Public Investment program
PPI – Public Policy Institute
PROCEED – Programm of Cooperation on Energy Economy Development
PSO – Personnel Service Overseas
RSS – Rural support service
RTSD – Road Traffic Safety Department
RTU – Riga Technical University
SAPARD – Special Assistance Programme for Agriculture and Rural Development
SCORE – Supporting the Cooperative Organization of Rational Energy Use
SFS – State Forest Service
SHMB – State Hidrometeorology Board
SIA – Limited liability company
SIDA – Swedish International Development
SLS – State Land Service
STEM – Swedish National Energy Administration
UN – United Nations
UNDP – United Nations Development Programme
UNEP – United Nations Environment Programme
UNESCO – United Nations Educational, Scientific and Cultural Organization
UNFCCC – United Nations Framework Convention on Climate Change
USSR – Union of Soviet Social Republics

WCDMP – World Climate Data and Monitoring Programme
WCRP – World Climate Research Programme
WMO – World Meteorological Organisation
WTO – World Trade Organisation
WWF – World Wildlife Fund

The following indicators are used

NE – not estimated
NI – no impact
NO – not occuring

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INTRODUCTION

Latvia takes part in the global climate change mitigation process and has acceded, together with many other countries, to the United Nations Framework Convention on Climate Change (Convention) adopted by the UN Conference on Environment and Development held in Rio de Janeiro in 1992. The Convention gained its affect on March 21, 1994. Saeima (Parliament) of the Republic of Latvia has ratified the Convention on February 23, 1995 and since March 23, 1995 Latvia is a Party to the Convention thus undertaking to implement series of international commitments.

The aim of the Convention is to reach stabilisation of the concentration of greenhouse gases (GHG) in the atmosphere on the level to prevent dangerous anthropogenic interference with the climate system. GHG are the natural and anthropogenic (man-made) atmospheric gaseous components that absorb and re-emit infrared radiation. These are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydro fluorocarbons (HFC), per fluorocarbons (PFC), sulphur hex fluoride (SF_6), carbon oxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC). In accordance with the Kyoto Protocol of the Convention (of December 11, 1997) Latvia, individually or in a joint action with another country, should reach the level when aggregate anthropogenic CO_2, CH_4, N_2O, HFC, PFC and SF_6 emissions by the years 2008 - 2012 are 8% below emission level of 1990.

Pursuant to the Convention, the Parties, including Latvia, should annually present to the Conference of the Parties the report on GHG emissions and removals in the state. Furthermore, Latvia every three years has to draft the National Communication by providing information not only about GHG emissions and removals but also highlighting the implemented and adopted policies and measures to fulfil the commitments prescribed in the Convention.

Research testifies the increase of anthropogenic GHG concentration in the atmosphere, which may result in regional and global climate change. Growth of GHG concentration causes additional warming up of the surface of the Earth and the atmosphere and has an adverse effect on climate. According to the Third Communication of the Intergovernmental Panel on Climate Change (IPCC), average temperature on the surface of the Earth in the 20th century has gone up by 0.6±0.2 ºC [14].

CO_2 concentration in the atmosphere since 1750 has increased by 31%, CH_4 concentration – by 151%, N_2O concentration – by 17%. These concentrations continue growing. In the last 20 years as the result of fossil fuel combustion there were generated approximately ¾ of anthropogenic CO_2 emissions in the atmosphere. At the moment the ocean and land together are able to sequestrate approximately one half of anthropogenic CO_2 emissions. Compared to 1980s, the annual CH_4 concentration growth in 1990s has slowed down. Slightly more than half of the present CH_4 emissions are of anthropogenic origin (fuel combustion, cattle, household waste landfills). Moreover, with the increase of the amount of emitted CH_4 also CO concentration in atmosphere goes up. Approximately one third of the present N_2O emissions are of anthropogenic origin (agricultural soils, organic fertilisers, and chemical industry).

The period of transition to market economy in Latvia started after 1991. This process provoked essential changes in all sectors of national economy and resulted in the decrease of GHG emissions after 1990.

The first National Communication was drafted and submitted to UNFCCC in 1995. The communication provided a complete GHG review only for the reference year, i.e. 1990. Since then, the reports are prepared every year and they have become more accurate. The first Communication forecasted that, due to the economic decline, emission in 2000 would not

exceed the level of 1990 even if no special mitigation measures were accomplished. The second National Communication, which was prepared in 1998, predicted that speedy economic development would result in gradual growth of emissions. In the baseline it has been predicted that emissions in 2010 could be 15-25% below the level in 1990 but implementing scenario "with measurements" the emissions in 2008 – 2012 would be 35-40% below the level in 1990.

The third National Communication contains the information on GHG emissions and removals in the period between 1995 and 2000. Data for 1990 are provided for the purposes of comparison and accepted as reference point. It must be noted that GHG emissions for the time period between 1990 till 1997 were not recalculated according to the new IPCC common reporting format presenting difficulties for complete analysis and comparison of data. The newest projections testify that GHG emissions in the baseline in 2010 will equal to 45% below the level in 1990, but in the scenario "with measurements" – 51% below the level in 1990. Hence Latvia will be able to fulfil the international obligations.

The third National Communication offers summarised information about both the political structure of the state and Latvian climate variations. It also constrains explanation of the peculiarities of economic development and orientation of sectors of the national economy. The communication also provides a general insight in the results of annual GHG emission reports for 1990 and for the time period between 1995 and 2000, noting that data for 2000 are provisional. Information about the newest political instruments and measures for GHG emission reduction in Latvia is presented in chapter 4, giving an insight both into international financial support programs and programs implemented in the last 3 years as well as into measures planned to be implemented in the nearest future in each of GHG generating sectors. In order to estimate the future trends of GHG emissions and removal, given the present level of economic and social development and the implemented and adopted policies and measures, chapter 5 contains individual projections for each sector of economy. The next chapter provides the information about climate change impacts, vulnerability assessment and adaptation measures and chapter 7 offers the overview on the recent research and observations aimed at assessment and elimination of climate change. Efficiency of environmental solutions directly depends on the degree of knowledge of people involved, their understanding of responsibility and opportunities to contribute the process of climate change elimination – therefore chapter 8 contains a concentrated information on all educational establishments, organisations and programs in Latvia aimed at informing the community about the problems addressed in this document.

1. EXECUTIVE SUMMARY

1.1. General facts about the Republic of Latvia

The territory of Latvia is 64 589 km^2. 44.4% of total area is forestland and 39% of land is used in agriculture. Latvia is situated in the temperate zone with high activity of cyclones causing dynamic changes of weather conditions (190-200 days per year). Annual mean precipitation equals to 600-700 mm, annual mean temperature is +7.7°C (in 2000). Clay, dolomite, limestone, gypsum and crude peat are the main mineral deposits of Latvia.

Latvia is an independent democratic parliamentary republic. The President elected by Saeima invites the Prime Minister (President of Ministers) to form the Cabinet of Ministers that is approved by Saeima. The Cabinet of Ministers implements its functions through 12 ministries.

There are 578 local governments in Latvia. The territory of Latvia is divided in 481 rural municipalities (pagasts) and 68 towns and cities united in 26 regions. Local governments are elected respectively in regions, rural municipalities and cities.

The population of Latvia in 2000 was 2.38 million, of whom 32.2% lived in Riga – the capital. Average density of population in Latvia was 36.8 persons per 1 km^2.

In terms of living standards, according to the HDI developed by the UNDP, in 2000 Latvia was ranked in the 63rd position in the world. Per capital GDP in 2000 equalled to only 29% of the average EU level. Registered unemployment rate at the end of 2000 was 7.8% of economically active population but real unemployment rate was approximately 13-14%.

Economic activity in Latvia goes up since the middle of 1990s and so does material welfare of people. In the period between 1995 and 2000 GDP has increased by 25.6% or in the average by 3.8% per annum. Gross wage of people employed in the same period went up from 170 till 247 US dollars. In the last two years Latvia showed the fastest economical growth among the Baltic States and in 2000 also in the group of EU candidate countries.

Foreign trade with the EU member states, since the regaining independence, is steadily going up and today 60% of total exports and imports of Latvia are linked to the EU.

Privatisation of manufacturing and extracting (mining and quarrying), gas supply, construction, fishing, agricultural and forestry enterprises was basically completed in Latvia in 2000. The share of the private sector in the total added value in 2000 equalled to 68%. The sector employed 71.4% of total workforce.

The potential of economical growth is described best by the growth of investment. Every year in the period between 1995 and 2000 investment has rised in the average by 18.8%.

Major structural changes have taken place in the Latvian economy after 1990. The share of services has substantially risen. In 1990 service sectors gave 32% of GDP, in 1995 it was already 56% and in 1999 – even 68%. Such sectors of services as trade, financial services, various commercial and domestic services have developed very dynamically. All these sectors in the days of Soviet rule were neglected or even deliberately obstructed. The mentioned sectors could start their serious development only after setting free the private initiative. The share of transport and communication services in total is relatively high (15% in 1999) in Latvia economy for transit services are an important export revenue item.

Both local energy resources (wood, peat, hydro resources, wind) and imported resources (oil products, natural gas, coal) are used by the sector of energy in Latvia. In 1991-1993 with the decline of the GDP and overall energy consumption, energy capacity or consumption of energy per one unit of GDP dramatically rapidly went up. Yet, since 1994 energy capacity is going down.

The favourable geographical position, proximity to the Baltic Sea, ice-free sea ports (Ventspils, Liepaja), railroad and motor road networks, gas and oil product networks create good pre-conditions for the development of a multi-modal transport system in Latvia. The majority of cargo transportation is transit and international haulage and the most important type of transportation is by land.

After the crisis at the beginning of 1990s caused by transition to the market economy, industrial outputs in Latvia in 1996 started gradually to go up. The share of manufacturing industry in GDP in 1996 was 20.9%, in 1997 – 22.2%, in 1998 – 17.9%, in 1999 – 15.3%, in 2000 – 14.5%. However, at present this equals to only 40% of the level in 1990 when industry was the dominant sector of Latvia economy. Food industry may be considered to be one of the most important industrial sectors producing slightly more than ¼ of the added industrial value; wood processing and light industry sectors follow food industry.

Construction is one of the most dynamic sectors of Latvia economy. Construction outputs in the last 5 years doubled (in current prices). In 2000 construction contributed 6.8% to GDP. At present, the sector employs ~6.5% of total workforce employed in national economy, additional ~ 13% are employed in construction related sectors.

2000 was the first year after 1997 when agricultural outputs went up again in comparison with the preceding year (by 3.9%). Between 1991 and 1996 agricultural production declined in the average by 12 percent every year. One of the main reasons for backwardness in agriculture is low production specialisation and technologies hindering increase of production efficiency and, consequently, also reduction of costs per unit.

Forests and wood resources are among the most important natural resources of Latvia. Total forest stock increment is 16.5 million m^3 per year. Export of wood equalled to 43.2% of total commodity exports of Latvia in 2000.

Waste is one of the most important problems of environmental protection in Latvia. There were more than 500 household waste landfills in Latvia in 1998. As a rule, they are poorly designed and equipped. Only about 50-60% of the generated waste is collected and transported to waste landfills.

After 1990, influenced by economic decline, decreased the use of all types of natural resources, as well as amounts of industrial waste, use of mineral fertilisers and pesticides in agriculture, and water and air pollution. Also GHG emissions created in the process of fossil fuel combustion went down due to the same reason. According to the Kyoto Protocol of Climate Convention Latvia, alone or in a joint action with another country, by 2008-2012 should reach the level when anthropogenic CO_2, CH_4, N_2O, HFC, PFC and SF_6 emissions, expressed in the aggregate format, are 8% below the level of emissions in 1990. Judging the present trends, this goal for Latvia is quite realistic. However, economic growth rates might be faster than assumed in program documents. In such case, the development of economy and increasing mobility of people combined with the low energy efficiency in the sector of energy, industry and households will result in the growth of CO_2 emissions. Therefore, it is very important to implement activities of raising energy efficiency and to encourage use of local renewable resources as well as to increase removals of GHG by biomass in the process of photosynthesis.

1.2. Inventories of anthropogenic emissions and removals of GHG

The direct GHG (CO_2, CH_4, N_2O and SF_6) and indirect GHG (NO_x, CO, NMVOC) and SO_2 in the time period between 1995 till 2000 are included in the emission inventory. Data for 1990 are assumed as a reference and used for comparison for the purposes of highlighting international commitments of Latvia to reduce GHG emissions (see Table 1.1).

Table 1.1

GHG emissions in 1990 and 1995 – 2000, Gg

SEG	1990	1995	1996	1997	1998	1999	2000
CO_2	23527	10145	9550	8619	8287	7545	7100
CH_4	196	101	95	104	125	124	124
N_2O	11	4	4	4	4	4	4
NO_x	102	42	35	45	43	41	38
CO	513	454	193	372	344	328	283
NMVOC	179	64	48	74	67	114	96
SO_2	119	59	59	44	40	33	18

The most important source of CO_2 in 1999 was fossil fuel combustion – 97.9%, including by the sector of energy– 41.3%; manufacturing industry and construction – 15.2%; transport – 27.7%, other sectors (agriculture, forestry, etc.) – 13%, and losses in transport and distribution – 0.8%. Other anthropogenic CO_2 emission sources are industrial processes – 1.4% and tilling and liming of agricultural lands. In 1999 in Latvia forests removed 5321.71 Gg CO_2 – by 5278.29 Gg less than in the proceeding years (-10600 Gg). 2316.89 Gg CO_2 was emitted into the atmosphere.

Anthropogenic CH_4 emissions in 1999 equalled to 123.62 Gg. Main sources of CH_4 emissions in Latvia are solid waste disposal sites and enteric fermentation of livestock. Other important sources of CH_4 emissions are leakage from natural gas pipeline systems and combustion of biomass (wood).

N_2O emissions in 1999 equalled to 4.01 Gg, of which the biggest part (84.2%), were emissions from agricultural soils. Other sources of N_2O emissions are transport and combustion of biomass, liquid and other solid fuels in sectors of energy conversion and industry, on-site burning of wood cutting residue and wastewater from sewage systems.

Energy sector was the main source of indirect GHG and SO_2 emissions in 1999. Furthermore, transport emitted 59.9% of total NO_x and 45.5% of CO emissions. Losses of gasoline in the process of distribution and consumption were the only items accounted for in leakage of fugitive emissions from oil products, i.e. NMVOC emissions in this sector equal to 3.9% of total energy sector emissions. With regard to SO_2 emissions, energy sector was the biggest source of emissions producing 99.7% of total emissions.

Industrial sector was the biggest producer of NMVOC in 1999 (57.2%). Total NMVOC emissions from industrial sector equal to 65.13 Gg, where production of mineral products gives 95.7%, food industry – 4.3% and steel production – 0.03% of emissions. Use of paints and on-site burning of wood cutting residues in forests also generate indirect GHG emissions.

1.3. Policies and measures

Priorities of the policy of environmental protection in Latvia were set forth in the Declaration on the Planned Action of the Cabinet of Ministers and implemented in the preparatory work for accession to the European Union. This policy was implemented by MEPRD. Environment Protection Policy Plan for Latvia was approved in 1995 and used as the basic document for all activities carried out in the environmental sector.

In 1997-1998 Climate Change Reduction Policy Plan was developed under the guidance of MEPRD for the first time. The plan is being updated at the moment. Policy plan comprises goals and requirements of the UNFCCC, Kyoto protocol.

Latvia has signed the Climate Convention, Kyoto Protocol of December 11, 1997. It foresees three mechanisms for GHG emission reduction of which two, in addition to attraction of additional financing, are applicable for Latvia. These mechanisms are JI projects and emission trade. AIJ are the pilot phase of JI projects as one of the means of implementation of development programs in the sector of energy in Latvia. Until now, there have been implemented joint projects with Sweden, Germany and Netherlands.

Latvia has made the agreement with the World Bank PCF about financial participation in the project on use of biogas generated in Liepaja waste disposal site.

In co-operation with the GEF Latvia implements the following projects related to the area of reduction of global climate change:

1. Modernisation projects of Getlini waste landfill;
2. Efficient Lighting Program;
3. Regional Baltic wind energy program;
4. Project on economically efficient use of wood waste in the local governments heating systems in Latvia.

There are several EU programs (PHARE, SAPARD and ISPA) that could provide financial resources to projects linked to climate change mitigation in Latvia.

Latvia in the area of climate change reduction participates in the EU OPET program, PSO program, SCORE program, as well as co-operates with the governments of Denmark and Sweden.

In line with the governmental policy, priorities in the energy sector related to climate change mitigation are raise of energy efficiency and energy conservation, use of renewable resources and construction of new, ecologically acceptable power stations, including co-generation plants. Therefore, the following measures have been analysed in greater detail:

- Wider use of fuel wood for district heating generation;
- Renewal of small HPSs;
- Use of wind energy;
- Biodiesel fuel as a internal combustion fuel in small scale co-generation plants (and/or transport)
- Wider use of co-generation;
- District heating rehabilitation project;
- Projects of Local Governments' Crediting Fund
- Increase of energy efficiency in Latvian dairy enterprises;
- Increase of energy efficiency in Latvian bakeries;
- Heat efficiency improvement program in buildings;
- Reduction of heat losses in buildings;
- Use of biofuel by road transport;
- Improvement of the public transport system;
- Development of cycling;

- Construction of technical check-up points;
- Introduction of type approval of new cars.

The communication describes separately some international activities carried out in the sector of energy, as, for example, the project On Efficient Energy Use in Agencies of Latvia supported by the Danish Environment and Energy Sector Program and the project on Economically Cost Efficient Use of Wood-Waste in Municipal Heating Systems of Local Governments of Latvia as well as the Efficient Lighting Program.

Besides the mentioned measures of CO_2 emission mitigation there are also implemented measures to reduce leakage of volatile substances from fuels in oil product storage sites and pipeline systems.

Pursuant to the declared fundamental positions of Latvian industry, at present there are two priorities in industry of Latvia:

- Creating favourable environment for industry;
- Formation of efficient and competitive structure of industrial sectors as well as high technology-based industries as foreseen in the National Innovation Concept.

Measures of GHG emission in this sector in Latvia at the moment are mainly linked with raising energy efficiency of technological processes and recycling of materials as well as with the introduction of environmental management systems and cleaner production matching ISO 14001 requirements. In connection with mentioned above, the following two measures are analysed in details:

- Introduction of the environment management system and cleaner technologies in pharmaceutical industry of Latvia;
- Introduction of the environment management system and cleaner production in the chemical industry of Latvia.

The basic agricultural development tasks identified in the Development Program of Agriculture are:

- Provision of residents with qualitative food made from local agricultural products;
- Competitive income earning possibilities to people employed in agriculture;
- Rational use of the natural resource – land.

Taking into account that the priorities for agriculture in the nearest future are fulfilment of conditions of good agricultural practice and accession of Latvia into the EU there are no special measures for GHG emission reduction planned in the agricultural sector of Latvia in the nearest years. Some activities that will affect GHG emissions are mentioned below:

- Rural development program;
- SAPARD rural development program;
- Good agricultural practice;
- Processing of animal-origin waste.

Sustainable forest management, respecting the place of forest ecosystems in local and global processes, ensuring continuous availability of wood resources, increasing usability of wood resources and especially use of wood waste are fundamental preconditions in CO_2 emission reduction and removal policy in Latvia. These problems are addressed in the Latvian Forest Policy. The principles of the policy, if implemented, would allow enlarging the share of forestland in Latvia till 48-52% in the nearest 20-25 years and also respectively increasing CO_2 removals. The following climate change mitigating measures are reviewed in this context:

- Targeted afforestation of abandoned agricultural land;
- Increase of forest productivity.

Waste management in Latvia is regulated in several political documents, such as State Strategy for Household Waste Management Program "500-" etc. The priorities emphasised in these documents are:

- Reduction of waste generation in the place of origin and lowering dangerousness;
- Waste processing;
- Energy generation and recycling of materials contained in waste;
- Safe disposal of non-recyclable and not suitable for energy generation waste and waste from energy production.

There are several laws fostering attainment of the formulated targets such as the Law On Natural Resources Tax, the Law on Waste Management, the Law on Pollution, Regulations of the CM "On Construction, Management and Closure of Household Waste Disposal Sites", etc. In the context of climate change mitigation the communication addresses the following measures:

- Waste recycling;
- Biogas generation.

1.4. Projections and the total effect of policies and measures

The objective of this section is to evaluate future trends in GHG emissions and removals, in given current economic and social development levels and implemented and adopted policies and measures. Only the impact on direct GHG – CO_2, CH_4, N_2O, HFC and SF_6 was assessed by giving an indication of the relation between the measure and GHG emissions.

According to the IPCC guidelines for drafting national communication, this section offers a more detailed description of one development scenario or the scenario "with measures" compared to the scenario "without measures" or the baseline scenario. The scenario "with measures" is based on the long-term economical development forecast for the time period of 2000 till 2020 (see Figure 1.1).

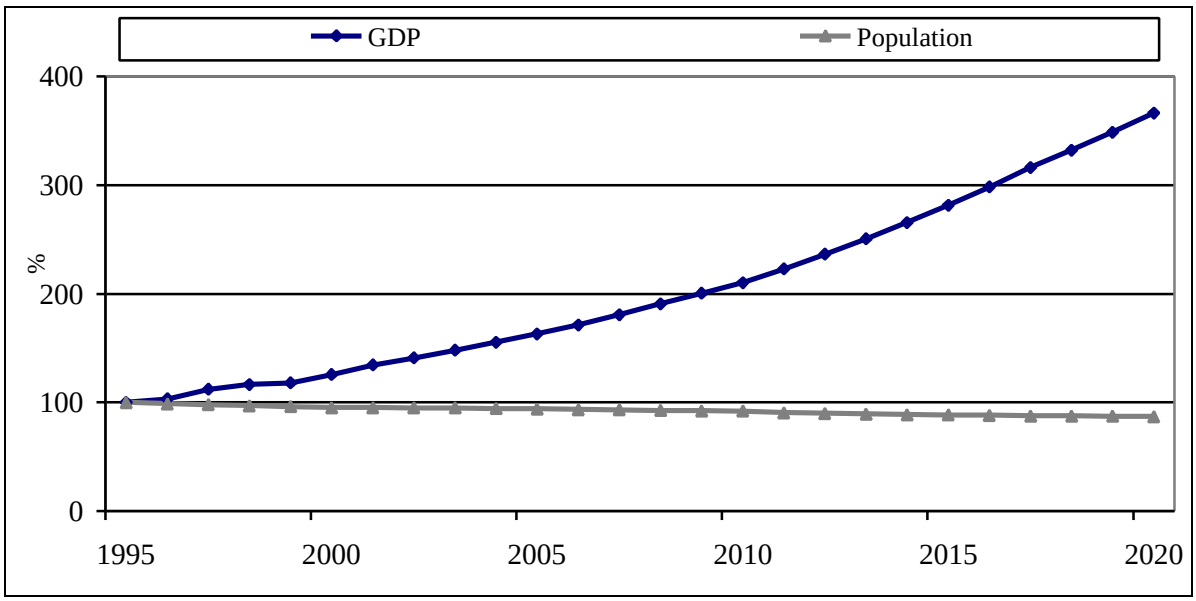


Figure 1.1. GDP growth and change in the number of population in 1995 – 2020 (1995=100)

Sectoral development scenarios were developed on the basis of the long-term macroeconomic forecast. Several measures described in the Chapter on Policies and Measures

were taken into consideration for devising development scenarios. GHG emission reduction is not the primary objective of the measures but rather a side effect of their implementation. Therefore, in many cases it was impossible to evaluate the impact on GHG emission mitigation. Resulting the implementation of measures the projected GHG emission reduction will gradually increase from 438.94 Gg in 2005 till 763.62 Gg in 2020.

GHG emission reference (baseline) scenario is given for the purposes of comparison. Estimation of GHG emissions in the baseline scenario is based on the assumption that none of the measures described in Section 4.3 is implemented and the share of coal, peat and oil resources in the consumption structure of energy resources goes up.

GHG emission projections show (see Figure 1.2) that Latvia will be able to fulfil the international commitments arising out of the Kyoto protocol of the UNFCCC on condition that there are kept the planned growth rates of the development of national economy.

IPCC common reporting format was used for GHG emission projections. Basic data of each sector were also forecasted in line with this document considering measures described in chapter 4. MARKAL optimisation model was used for making projections in the energy sector. Projections in other sectors were mainly based on expert judgement and sectoral plans.

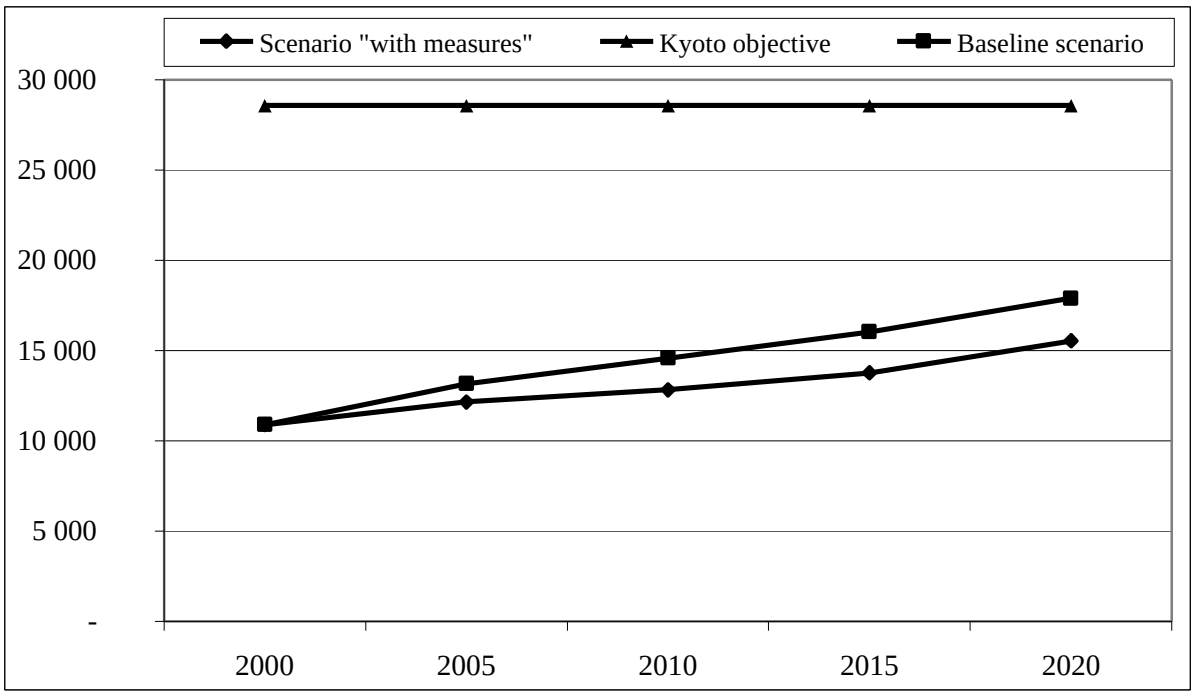


Figure 1.2. Aggregated GHG emissions in 2000 – 2020, Gg CO_2 equivalent

1.5. Climate change impacts, vulnerability assessment and adaptation measures

In Latvia, the same as elsewhere in the world, warming up of the air temperature and in the second half of the 20th century also increase of precipitation is observed. Mean annual temperature rise in Riga in the last 100 years equals to approximately 1ºC. This sharp change partly is linked to the urban environment effect. Temperature outside urban settlements in Latvia in the same period of time has gone up by average 0.5ºC. Variations of yearly temperatures are declining tending to become more equalised (especially in winter and spring). Specialists consider that in future under the impact of the greenhouse effect the snow-covered period will become shorter, vegetation period will be longer, rivers will develop

different through-flows and distribution of precipitation will change.

Temperature rise caused by the global warm-up promotes melting of arctic and antarctic glaciers and expansion of thermic water resulting in the raise of water level in the World Ocean. Consequences of this phenomenon will be also aloud in Latvia.

Geographical situation predetermines vulnerability of Latvia to weather conditions and changes of water level in the World Ocean. Water level variations in the Baltic Sea and Riga Bay are mainly dependent on the wind-borne ebbs and flows of tides though Zunda strait. Water mass during strong storms in the coastal zone and especially in bays may reach the height of even 2-2.3 m as it happened during the hurricane in 1969. Observations show that in the open sea in the Baltic coastal zone in the west of Kurzeme, water level rise in the last 100 years does not exceed 10-15 cm.

If the mentioned phenomena are correctly assessed and the trends are kept also in future the groundwater level in the lowest coastal zone of Riga Bay could rise by approximately 50-70 cm. Risk of floods in the lower reaches of the big rivers (Lielupe, Daugava, Gauja) will become higher. Ground water elevation may cause serious problems to people living in lower settlements in the coastal zone where the height above the sea level is 0.7-2 m. Overbogging of these territories is quite possible, the same as flooding of basements and basement floors and certain deformation of foundations of the buildings. Change in the water level is one of the reasons for higher intensity wash-off of the shore in the coastal zone of the Baltic Sea. The most important coastal erosion in the coastal zone of Latvia is observed in 130-140 km long area. The most intensive erosion is near Kurzeme coast (near Bernati and Jurkalne) where the coast during the year may step back by up to 20-30 metres. Seriously endangered is also the western coast of Riga Bay because of the concentration of housing in historical villages of fishermen.

Surveys show that plant communities are becoming on the whole unstable, there is aggressive proliferation of many alien species. Main routes of plant migration in Latvia are the Baltic Sea coast and river valleys (especially Daugava). Motor roads, railways and seaports are also important for arrival of alien species. Non-indigenous species that have naturalised have mainly originated from South and South-East Europe, Middle East and America. Consequently, this provokes changes in the structure of geographical elements of flora: the share of boreo-temperate species is going down and the share of sub-meridional and meridional species is going up.

Notably, the changeable economic, technological, social and political conditions have caused much more transformation in Latvian vegetation than potential changes of climatic conditions.

Latvia has reached awareness of the problem of the impact of climate change for environment and national economy, yet the problem is not studied to the end. Special studies should be carried out in the endangered areas of the coastal zone to assess and follow the extent of possible changes. These data should be taken into consideration in all territorial planning activities to timely foresee and prevent material losses.

Agriculture and forestry are the sectors of economy that are most of all vulnerable to climate change. Long-term changes in ecosystems result in change of productivity and influence the development of these sectors. Projections of climate change should result in the development of policies and strategies of adaptation measures to changes.

1.6. Research and systematic observations

Surveys and programs dealing with climate and climate change problems, possibility of climate change mitigation and impact of climate change on ecological and social and

economic systems in Latvia are carried out by higher educational establishments, research institutes, ministries and agencies, state environment institutions, scientific research and consulting companies, non-governmental organisations.

Funding for research is very scarce and it comes from the state budget resources, Public Investment Program, Latvian Environmental Protection Fund, different enterprises of Latvia, international programs and projects.

Being a party to the Convention on the WMO Latvia has been involved in implementation of various international programs and projects connected with observation of weather conditions and climate.

The Faculty of Geography and Land Science of LU and SHMB carry out research on coastal processes in Latvia. Changes in Latvian vegetation caused by environmental dynamics are studied in the Faculty of Geography and Land Science of LU where the Biogeography Laboratory was opened in 1998. In turn, problems related to forestry are studied in the Latvian State Forest Science Institute Silava and Forest Faculty of LUA. Protected territories of Latvia are also very important for monitoring nature and environment, scientific research, educating and raising awareness and informing the community.

LRC provides regular funding to various research works directly or indirectly addressing technological aspects of GHG emission reduction. Problems addressed in such research are mainly focussed on optimisation of technologies or systems. Thus, a joint project between Latvia and the Netherlands – *On Policy and Activities to Eliminate GHG Emissions and Increase of Removals in Latvia* was implemented in 1998-2000 in Latvia under the guidance of MEPRD.

There are various environmental research projects, which, among others, also focus on the analysis of reasons causing global climate change and are running in Latvia already for several years. Such projects are: Baltic Sea project, project *Air Researchers Web*, international GLOBE project as well as the project – *School Network for Sustainable Development* addressing also analysis of opportunities of schools and local governments in the area of implementing sustainable development principles on the local level.

Meteorological observations in Latvia, within the scope of the World Weather Watch program, are done in 22 stations. Measurements include main physical condition of the lower levels of atmosphere as well as elements characterising land surface, such as temperature of air, air humidity, wind direction and speed, atmospheric pressure, meteorological visibility, cloudiness, atmospheric precipitation, parameters of snow cover, atmospheric phenomena, soil surface condition and temperature. Sea level observations are made in 7 points in the coastal area of Riga Bay and in 3 points in the eastern side of the Baltic Sea. Co-operation between the Baltic States in the *Baltic Ice Meeting* project is based on the use of the uniform ice codes and exchange of data on observation of ice to ensure navigation in winters.

Latvian Environmental Agency tests the quality of environment, provides methodological guidelines for this work in Latvia, develops methodologies of environment quality analyses and creates a united environment information data system.

1.7. Education, training and public awareness

To encourage development of co-ordinated and effective environmental awareness and communication system in Latvia and to respect provisions of Arhus convention, Strategy on Environment Awareness and Education and the Action Plan were developed in 1998-2000. The goal of these environmental policy documents is to form the knowledge and understanding in the society about environmental regularities, problems and possibilities of their solution, as well as about activities resulting in global climate change and to encourage

co-operation between different target groups in the society in the area of environment-related decision making and development of environmentally friendly public attitudes.

The Environmental Education Guidelines approved by the Ministry of Education and Science of Latvia define environment education as an inter-disciplinary subject to be integrated in the content of other subjects. With the support of PHARE program the book *Our Ecological Footprint* by M.Wakernagel and V.Reese and *Heating in Private Houses* by B.Davin were published in 2000. Since 1997/1998, schools every year organise project weeks when school students develop projects, among them also on the possible alternatives of energy conservation in schools, alternative means of transport and other topics related to the global climate change.

Environment education plays an important role in the secondary vocational education. The 120-lesson course on Environmental Science is a compulsory minimum to be learned by any student of a secondary vocational school. Data of the Ministry of Education and Science of Latvia show that environmental education may be mastered in 4 vocational education schools.

Since 1992 there are available various bachelors, engineering, master and doctor degree programs in varied environmental science and management areas in Latvia. Study programs of the three biggest higher education establishments of Latvia – Riga Technical University, Latvia University of Agriculture and University of Latvia comprise subjects revealing and analysing impact on climate change.

Community information actions are implemented with the assistance of both state institutions and public and non-governmental environment organisations. Information actions and campaigns are carried out within the scope of various co-operation programs. These in the majority of cases are linked with promotion and introduction of new environmentally friendly technologies.

With the development of international professional and business co-operation between enterprises and different associations, new modern technologies and experience come into Latvia and various environmental management schemes are more frequently applied. Quality, management, product performance and other certificates are obtained.

Issues and problems of climate change are included also in several in-service retraining and post-graduate training programs. Within the SCORE program between Netherlands and Latvia a training program for Latgale municipalities was implemented, setting up the support centre for projects aimed at increase of energy efficiency in Latgale. Co-operation between Latgale and Dutch municipalities was encouraged and three manuals prepared.

Access to environmental information including also activities' results on climate change in Latvia is provided by mass media, internet, NGOs as well as by activities of international organisations and implementation of individual programs focussed on environment related matters and translation and distribution of IPCC information materials.

Lately NGOs are playing an increasingly bigger role in stimulating people to be more active and participate in the decision-making as well as popularising environmentally friendly action and way of living. NGOs are the ones that regularly update environmental information and attract attention of wider public to this information by organising actions, rallies, campaigns and other attractive events of drawing public attention. At the beginning of 2001 NGO – PPI with the financial support of Soros foundation started a survey on *Energy Efficiency of Housing in the Latvian Climate Policy*. Within the financial support of the Latvian Environment Protection Fund, the Environment Protection Club already several years publishes a specialised journal "Vides Vestis" highlighting global environment topics as well as different local environment protection problems and encouraging environmentally friendly models of behaviour. Representative offices of many international non-governmental

environment organisations actively work in Latvia. These organisations are, for example, WWF and CCB, which are implementing the projects on non-depleting rural development and forestry. One of the most important international projects is the already implemented NGO co-operation project between the Latvian Green Library, Polish Ecological Club and Hungarian National Environment Protection Union with the goal to analyse activities of the countries independently within the scope of the AIJ as well as to analyse the role and opportunities of CEE in international negotiations on climate policy in Hague in November 2000.

2. THE REPUBLIC OF LATVIA: GENERAL FACTS

2.1. Geographical profile and climate

Latvia is located on the edge of the East European plane near the Baltic Sea between 55°40’ and 58°05' north and from 20°58' to 28°14' east. Total length of land border of Latvia is 1 368 km and coastline is 494 km. In the north Latvia borders on Estonia, in the south – on Lithuania and Belarus and in the east – on Russia.

The whole territory is 64 589 km^2. Its length in the north-south direction is 210 km, width – in the west-east direction – 450 km. Average height is 87 m above the sea level and the highest peak is mount Gaizinkalns (311.6 m above sea level) [47].

Two types of forest zones meet each other on the territory of Latvia. Deciduous trees come from the south and elements of boreal forests – pure (unmixed) pine and spruce forests – from the north. This determines the diversity of tree species and the high share of mixed stands as well as overall biological diversity. Forest ecosystem is the most significant part of environment in Latvia. There is a immense diversity of forest site types in Latvia – forests that grow on dry mineral soils constitute 57%, on wet mineral soils – 11%, on wet peat soils – 11%, on drained mineral soils – 11% and on dried peat soils – 10%. Main species of trees are pine, spruce, and birch. Types of land use are presented in Figure 2.1.

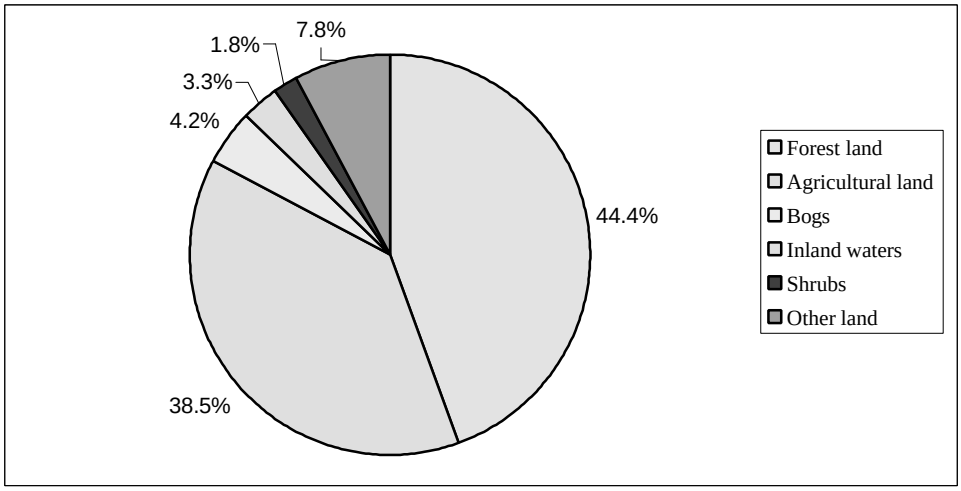
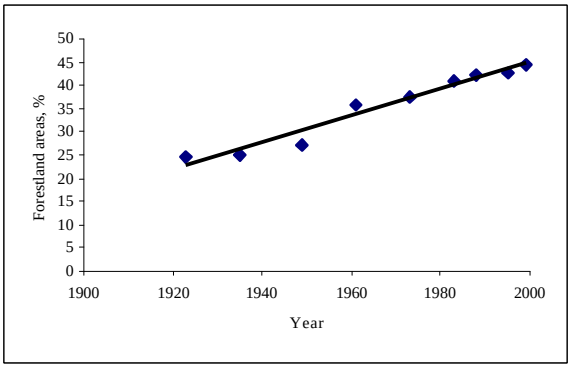


Figure 2.1. Usage of land in Latvia, dated by January 1st, 2001 [47]

There are two mutually linked tendencies describing changes of forestland areas in the 20th century: gradual reduction of agricultural land (arable lands and pastures) starting from the beginning of the century and expansion of forestland areas (see Figure 2.2).



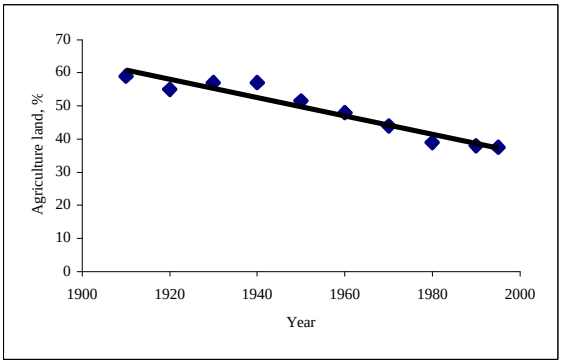


Figure 2.2. Dynamics of forest and agricultural land areas [31]

As of January 1, 2001 forestland occupies 2 868 thousand ha or 44.4% of the territory of the state. It is expected that in the near future forest coverage in Latvia will reach 50-55% ensured by afforestation of abandoned agricultural land and land not claimed for any other purpose.

Latvia is not rich in mineral deposits. Minerals used in construction and agricultural sectors – clay, dolomite, sand, gravel, limestone, and gypsum are among the most important pieces. Latvia also possesses considerable crude peat deposits.

Seismic research carried out in the Baltic Sea shelf in 1980s shows that accumulation of oil is possible in some underground structures. Some of these structures are located in the part of shelf belonging to Latvia.

Latvia is divided into the eastern continental part and coastal zone. Proximity of the Baltic Sea and the Atlantic Ocean determines frequent cyclones and considerable changes of weather conditions during 190-200 days in a year. Climatic profile of Latvia is presented in Table 2.1.

Table 2.1

Climate of Latvia[1]

	Liepaja	**Riga**	**Daugavpils**	**Aluksne**
Mean air temperature (ºC)				
• January	-3.0	-4.7	-6.7	-7.6
• July	16.4	16.9	16.9	16.1
Average variation of air temperature in 24h (ºC)				
• January	5.2	5.3	6.2	5.4
• July	6.8	9.2	10.7	9.5
Mean relative air humidity (%)				
• January	85	85	85	87
• July	80	76	75	75
Mean precipitation (mm)				
• Year	690	636	634	691
• Driest month	31	25	27	32
• Wettest month	83	79	83	85
Mean speed of wind at the height of 10 m (m/s)	5.3	4.4	3.2	2.7
Mean annual sunshine (in hrs)	1853	1757	1674	1679

[1] Observation period - 1961-1990. Liepaja – Baltic Sea coastal station; Riga – state capital on the coast of the Riga Gulf; Daugavpils – continental station in the far south-east of Latvia; Aluksne – continental station on a height in the east of Latvia. Source: SHMB

2.2. Political system

2.2.1. Political order

Latvia is an independent democratic parliamentary republic. The highest political authority in Latvia belongs to Saeima (parliament). All citizens having reached 18 years of age elect Saeima members in general elections. Elections are based on the principle of proportional representation where people vote for lists of parties. Saeima consists of 100 deputies. Saeima elects the President of Latvia for the office of four years. Vaira Vike-Freiberga was elected President of Latvia in 1999.

The President elected by Saeima invites Prime Minister (President of Ministers) who forms the Cabinet of Ministers to be approved by Saeima. Despite 5% limit to be exceeded by each political party for representation in Saeima, all the governments formed after 1991 were, as a rule, coalition governments consisting of several parties. 6 parties got seats in the parliament during the last general election to Saeima in 1998. Cabinet of Ministers implements its functions through ministries. The task of ministries is to develop strategies of the respective sector and devise policies for strategy implementation. In 2000 there were 12 ministries:

- Ministry of Defence,
- Ministry of Foreign Affairs,
- Ministry of Economy,
- Ministry of Finance,
- Ministry of Interior,
- Ministry of Education and Science,
- Ministry of Culture,
- Ministry of Welfare,
- Ministry of Transport,
- Ministry of Justice,
- Ministry of Environmental Protection and Regional Development,
- Ministry of Agriculture.

There are two ministers for special assignments in the Cabinet of Ministers: on state reforms and on co-operation with international financial institutions.

2.2.2. Administrative and territorial division

Constitution of Latvia (*Satversme*) stipulates that Vidzeme, Latgale, Kurzeme and Zemgale regions form territory of the Latvian state within the borders prescribed by international treaties. However, they do not represent administrative territories. In the present territorial structure of Latvia, there are two types of local governments:

- Local municipalities, i.e. municipalities of towns, reformed municipalities (*novads*) and rural municipalities (*pagasts*);
- District municipalities.

There are 552 local level municipalities including 473 rural municipalities (*pagasts*), 7 reformed municipalities (*novads*) and 65 towns. There are 7 all-republic importance cities performing functions of a region. Other 5 cities function as territorial units within regions of Latvia. Local governments of Latvia in 2001 were united in 26 districts. Local governments in regions, rural municipalities and cities are elected and municipalities of districts consist of delegated members of local municipalities. Both levels of local government function

independently within the limits of their competence spelt out in legislation. The law of the Republic of Latvia "On Local Governments" regulates general principles of work and economic base of local governments of Latvia, their competence, executive powers and responsibility.

2.3. Social development

At the beginning of 2000 population of Latvia amounted to 2.38 million inhabitants, of whom 32.2% lived in Riga – the capital of Latvia (see Table 2.2). An average density of the population was 36.8 persons per 1 km².

Table 2.2

Number of population in Latvia in 1990 and 1995 – 2000 (thous., at the beginning of the year) [47]

	1990	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Number of population, total, including	2667.9	2499.3	2468.1	2443.4	2419.2	2379.5	2375.3
- Cities	1848.9	1727.0	1703.0	1688.4	1671.7	1654.3	1624.6
- Rural areas	819.0	772.3	765.1	755.0	747.5	743.2	750.7

In terms of living standards, according to the Human Development Index (HDI[2]) developed by the United Nations Development Program (UNDP), in 2000 Latvia was ranked in the 63rd position in the world (92nd in 1998 and 74th in 1999). Although wages of people employed in national economy, pensions, disposable income of households went up in the previous year – still living standards remain rather low. Per capital GDP estimated in purchasing parity units according to data of EUROSTAT in 2000 equalled to only 29% of the average EU level.

Demographic indicators are among the least favourable in Europe. Number of population in the state continues going down and, according to the provisional data of the population census, on March 31, 2000 equalled to 2375.3 thousand persons or by 291 thousand persons or 10.9% less than counted in the population census of 1989. During 2000 number of population in Latvia went down by 14 thousand persons.

Average life expectancy in 2000 equalled to 70.7 years (men – 64,9, women – 76.0), which is substantially lower than in the EU member states and is amongst the lowest indicators in the group of the EU applicant countries. Still this indicator is higher than in 1990 and has considerably risen since 1994 when it equalled to only 66.4 years (men – 60.7, women – 72.9).

Reforms in educational system have brought about positive changes resulting in depolitisation of education, opportunity to choose types of education, liquidation of state monopoly in the area of education, decentralisation of administration of education. Data of population census show that in comparison with 1989 the share of persons with higher education at the end of March 2000 had gone up by 2 percent and those with average vocational education – by 2.2 percent. The number of people with reading and writing illiteracy had dropped by more than 2 times[3].

Although economical activity is going up, the number of employed population during 2000 has not changed and has remained on the level of 1999 (1038 thousand persons).

[2] HDI is estimated on the basis of average life expectancy, level of education; and real per capital GDP estimated according to the purchasing parity principle. However, as recognized by HDI developers, this is not a complete characterisation of quality of life.

[3] According to the program of population census, the question about the level of education had to be answered by persons starting from 7 years of age.

High level of unemployment remains a topical issue. In the second half of 1998 and the first half of 1999 many enterprises of Latvia, influenced by the Russian crisis, were forced to lay off their employees. Unemployment reached its highest peak in April 1999, and then it went down, starting with May. In 2000 it continued going down and at the end of the year the registered level of unemployment equalled to 7.8% of economically active population. However, real unemployment rate was substantially higher (estimations based on labour surveys carried out by the CSB according to the methodology of International Labour Organisation indicate that this figure in 2000 equalled to 13.2%). Real unemployment stays approximately on the level of 13-14% for already several years.

2.4. Economical development

2.4.1. General facts

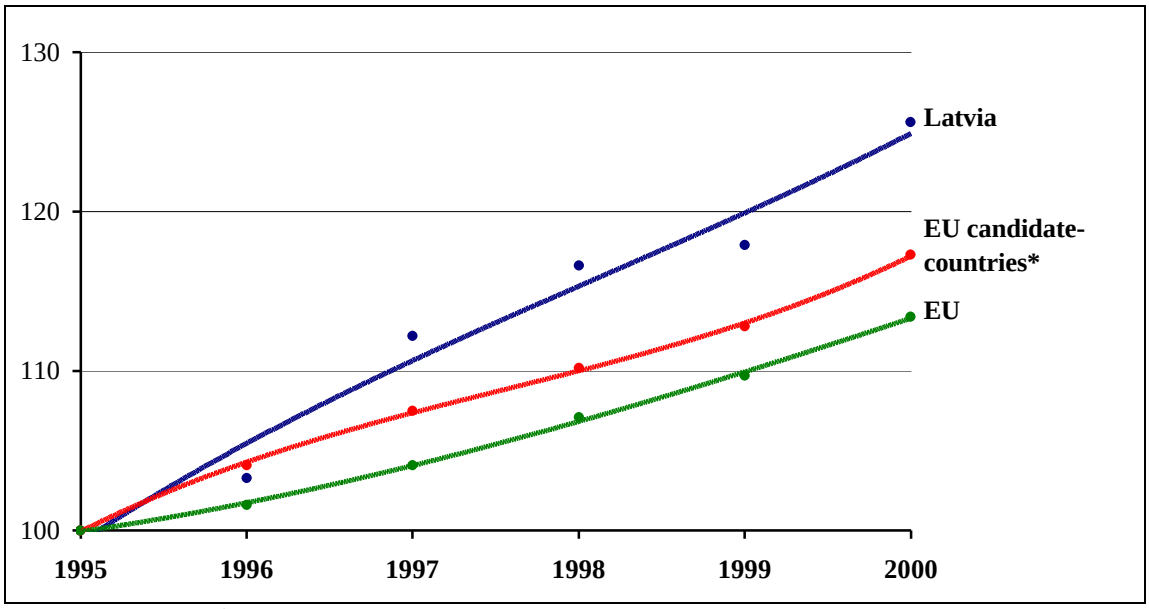
Economic activity in Latvia goes up since the beginning of 1990s and so does material welfare of people. In the period between 1995 and 2000 GDP has gone up by 25.6% or in the average by 3.8% per annum. Gross wage of people employed in the same period went up from 170 till 247 US dollars.

Development was particularly successful in 1996 and 1997 when average growth rates of GDP equalled respectively to 3.3 and 8.6%. Such growth was mainly predetermined by rapid development of manufacturing industry where outputs over the period went up by 39%.

Likewise in other countries, also economy of Latvia in the second half of 1998 and at the beginning of 1999 was influenced by the economical crisis in Russia. Thus, Latvian commodity exports went down due to the crisis, some commercial banks were in difficulty, budget revenues lagged behind the plan and unemployment was on the rise. Still, high activity levels in construction and several service sectors offset the decline of industrial and agricultural production caused by the crisis. Production outputs also continued going up in industrial sectors that were basically oriented towards the western market (wood and wood products, metal sector and production of wearing apparel). Therefore GDP continued going up also in 1998 and 1999, although growth rates were more modest – respectively 3.9% and 1.1% (see Figure 2.3).

GDP went up by 6.6% in 2000 showing that Latvia has overcome difficulties caused by external conditions. Also the beginning of 2001 is quite promising. GDP in the first quarter of 2001 has gone up by 8.2% compared to the respective period in the preceding year.

In the last two years Latvia had the fastest growth among the Baltic States and in 2000 also in the group of EU candidate countries.



* 10 candidate countries of Central and Eastern Europe

Figure 2.3. GDP growth (1995=100)

Foreign trade

Latvia implements a relatively liberal trade policy. In the conditions of globalisation and economic convergence in the world Latvian trade is based on international bilateral and multilateral treaties, respecting trading policies of the EU. Bilateral and trilateral preferential treaties regulate trade with the most important trading partners of the state. Further liberalisation of foreign trade of Latvia is linked with foreign policy priorities of the state – accession to the EU and participation in the World Trade Organisation (WTO).

EU is the main trading partner of Latvia. Since the regaining of independence foreign trade with EU is steadily going up and today 60% of total exports and imports of Latvia is linked to the EU member states.

Privatisation

The aim of privatisation proposed by the government of Latvia is to establish competitive private enterprises by selling the majority stake of companies undergoing privatisation to strategic investors. Privatisation of manufacturing and extracting (mining and quarrying), gas supply, construction, fishing, agricultural and forestry enterprises was basically completed in Latvia in 2000. The share of the private sector in the total added value in 2000 equalled to 66%. 70% of total workforce was employed in the private sector. The development of the private sector in Latvia economy was significantly supported by foreign direct investments into privatised enterprises [77].

Investment

The potential of economic growth may be described the best in terms of growth of investment. In the period between 1995 and 2000 investment in the average went up by 18.8% every year. Such dynamic growth of investment was basically encouraged by several factors: inflow of foreign investment mainly linked with privatisation, lowering of interest rates on loans and stabilisation of the banking sector, growth of overall economic activity and formation of positive future expectations, etc. Due to the dynamic increase of investment the share of fixed capital formation in GDP reached 25%. We may expect investment remaining on the high level also in the nearest future.

Despite completion of privatisation in Latvia, interest of foreign investors to invest in this country remains high. In 2000 foreign investments in Latvia went up by 22% and equalled to 5.7% of GDP.

Since 1995 public investments in Latvia are made according to the Public Investment Program (PIP). PIP comprises infrastructure investment projects funded from financial resources available in the state – state budget, guaranteed loans, donations and own resources of project implementers. At present PIP priorities are basic infrastructure construction projects in transport, energy and environment protection sectors.

Latvia and the European Union

Future development of Latvia cannot be separated from globalisation and liberalisation processes, integration in the world economy and also into the European Union. In February 2000 Saeima approved the Strategy for Integration in the European Union. Its aim is to enhance uniform understanding and activities on the EU matters by public institutions and the community. The Strategy foresees harmonised planning of the integration process and offers decision-making parameters on the issues of the EU policy. The document provides formulation of the most important preconditions for the country to successfully accede to the EU and highlights such strategically important aspects of integration as society integration, economic integration, sector, environmental and regional development, welfare, justice, culture and education and others [77].

The European Commission in the latest Progress Report on situation in Latvia has offered a positive evaluation of the results in the area of integration in 2000. At present, work at drafting the National Development Plan is going on which will identify development priorities of Latvia linking them with the available financial resources from the Latvian government and the European Union.

2.4.2. Structure and dynamics of the sectors of National economy

Major structural changes have taken place in the Latvian economy after 1990. The share of services has substantially risen. In 1990 service sectors amounted to 32% of GDP, in 1995 it was already 56% and in 1999 – even 68% (see Table 2.3). Such sectors of services as trade, financial services, various commercial and domestic services have developed very dynamically. All these are sectors that in the days of Soviet rule were neglected or even deliberately obstructed. The mentioned sectors could start their serious development only by setting free the private initiative. In the economy of Latvia the share of transport and communication services in total is relatively high (15% in 1999) for transit services are an important export revenue item.

Table 2.3

Sectors of Latvian economy in GDP, %

	1990	**1995**	**2000**
Gross Domestic Product	100.0	100.0	100.0
Commodity production sectors	68.1	44.0	29.8
- Agriculture[1)]	21.9	10.8	4.6
- Industry[2)]	36.4	28.1	24.3
- Construction	9.7	5.1	4.3
Services	31.9	56.0	70.2
- Trade[3)]	6.8	12.4	19.8
- Transport and communications	10.9	16.0	16.6

	1990	1995	2000
- Financial services	1.7	5.6	5.0
- Other services	12.6	22.0	30.7

[1)] Including forestry, hunting and fishery
[2)] Including electricity, gas and water supply
[3)] Including hotels and restaurants

Energy

The most important areas for the development in the sector of energy are: alignment of legislation, reliability of energy supply, privatisation and restructuring of power utilities, raising the efficiency of energy.

Both local energy resources (wood, peat, hydro resources) and imported resources (oil products, natural gas, coal) are used by the Latvian energy sector. Consumption of primary energy resources in Latvia in 1995-1999 is presented in Figure 2.4.

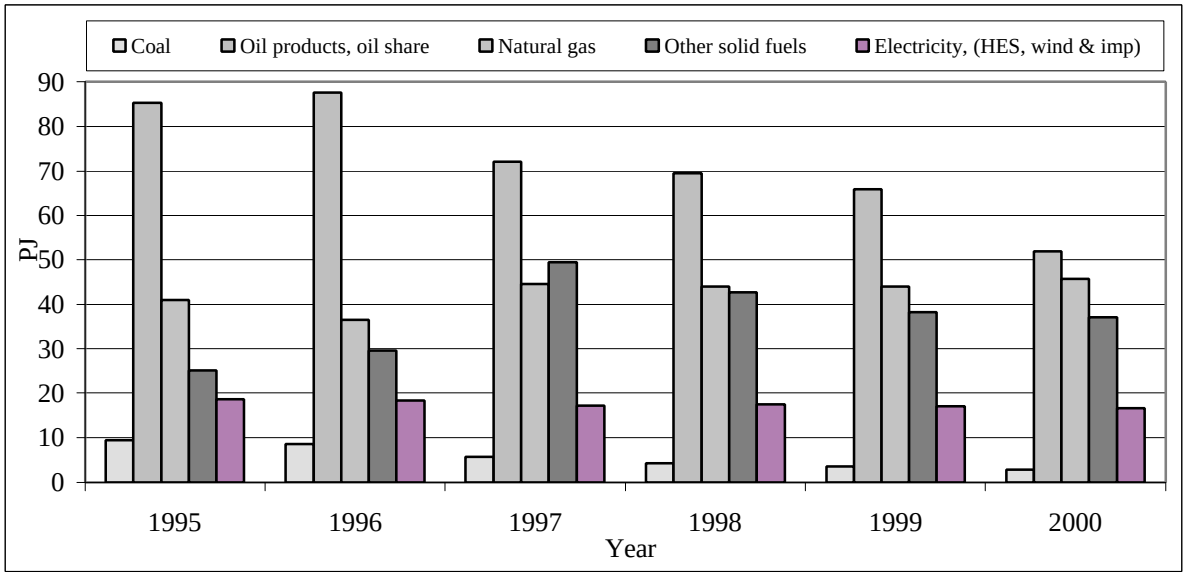


Figure 2.4. Consumption of primary energy resources, PJ [20, 78]

In 2000 electrical power in Latvia was generated by the big hydroelectric power stations of JSC LATVENERGO – Daugava cascade HPS and CHP (66.8%), in heat plants of industrial companies (2.6%), small HPS (0.33%) and by wind generators (0.07%). The rest was imported. The biggest consumers of electrical energy are industry (~34%) and households (~23%) [79].

In the last 2-3 years the demand for electricity has stabilised and constitutes in the average 6.0-6.3 GWh per year. Import of electrical energy is directly dependent on the through-flow of the Daugava. Due to low precipitation and the respective small generation, locally produced energy in Latvia in 2000 could satisfy only 70% of the demand [77].

Heating in Latvia is provided through centralised district heating or local heat supply systems. A typical feature of the centralised district heating is the growing use of natural gas and wood. Main source of fuel for local heat supply is wood (firewood, wood chips). Heat energy consumption in the heating season of 1999/2000 has gone down mainly due to the high average temperature of air [78].

Final energy consumption by sectors in 1995-2000 is presented in Figure 2.5.

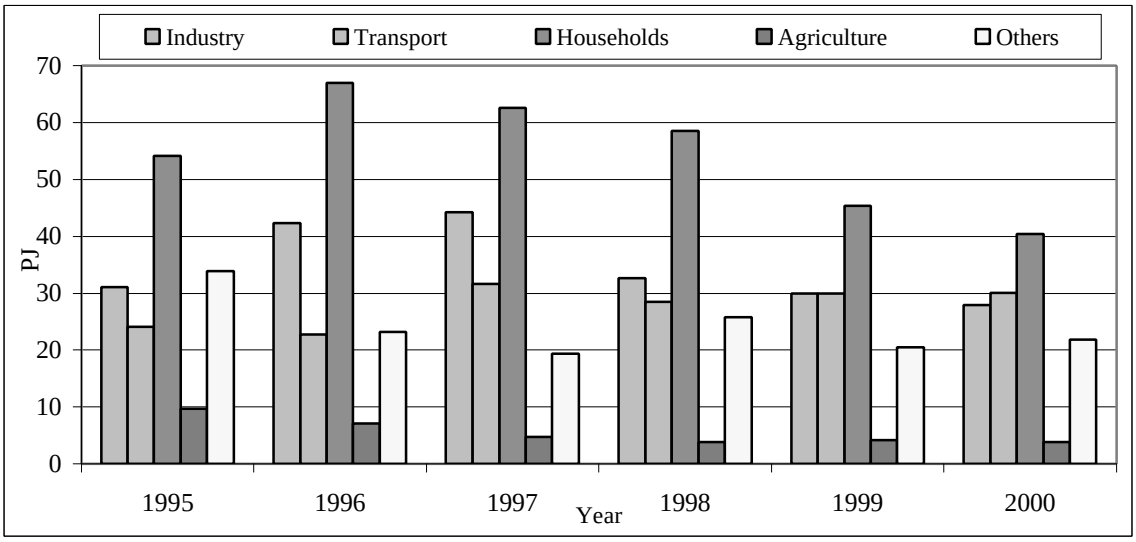


Figure 2.5. Final energy consumption by sectors, PJ [32]

In 1991-1993 with the decline of the GDP and overall energy consumption, energy capacity or consumption of energy per one unit of GDP rapidly went up. Yet, since 1994 energy capacity is going down (see Figure 2.6).

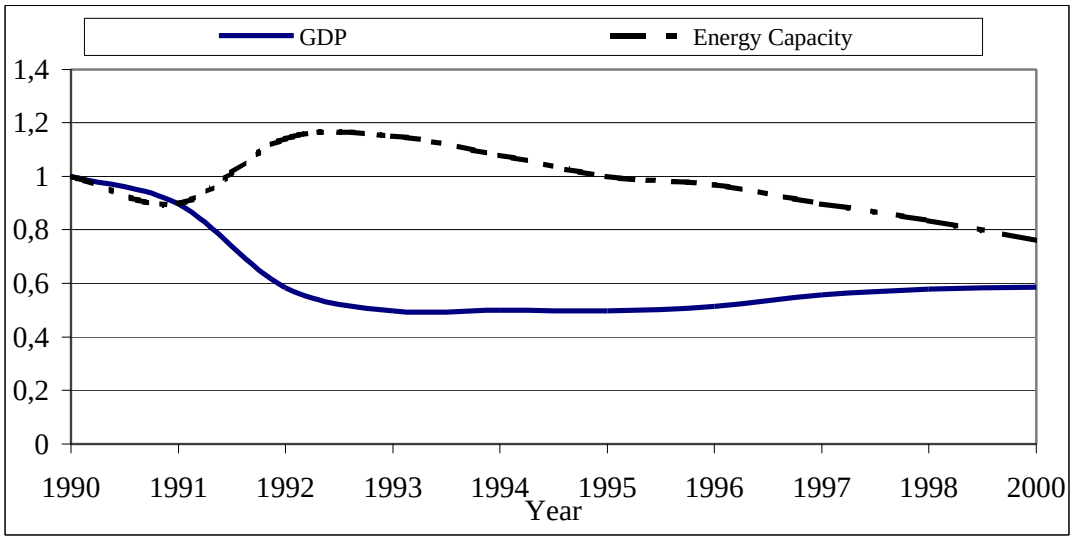


Figure 2.6. GDP and energy capacity index [4] (1990=1) [67]

There were no substantial changes in prices for energy resources established by the free market. The exception is prices of heavy fuel oil that essentially went up in 2000 (see Table 2.4).

Table 2.4

Prices of fuel (less taxes) [6]

Fuel	Unit	1998	1999	2000
Natural gas	Ls/1000 m^3	60	60	60
Heavy fuel oil (CIS) in Latvia	Ls/t	40	44	71
Heavy fuel oil in Europe	Ls/t	77	81	86

[4] Energy consumption per one unit of GDP.

Coal (CIS) in Latvia	Ls/t	35	35	36
Coal in the world market	Ls/t	29	30	31
Milled peat (W=40%)	Ls/t	8.5	8.8	9.2
Block peat (W=33%)	Ls/t	9.9	10.1	10.4
Wood* (W=50%)	Ls/t	6.7	6.7	7
Diesel fuel	Ls/t	143	129	142
Electricity import	Ls/MWh	14.75	14.75	15.3

* Price of wood is made up of prices for different wood resources (firewood, chips, wood waste etc.) [28]

Transport

Favourable geographical position, proximity to the Baltic Sea, ice-free sea ports (Ventspils, Liepaja), railroad and motor road networks, gas and oil product networks create good pre-conditions for the development of a multi-modal transport system in Latvia. The majority of cargo transportation is transit and international haulage and the most important type of transportation is by road. Cargo haulage by main types of transportation is summarised in Table 2.5.

Table 2.5

Cargo haulage by types of transport (thous. tons) [65]

	1990	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Railway	84111	28840	35264	41019	37857	33208	36413
Water[5]	28106	10587	10063	7699	-	-	-
Road	206210	25026	29499	25169	33765	33401	32911
Aviation	15	5	3	8	7	5	4

The number of transport vehicles in Latvia is presented in Table 2.6.

Table 2.6

Number of transport vehicles, end of year [15]

	1990	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Ships[1)]	NE	317	312	297	305	287	271
Lorries, thous.	60	68.7	72.9	76.8	84.9	90.2	97.1
Buses, thous.[2)]	11.7	16.5	17.3	18.6	11.5	11.6	11.5
Passenger cars, thous.	282.7	331.8	379.9	431.8	482.7	525.6	556.8
Trolley-buses	416	348	336	319	321	314	306
Tram cars	402	358	355	349	339	336	336
State Railway mobile equipment:							
Locomotives	484	349	322	308	288	270	248
Railcars	265	246	277	217	200	192	181
Aircraft (engine propelled)	NE	74	75	68	71	74	72

[1)] Ships with 100 and over gross tonnage registered in the Latvian Ships' Register.

[2)] Until 1997 – including all vans (minibuses), in 1998 – including only those vans registered as buses for passenger transportation.

Natural gas supply system in Latvia consists of 1223 km long main pipeline and 31193 km long distribution pipelines. Natural gas is imported from Russia and pumped into Incukalns underground gas storage facility with total capacity of 4 billion m^3 (active volume –

[5] Starting with 1998, Latvian cargo fleet flying foreign flags and the cargo transported by such ships are not recorded in Latvia.

1.855 billion m^3). Operation of pipeline transport in Latvia (including transit) is presented in Table 2.7.

Table 2.7

Pipeline transport operations [65]

	1995	**1996**	**1997**	**1998**	**1999**	**2000**
Oil transported over the main oil pipeline, million t	15.2	18.0	19.6	20.9	18.0	21.0
Oil products transported over the main oil products' pipeline, million t	2.9	2.7	3.0	3.2	3.6	3.5
Gas transported over main gas pipeline, billion m^3	3.1	3.4	2.8	3.7	3.6	3.9

Industry

Industry plays a decisive role in the growth of national economy. After the crisis at the beginning of 1990s caused by transition of Latvia to the market economy, industrial outputs, after 1996, started gradually to go up. The share of manufacturing industry in GDP in 1996 was 20.9%, in 1997 – 22.2%, in 1998 – 17.9%, in 1999 – 15.3% and in 2000 – 14.5%. However, at present this equals to only 40% of the level in 1990 when industry was the dominant sector of Latvian economy. Table 2.8 offers data on various sectors of Latvian industry from the perspective of the Ministry of Economy.

Table 2.8

Some sectors of Latvian industry, % [79][6]

	Manufacturing value added					**Share of exports in output**
	1996	**1997**	**1998**	**1999**	**2000**	2000
Total	100	100	100	100	100	52
Food industry	40.3	37.3	35.4	32.1	27.5	20
Light industry	11.5	11.5	11.8	12.5	14.2	86
Wood industry	9.1	13.2	14.7	17.6	19.7	73
Paper industry, publishing and printing	6.4	5.7	6.6	7.0	7.9	18
Chemical industry	6.8	6.9	6.2	4.4	3.0	57
Other non-metal mineral products	2.5	2.9	3.6	3.8	4.3	29
Metal and metal products	4.5	11.4	10.7	12.4	10.7	79
Machinery and equipment	15.0	7.7	7.7	6.6	8.5	78
Other industries	3.6	3.4	3.3	3.5	4.1	72

Food industry may be considered to be the one of the most important industrial sectors producing approximately 33% of total industrial output of Latvia. There are approximately 400 food producing enterprises having a significant impact on agriculture and supporting its development. Modernisation of food processing will be assisted from the funds of the EU SAPARD program within the framework of the Latvian Rural Development Plan.

Wood processing industry, the second biggest industrial sector in Latvia, is increasing its processing of wood materials. Main sectors of wood processing in Latvia are woodcutting,

[6] Table 2.8 does not provide data about the structure of added value for years 1990 and 1995 as structure of sectors, then, was estimated according to production outputs in current prices, which differs from the structure of added value.

production of plywood, wood boards and furniture. Light industry increased production outputs in 2000 compared to 1999. Outputs of textile industry went up by 9.2%, clothing – by 12.8%.

One of the fundamental challenges of Latvian industry is the development of production with export's potential and high added value. Taking into consideration the fact that Latvia is relatively poor in natural and energy resources (except timber), sectors where qualified specialists ensure added value, scientific potential and use of modern technologies should be regarded as the most prospective and should be encouraged the most. These are sectors that at the moment have a relatively small share in the total added value, yet have good prospects for future development, taking into account the existing potential of specialists and research. Such sectors are, for example, information technologies, sub-sectors of chemical and pharmaceutical industry, biotechnologies, material technologies, etc.

Also wood-processing sector has a high development potential where is high possibility to increase added value and export revenues from in-depth wood processing activities.

Construction

Construction is one of the most dynamic sectors in the economy of Latvia. Construction outputs in the last 5 years have gone up 2 times (in current prices). In 2000 construction contributed 6.8% to GDP. At present, the sector employs ~6.5% of total workforce employed in national economy, additional ~ 13% are employed in construction related sectors.

More than 70% of total generated heat energy in Latvia is used in residential houses and public buildings. In 2000 there were 31 471 living houses in Latvia, of which 93% belonged to the public sector. Almost 1/3 of total living fund is pre-fabricated panel houses built after 1958. Heat insulation capacity of framework constructions in these houses is very low. Additional heat insulation, according to the effective construction regulations in Latvia, is required in nearly all-residential and public buildings, however this demands considerable investments.

At the beginning of 2000 total living fund of Latvia equalled to 53.4 mill.m^2. Data on distribution of the living fund in towns and rural areas are presented in Table 2.9.

Table 2.9

Living fund of Latvia
(as of January 1 of the respective year; mill.m^2 total area) [17]

	1990	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Total living fund	52.9	52.7	52.8	53.0	53.2	53.4	53.4
Average per one resident	19.8	21.1	21.3	21.5	21.8	22.0	22.6
Living fund in towns	33.8	34.1	34.3	34.4	34.6	34.7	34.7
Average per one urban resident	17.9	19.8	20.0	20.3	20.5	20.8	21.5
Living fund in rural areas	19.1	18.6	18.5	18.6	18.6	18.7	18.7
Average per one rural resident	24.5	24.1	24.1	24.4	24.6	24.8	25.0

Agriculture

2000 was the first year after 1997 when agricultural outputs went up again (by 3.9%). Until then, agricultural production every year declined in the average by 12 percent. One of the reasons for backwardness in agriculture is low level of production specialisation and technologies hindering increase of production efficiency and, consequently, also reduction of per unit costs. Quality of products sometimes fails to meet the EU standards, which reduces competitiveness of agricultural products both in the domestic and foreign markets. Plant production was the dominant sector in total agricultural output of Latvia. However, situation

changed in 2000. Value of output (in current prices) in plant production compared to 1999 went up only by 1%, whereas in cattle breeding – by 10%. As a result, the share of cattle breeding in the total agricultural output reached 51.5% [79].

In the previous years, alongside with narrowing of agricultural production, also the amount of used fertilisers dropped by 90%, use of pesticides declined by 88%. With the reduction of the number of big animal farms 2.7-3 times in the average, also production of organic fertilisers and, consequently, use of organic fertilisers are declining resulting in lower pollution of environment caused by agriculture. Despite the fact that overall pollution level is low, in some individual places quite substantial point pollution sources are observed, for instance, in former big animal farms, fertiliser warehouses, etc. There is lot of uncultivated and abandoned agricultural land that has appeared in the result of change of landowners and users as well as narrowing of agricultural activities. There is an excessive reproduction of weeds – 144 thousand ha (6.2% of surveyed area); overgrowing with shrubs – 21.5 thous.ha (0.93%); in 203 cases land users did not re-cultivate agricultural lands damaged in the result of business activity ~400 ha; reduction of liming of soils has a negative impact on the quality of soil.

Another problem that has appeared recently is concentration of production in certain areas (localities, regions), which, with increase of production outputs, will accumulate the majority of production and processing capacities. Since rural territories of Latvia are not densely populated and are greatly dependent on agricultural production, the principle of regional differentiation of support will be respected in the national support scheme to Latvia as foreseen by *acquis communautaire*. It is projected to award the status of the less favoured area (LFA) to the whole rural territory of Latvia, except Riga region and cities. Support activities will cover state support to production corresponding to the EU quality requirements, and, in regard to environment – mainly to afforestation of agriculturally used, yet not very suitable for agriculture lands, support to biological farming, farm specialisation and mechanisation, diversification of rural economic activities.

Forestry

Forests and wood resources in forests are listed among the most important natural resources of Latvia. Latvian Forest policy and legislation determine that forest resources should be used in an economically efficient way, respecting principles of sustainable forest management. Total growing stock in 2000 was 546 mill.m^3, gross annual increment being 16.5 mill.m^3. Net annual increment (gross annual increment excluding consideration of natural loss of trees and restrictions to forest management for the purposes of nature protection) was 13.2 mill.m^3 per year [34]. In the result of increase of forest area (see Figure 2.2) and existing forest management practice, stock increment has gone up by 17% during the last decade. Forest management practice targeted at forest productivity growth in last century has considerably increased the average growing stock. Average growing stock is presented in Figure 2.7.

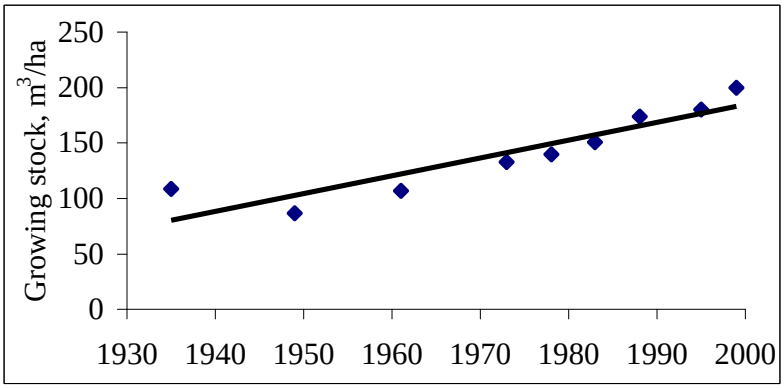


Figure 2.7. Average growing stock [31]

Stands of 50-90 year old coniferous trees and 40-60 year old deciduous, mainly birch, dominate in Latvia. Age structure of the growing stock in Latvia is presented in Table 2.10.

Table 2.10

Age structure of growing stock in 2000, %

Age class, years	Coniferous trees	Soft deciduous trees	Hard deciduous trees
1 – 10	4,3	4,0	6,4
11 – 20	5,5	5,4	9,9
21 – 30	6,7	7,9	7,1
31 – 40	7,5	13,9	8,0
41 – 50	6,8	18,6	8,7
51 – 60	10,2	19,3	10,9
61 – 70	11,3	12,5	8,9
71 – 80	11,5	9,1	8,2
81 – 90	11,4	5,9	8,3
91 – 100	8,8	2,4	6,9
101 – 110	5,9	0,7	5,4
111 - 120	3,6	0,2	2,8
More than 120	6,5	0,1	8,5
Total	100	100	100

Percentage calculated according to area covered by forest stands in hectares.[7]

According to the data of the State Land Service, all forests in Latvia, in terms of ownership, in 2000 were divided in the following groups: state-owned forests – 1.43 mill.ha (49.9%), private forests – 1.23 mill.ha (42.9%); other forests – 0.20 mill.ha (7.2%). Land reform is still in progress and, as a consequence, the number of private landowners is changing.

Annual forest harvesting between 1992 and 2000 went up from 4 mill.m^3 till 11 mill.m^3. Natural persons link the dynamic growth of forest harvesting with the regained forest properties during the land reform that led to restart of production of wood materials from these forests. Except for increasing felling volume, not more than 67% of the annual increment was felled in 2000. Quantity of felled wood is stable in state-owned forests, major reason being maximum amount of wood allowed for felling in final felling regulated directly by law. Felling volumes in both private and state forests are also regulated indirectly by determining fellingage of forest stands. Final felling is prohibited if forest is not regenerated in the order

[7] Source: State Forest Service

prescribed in normative acts.

Approximately 34% of the cut forest area in Latvia is artificially regenerated. Till the middle of 1950s different sowing methods were mostly employed for pine stands. After that, with the development of tree nurseries and production of containerised seedlings, planted cultures started to dominate. Share of artificially regenerated forest areas is decreasing hence taking into account economic and ecologic factors. Latvian Forest policy determines that it is desirable to use methods imitating natural processes in forest management.

Export of wood equalled to 43.2% of total commodity exports of Latvia in 2000. Changes in outputs of the forest sector are presented in Table 2.11. From the new investment projects in the sector, the new pulp plant project should be mentioned as the most important. It is planned that the plant will annually produce 600 000 tons of bleached coniferous and deciduous tree pulp. Construction of the plant, according to plans of investors, could be started in 2003.

Table 2.11

Outputs of forest sector, thous.m^3 [34]

	1994	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Sawn timber	200[1)]	1300	1800	2700	3200	3640	4030
Plywood	65	73	103	120	150	155	156
Chipboard	192	130	143	149	115	129	102
Hardboard	28	23	23	27	26	24	17
Paper and cardboard (thous. t)	NE	7	8	15	15	19	24

[1)] These data are approximate, source: Ministry of Agriculture

Waste management

Waste is one of the most important problems of environment protection in Latvia. There were more than 500 household waste landfills in Latvia in 1998. As a rule, they are poorly designed and equipped. Total annual amount of waste is 600-700 thous.tons, of which approximately 500 thousand tons are household waste. Only about 50-60% of the generated waste is collected and transported to waste landfills. Waste disposal sites create pollution of the surrounding territory, water, air and soil.

The strategy of household waste management in Latvia developed in 1997 identifies solution of problems in the waste management sector as an urgent task to be handled on the national level. Implementation of waste management strategy is defined as a priority area for the state financial support in the sector of environment protection. Implementation of the strategy is based on the “National Household Waste Management Program, 500-“. These documents are discussed in greater detail in Annex 1.

Possibilities for household waste recycling in Latvia are limited. Sorting is first of all needed for recycling waste and using it later as a raw material. At the moment some small pilot projects for sorting of waste have been launched in Riga, Jelgava and Valmiera.

Separation of cardboard, glass containers, ferrous and non-ferrous metals and polyethylene is done in “Getlini”, Riga municipal landfill. Later these materials are pressed and transferred for recycling, although this equals to approximately 2% of total waste.

Creation of a centralised waste management system and construction of a regional waste disposal sites as foreseen by the strategy and program “500-“ will create preconditions for effective use of waste for energy generation. At the moment use of waste for energy generation is planned in Riga and Liepaja waste landfills.

2.5. Factors influencing GHG emissions in Latvia

After 1990, influenced by economic decline, use of all types of natural resources, amounts of industrial waste, use of mineral fertilisers and pesticides in agriculture, water and air pollution decreased. Also GHG emissions created in the process of fossil fuels combustion went down due to the same reason (see Table 2.12).

Table 2.12

Climate change indicators in Latvia, 1990, 1995 – 2000 [64][8]

Indicator	1990	1995	1996	1997	1998	1999	2000
Energy consumption, GJ/resid.	NE	71.85	73.25	77.35	73.55	68.03	64.90
Energy productivity, LVL/TJ	NE	12.52	12.86	14.48	15.00	16.24	18.96
Total CO_2 emission, mill.t	23.70	11.80	10.70	11.90	8.40	7.39	7.00
CO_2 emission, t/resid.	8.87	4.67	4.28	4.80	3.42	3.03	2.95
CO_2 emission, t/GDP unit[1)]	NE	0.0050	0.0044	0.0045	0.0031	0.0027	0.0024

[1)] GDP in 1995 current prices, LVL

To evaluate the correlation between the mentioned circumstances and changes in the amount of GHG emissions there was developed a set of climate change indicators. This work was co-ordinated by the Baltic Environmental Forum when was prepared the Second Baltic States Environment Report. Indicators were selected using the method devised by OECD and supplemented by the European Environment Agency (EEA). Since experts from the three Baltic States participated in selection of climate change indicators, these indicators were universal and comparable. Such indicators allow evaluate improvements of environment and provide opportunity to forecast and evaluate results of environmental policies.

Energy productivity in national economy by showing the amount of primary resources needed to produce one unit of GDP and sector structure of energy consumption were selected as indicators to characterise causes of GHG emissions. In turn, the structure of primary energy resources shows how much of these fuels are creating GHG emissions. Fossil fuel combustion is the main source of GHG emissions and, conversely, nuclear energy, hydro-energy, wind, sun and energy generated from biomass combustion do not directly influence increase of GHG emissions. Therefore this indicator reflects economic considerations affected by fuel prices, availability of certain energy resources and the existing energy supply structure.

Since wood, hydro energy as well as import of electrical energy are widely used in the energy sector of Latvia, the share of fossil fuel in the consumption of energy resources in Latvia in comparison with other European countries is small (see Section 2.4.2). Furthermore, energy productivity is rather low despite the tendency of growth (see Table 2.12).

CO_2 emissions created in the process of fossil fuel combustion are the most important indicator characterising the strain on the world climate caused by human activity. If to relate this indicator to the number of residents and GDP it is possible to get GHG capacity in a national economy.

The indicator that best of all describes climate change in Latvia is the date of the drifting of ice in rivers. Although this indicator depends on natural variations, for example, activity of the sun, it convincingly proves that in the 20th century drifting of ice in rivers has a tendency of earlier start (see Figure 2.8) [1].

[8] Figures for 1999 and 2000 were calculated according to methodology described in "2nd Baltic States Environment Report" [1].

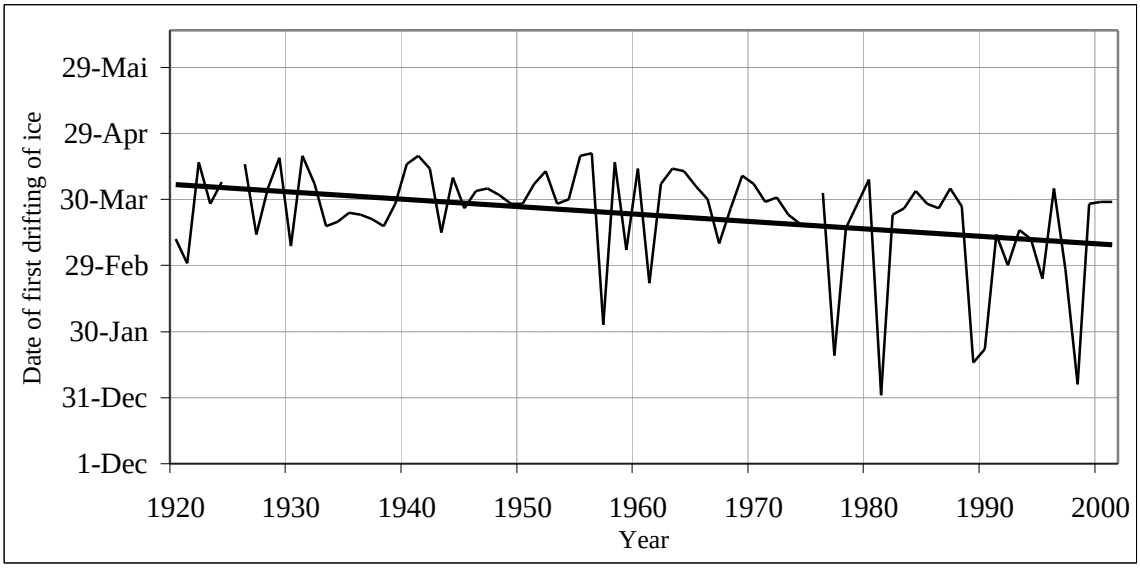


Figure 2.8. The date of first drifting of ice in Gauja River since 1920 [1]

According to the Climate Convention, Kyoto Protocol of December 11, 1997 Latvia, alone or in a joint action with another country, should in 2008-2012 reach the level where anthropogenic CO_2, CH_4, N_2O, HFC, PFC and SF_6 emissions, taken together, are 8% below the level of emissions in 1990. Judging the present trends, set-up goal is quite realistic for Latvia. However, economic growth rates might be faster than assumed in program documents. In such case, the development of economy and increasing mobility of people combined with the low energy efficiency in the power sector, industry and households will result in the growth of CO_2 emissions. Therefore, it is very important to implement activities of raising energy efficiency and to encourage use of local renewable resources as well as to increase removals of GHG by biomass in the process of photosynthesis.

3. INVENTORIES OF ANTHROPOGENIC EMISSIONS AND REMOVALS OF GHG

The chapter provides information on GHG emissions and removals in Latvia between 1995 and 2000. Data for 1990 are assumed as a reference and used for comparison for the purposes of highlighting international commitments of Latvia to reduce GHG emissions. Data on GHG emissions for the time period between 1990 and 1999 are taken from annual reports of Latvia under the UNFCCC and data for 2000 are provisional.

Annual report on anthropogenic emissions and removals of GHG is prepared by the Latvian Environment Agency – a civil institution subordinated to the Ministry of Environment Protection and Regional development, which, within the scope of its competence, implements the state environment policy, including also in the area of nature protection and information provision. The task of the Latvian Environmental Agency is to develop and maintain information system on Latvian environment, create data bases of water use and pollution, water treatment facilities, air pollution, hazardous wastes and waste disposal sites, protected plants and animals, cadastre of especially protected nature territories and objects and summarise data on radiation monitoring.

Classification of sectors of national economy discussed in this chapter and also Chapter 5 and 6 corresponds to Intergovernmental Panel on Climate Change (IPCC) common reporting format (CRF) approved at the 5th session of member states in 1999.

The report covers direct GHG (CO_2, CH_4, N_2O) and indirect GHG (NO_x, CO, NMVOC) and SO_2. Halocarbons (HFC and PFC) were not produced in Latvia in the reviewed period therefore the 3rd National Communication does not contain their emission data. The 1999 Inventory provides potential SF_6 emissions from electrical equipment – 0.09 Gg CO_2 equivalent.

Estimation of GHG emissions is done according to the IPCC 1996 Revised Guidelines for National Greenhouse Gas Inventories, common reporting format and using data of publications and databases of the CSB. For estimation of transport sector emissions, alongside with IPCC Guidelines, also the data of the CSB survey of 1994 on the percentage distribution of transport vehicles were used.

Summary tables of annual reports of 1990, 1995-2000, according to methodological instructions, are attached in Annex 2. Notably, those GHG emissions for the time period between 1990 and 1997 have not been re-estimated according to the IPCC CRF. Emissions for this period are estimated in national database. CRF for emissions is used only as summary and trend tables; consequently differences in data are possible due the round up. The chapter also presents the aggregate of CO_2, CH_4 and N_2O CO_2-equivalent emission based on their global warming potential (GWP) values for the horizon of 100 years.

Since the classification of soils used in Latvia does not correspond to the requirements of IPCC Guidelines, GHG emission estimations do not contain CO_2 emissions and removals from soil. Estimation also does not cover GHG emissions from international fuel storage sites [35].

3.1. CO_2 emissions and removals

The most important source of CO_2 in 1999 was fossil fuel combustion – 97.9%, including by energy sector – 41.3%; manufacturing industry and construction – 15.2%; transport – 27.7%, other sectors (agriculture, forestry, etc.) – 13%, and losses in transport and distribution – 0.8%.

Other anthropogenic emission sources of CO_2 are industrial processes – 1.4% and tilling and liming of agricultural lands. CO_2 removals take place by green plants absorbing CO_2 in the process of photosynthesis. In 1999 forests in Latvia removed 5321.71 Gg CO_2 – by 5278.29 Gg less than in the preceding years (-10 600 Gg). 2316.89 Gg CO_2 was emitted into the atmosphere (see Figure 3.1).

Changes of forest stock in 1990 and 1995-1998 were taken from estimations presented in the Second National Communication. Net CO_2 emissions and removals for these years are re-calculated according to the CRF.

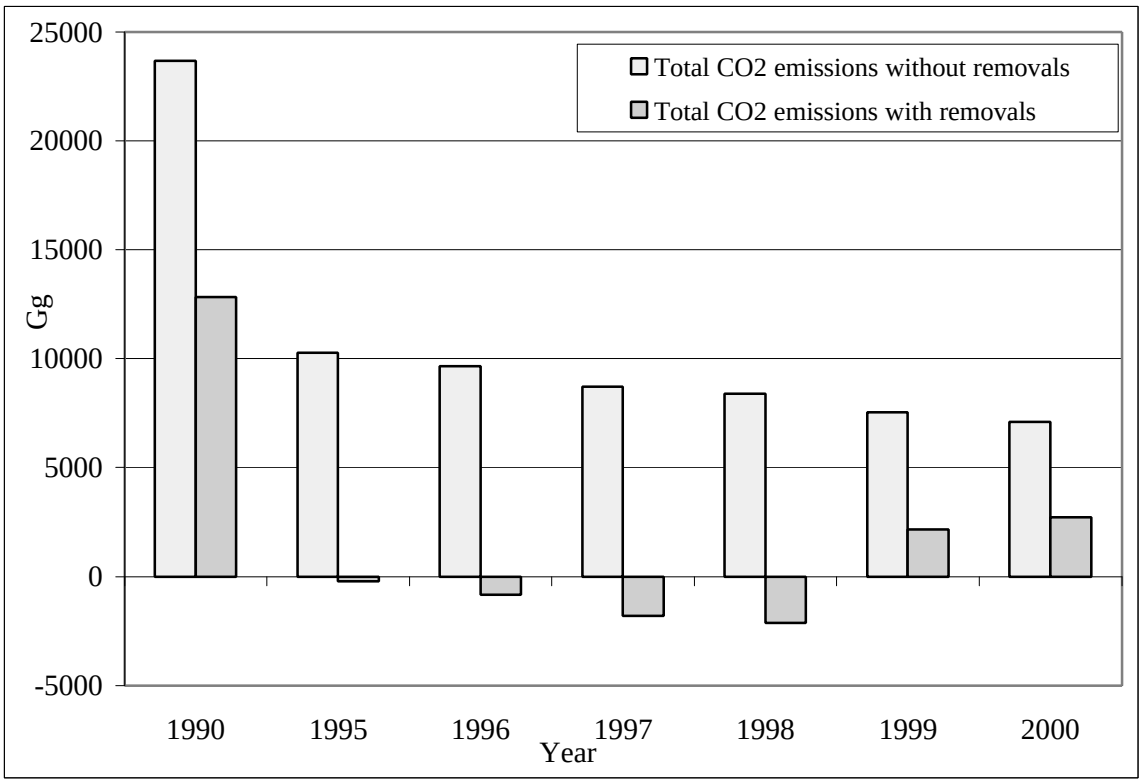


Figure 3.1. CO_2 emissions and removals in 1990, 1995-2000

More detailed distribution of CO_2 emissions and removals is given in Table 3.1.

Table 3.1

Total CO_2 emissions and removals in 1990, 1995-2000

Sectors of economic activity	Emissions/removals, Gg						
	1990	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
1. Energy	22964.29	10017.90	9364.12	8465.21	8050.97	7384.78	6999.20
A. Fuel combustion	22964.29	10017.90	9364.12	8465.21	8050.97	7384.78	6999.20
1. Energy industries	8288.17	4542.83	3901.56	3819.17	3543.18	3116.00	2895.00

Sectors of economic activity	Emissions/removals, Gg						
	1990	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
2. Manufacturing industry and construction	2682.76	1038.33	741.27	1242.94	1275.28	1146.21	1055.00
3. Transport	6011.22	1748.79	1611.92	2178.37	2126.22	2087.00	2088.00
4. Other sectors*	5956.92	2558.42	3053.56	1163.73	1047.79	978.37	901.00
5. Others**	25.22	129.52	55.82	61.00	58.50	57.20	60.20
2. Industrial processes	562.91	127.40	185.38	153.50	236.14	160.66	100.86
A. Mineral products	562..91	127.40	185.38	153.50	236.14	160.66	100.86
5. Land use change and forestry	-10825.58	-10483.55	-10496.38	-10508.48	-10508.48	-5228.55	-4290.19
A. Changes in forest stocks	-10960	-10600	-10600	-10600	-10600	-5321.71	-4384.88
D. CO_2 emissions and removals from soil	134.42	116.45	103.62	91.52	92.52	93.16	94.69
Total CO_2 emissions, excluding Land use change and forestry	23527.20	10145.30	9549.50	8618.71	8287.11	7545.44	7100.06
Total CO_2 emissions, including Land use change and forestry	12701.62	-338.25	-946.88	-1889.77	-2221.37	2316.89	2809.87

* Agriculture, forestry, fishing, households, trade, services
** Transport and distribution losses

3.1.1. Energy (1A,B)

CO_2 emission values from fuel combustion are based on the information from the approved energy balances on consumption of various types of fuel as well as on the emission factors provided in guidelines [22]. Emissions from centralised heat production in DH and CHP plants are accounted for in the energy conversion sector. As a contrast to 1998, in 1999 both sector approach and reference approach were used in estimation of emission values of energy sector. Sector approach is mainly focussed on the consumption of fuel in different sectors. Using both approaches it is possible to control estimated CO_2 emissions in the sector. The admissible variation between the two approaches should not exceed 2%, which is possible due to statistical discrepancy (see Annex 2).

CO_2 emissions from metal and steel production were included in the group of manufacturing and construction (energy related) in 1998 and 1999.

As proved by the data of annual reports, CO_2 emissions from the energy sector keep going down every year. This is caused by lowering of the average temperature in winters, changes in fuel structure and measures of energy efficiency.

As mentioned above, emissions of the energy sector in 1990-1997 were not re-estimated in the CRF. Annex 2 contains data on emissions from the energy sector in the respective years that were taken from the national data base, therefore there might be some discrepancies due to the round–up.

3.1.2. Industrial processes (2A)

CO_2 emissions in Latvian industry (not related to energy) are created in the process of production of clinker, an intermediate product of cement and lime.

CO_2 emission variation from industrial processes is determined by fluctuations in the production of cement and lime. Thus, for example, production of lime in 1999 had dropped approximately 5 times compared to 1998.

3.1.3. Land use change and forestry (5A,D)

Forest area in Latvia is growing alongside the dynamic increase of the harvested areas. In comparison with the first half of 1990, annual volume (liquid) of harvesting in 1999 and 2000 was approximately two times bigger (see Annex 3). Today it accounts for approximately 60 % of annual increment.

GHG emission estimation in the forestry sector was based on the statistical data, information and opinion of forestry experts. The area of managed forests, newly managed forests; forest clearings and unfinished afforestation as well as shrub area were considered in estimation of CO_2 sequestration in the sector of land use and forestry. At the same time, following IPCC guidelines CO_2 sequestration from reserves was not accounted for and therefore is not included in GHG estimations. Growing stock increment in clearings and unfinished afforestation as well as in the newly afforested land is assumed as given in Table 3 in Annex 3 and expansion value of 1.9 is assumed for transition from stem volume to the total biomass volume (as prescribed in IPCC guidelines).

CO_2 emissions estimation was also made from agricultural soils with intensive farming. These are drained, mechanically tilled, fertilised and limed soils. The fact that the area of these soils became smaller between 1995 till 1999 is resulted in consequent reduction of CO_2 emissions.

Data presented in Table 3.1 show that CO_2 emissions from soils in 1997 and 1998 have gone down in comparison with the preceding years; yet starting with 1999 CO_2 emissions have a tendency to grow.

Annual changes of emissions and uptake of CO_2 depending on changes in forest stock in the sector of land use change and forestry in 1990-1998 except for 1990 and 1995 were not estimated. Calculation was split into two time periods: 1990-1994 (-10 960 Gg) and 1995-1998 (-10 600 Gg). Consequently, only net CO_2 emissions and removals are presented in the CRF (see Annex 2). Starting from 1999 emissions and uptake of CO_2 depending on changes in forest stocks are estimated on the annual basis, according to the CRF.

3.2. CH_4 emissions

Main sources of CH_4 emissions in Latvia are solid waste disposal sites and enteric fermentation of livestock. Other important sources of CH_4 emissions are leakage from natural gas pipeline systems and combustion of biomass. Total CH_4 emissions in 1990 and 1995–2000 are presented in Figure 3.2 and Table 3.2. Estimation is based on 1996 IPCC Revised Guidelines and emission factors.

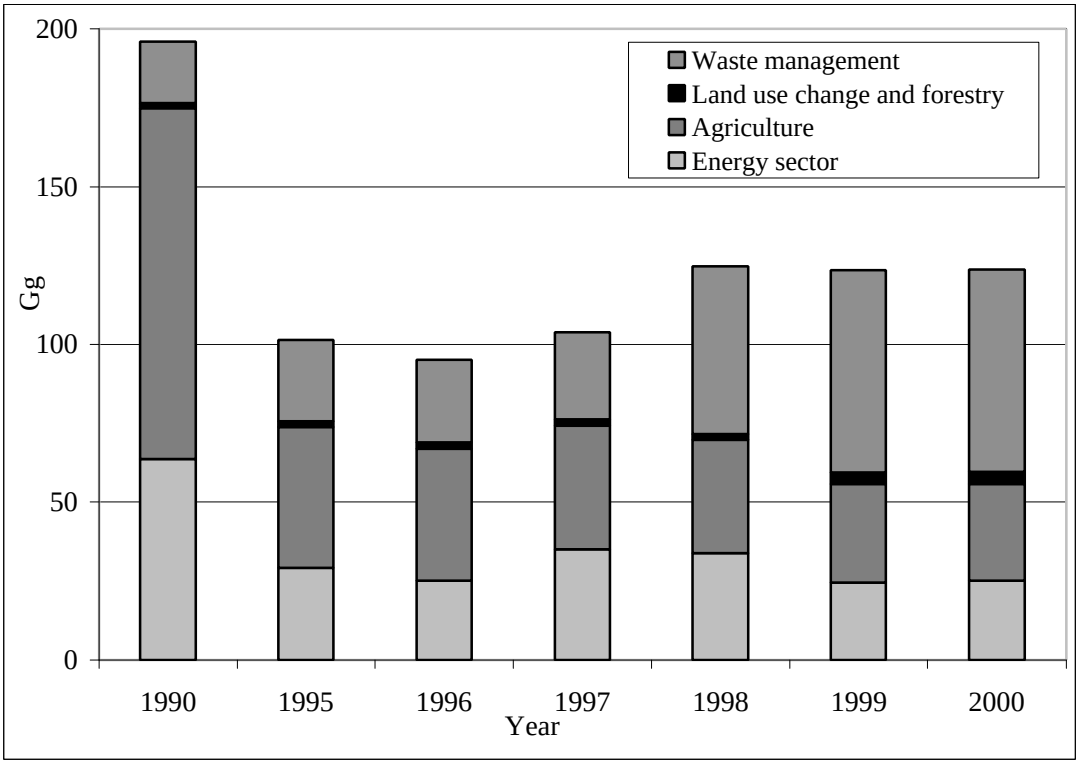


Figure 3.2. CH_4 emissions in 1990, 1995-2000

Table 3.2

Total CH_4 emissions in 1990, 1995-2000

Sectors of Economy	Emissions, Gg						
	1990	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
1. Energy	**63.69**	**29.10**	**25.04**	**35.10**	**33.81**	**24.50**	**25.20**
A. Fuel combustion	10.45	7.5	6.26	12.06	11.22	9.57	7.52
1. Energy industries	0.66	0.36	0.37	0.50	0.45	0.31	0.39
2. Manufacturing industry and construction	0.22	0.17	0.05	0.19	0.21	0.27	0.27
3. Transport	1.43	0.38	0.32	0.49	0.48	0.47	0.42
4. Other sectors*	8.15	6.60	5.51	10.87	10.09	8.53	6.44
B. Fugitive emissions from fuels	53.24	21.60	18.78	23.04	22.59	14.93	17.68
2. Oil and natural gas	53.24	21.60	18.78	23.04	22.59	14.93	17.68
4. Agriculture	**111.27**	**44.64**	**41.86**	**39.19**	**35.86**	**31.35**	**30.64**
A. Enteric fermentation	97.96	39.32	37.09	34.72	31.67	27.52	26.91
B. Manure management	13.31	5.32	4.77	4.47	4.20	3.83	3.73

Sectors of Economy	Emissions, Gg						
	1990	1995	1996	1997	1998	1999	2000
5. Land use change and forestry	**1.6**	**2**	**2**	**2**	**2**	**3.64**	**3.71**
B. Changes in forest stocks	1.6	2	2	2	2	3.64	3.71
6. Waste	**19.39**	**25.60**	**26.18**	**27.51**	**53.19**	**64.14**	**64.23**
A. Solid waste disposal on land	19.39	25.60	26.18	27.51	40.2	58.11	59.87
B. Wastewater handling					12.99	6.03	4.36
Total CH_4 emissions	**195.95**	**101.34**	**95.08**	**103.80**	**124.87**	**123.62**	**123.77**

* Agriculture, forestry, fishing, households, trade, services

3.2.1. Energy (1A)

The main source of CH_4 emissions in the energy sector is biomass (wood) combustion. CH_4 is produced due to incomplete combustion of hydrocarbons in fuel. Such conditions most often occur in residential applications (small stoves and open burning). CH_4 emissions from natural gas transmission pipelines in between 1990 and 1998 are estimated according to the consumption of natural gas in the state during the period, assuming 0.5 Gg/PJ as emission factor [22]. On the other hand, according to the expert evaluation, emission factor in 1999 was reduced to 0.34 Gg/PJ [22]. Data on fugitive emissions from Incukalns underground gas storage were taken from annual reports “No.2-Air”. Emissions from main gas pipelines, oil and oil product pipelines were not estimated due to the lack of data.

3.2.2. Agriculture (4A,B)

CH_4 from animals is produced in the processes of enteric fermentation in the alimentary canal of animals as a normal side product of rumination and is emitted during manure decomposition under anaerobic conditions. Table 3.2 shows that CH_4 emissions in agriculture are going down with every year mainly due to the reduction of animal herd.

3.2.3. Land use change and forestry (5B)

CH_4 emissions in the sector are produced during on-site burning of wood residues after harvesting. See more detailed information in section 3.4.4.

3.2.4. Waste management (6A)

CH_4 is produced in solid waste disposal sites during anaerobic decomposition of organic matter.

CH_4 emissions in 1999 were estimated also in the wastewater treatment sub-sector where data were taken from annual reports “No.2-Water”. Notably that in Latvia there is no separation between wastewater coming from the industrial sector and households, therefore data on combined (industrial and household) wastewater were included in calculations.

Till 1998 CH_4 adjustment factor for managed waste disposal sites was 0.6 and for unmanaged – 0.16 as, according to expert opinion, emission factors provided in IPCC

guidelines did not correspond to Latvian conditions. After 1998 emission factors of, respectively, 1 and 0.6 were used as provided in IPCC guidelines. Therefore CH_4 emission in 1998–2000 went up approximately two times compared to 1995 (see Table 3.2).

3.3. N_2O emissions

Agricultural lands are the main source of N_2O emission in Latvia generating 84.2% of all N_2O emissions in 1999 (see Figure 3.3 and Table 3.3). Other N_2O emission sources are transport and biomass, combustion of liquid and other solid fuels in sectors of energy conversion and industry, on-site burning of wood harvesting waste and sewage waters.

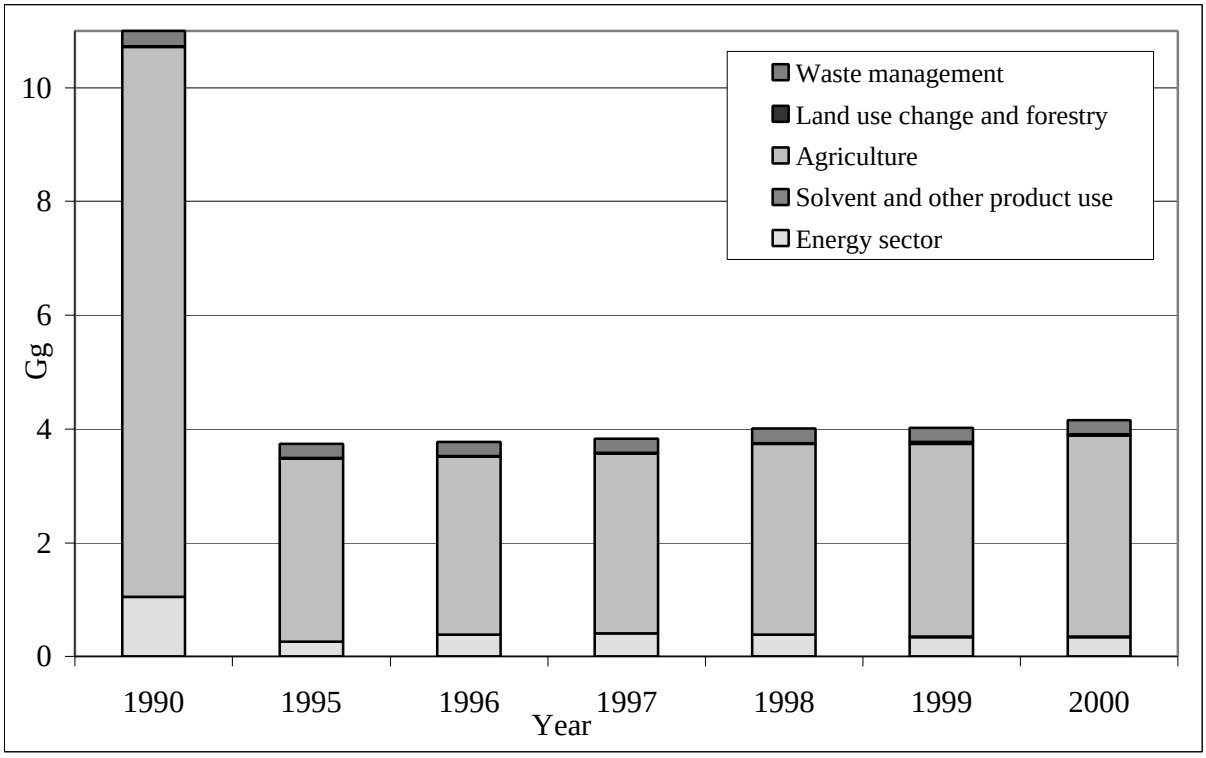


Figure 3.3. Total N_2O emissions in 1990, 1995-2000

Table 3.3

Total N_2O emissions in 1990, 1995-2000

Sector of economy	Emissions, Gg						
	1990	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
1. Energy	**1.05**	**0.26**	**0.38**	**0.41**	**0.38**	**0.34**	**0.32**
A. Fuel combustion	1.05	0.26	0.38	0.41	0.38	0.34	0.32
1. Energy industries	0.10	0.06	0.06	0.07	0.06	0.04	0.05
2. Manufacturing industry and construction	0.02	0.01	0.003	0.02	0.03	0.03	0.03
3. Transport	0.86	0.12	0.25	0.17	0.16	0.15	0.15
4. Other sectors*	0.08	0.08	0.08	0.14	0.13	0.10	0.09
3. Use of solvent and other product						**0.01**	**0.01**
D. Others **						0.01	0.01
4. Agriculture	**9.67**	**3.22**	**3.13**	**3.16**	**3.36**	**3.39**	**3.53**

Sector of economy	Emissions, Gg						
	1990	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
B. Manure management					0.57	0.49	0.49
D. Agricultural soils	9.67	3.22	3.13	3.16	2.78	2.90	3.04
5. Land use change and forestry	**0.011**	**0.014**	**0.014**	**0.014**	**0.014**	**0.03**	**0.03**
B. Changes in forest stocks	0.011	0.014	0.014	0.014	0.014	0.03	0.03
6. Waste management	**0.27**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.24**
B. Wastewater handling	0.27	0.25	0.25	0.25	0.25	0.25	0.24
Total N_2O emissions	**11.00**	**3.75**	**3.77**	**3.83**	**4.00**	**4.01**	**4.12**

* Agriculture, forestry, fishing, households, trade, service
** N_2O use in anaesthesia

More detailed information on N_2O emissions by sectors is provided below.

3.3.1. Energy (1A)

The main sources of N_2O emissions in energy sector are transport and fuel combustion in energy transmission and industrial sectors (see Table 3.3).

3.3.2. Use of solvent and other product (3)

The only GHG emissions in this sector are N_2O from the laughing gas used in anaesthesia. GHG emission estimations of this sector were made starting with 1999 (see Table 3.3).

3.3.3. Agriculture (4B,D)

N_2O emission estimation in agriculture in Latvia includes use of organic manure and agricultural soils. Estimations are based on expert evaluation that cultivated organic (nitrogen enriched) soils in Latvia equal to 7% of total agricultural land. In 1999 and 2000 in comparison with the preceding years net amount of nitrogen from mineral fertilisers worked into agricultural lands has gone up reaching, respectively, 19 and 23 thousand tons.

Comparing N_2O emission in agricultural sector in 1990 and 1999 it is evident that the emissions have gone down by 60% (see Table 3.3). This is linked with narrowing of agricultural production. Data of CSB are used to estimate emissions and emission values were taken from IPCC Guidelines.

Similarly to the energy sector, also in the agricultural sector emissions between 1990 and 1997 were not re-estimated in the CRF. Data from the national database were used for the purposes of estimations in this period, which are presented in CRF summary tables.

3.3.4. Land use change and forestry (5B)

On-site burning of wood residues after harvesting also produces N_2O emission (see details in section 3.4). In 1999 and 2000 N_2O emissions were growing in comparison with the preceding years (see Table 3.3). This is linked with the increase of forest felling amounts resulting in increased burning of wood residues.

3.3.5. Waste management (6B)

Small amount of N_2O is released from discharge of human sewage to aquatic environments. Calculation is based in the assumption that annual protein consumption is 0.11 kg per person per day or 40.15 kg per person per year, according to the survey of 1991. Calculated emissions are presented in Table 3.3.

3.4. Indirect GHG and SO_2 emissions

As mentioned above, nitrogen oxides (NO_x), carbon oxide (CO) and non-methane volatile organic compounds (NMVOC) are counted as indirect GHG emissions. Sulphur dioxide (SO_2) is not a GHG, however being a creator of sulphate aerosols in the atmosphere it has an impact on climate. Figure 3.4 presents data on indirect GHG and also SO_2 emissions in 1990 and for the period of 1995-2000.

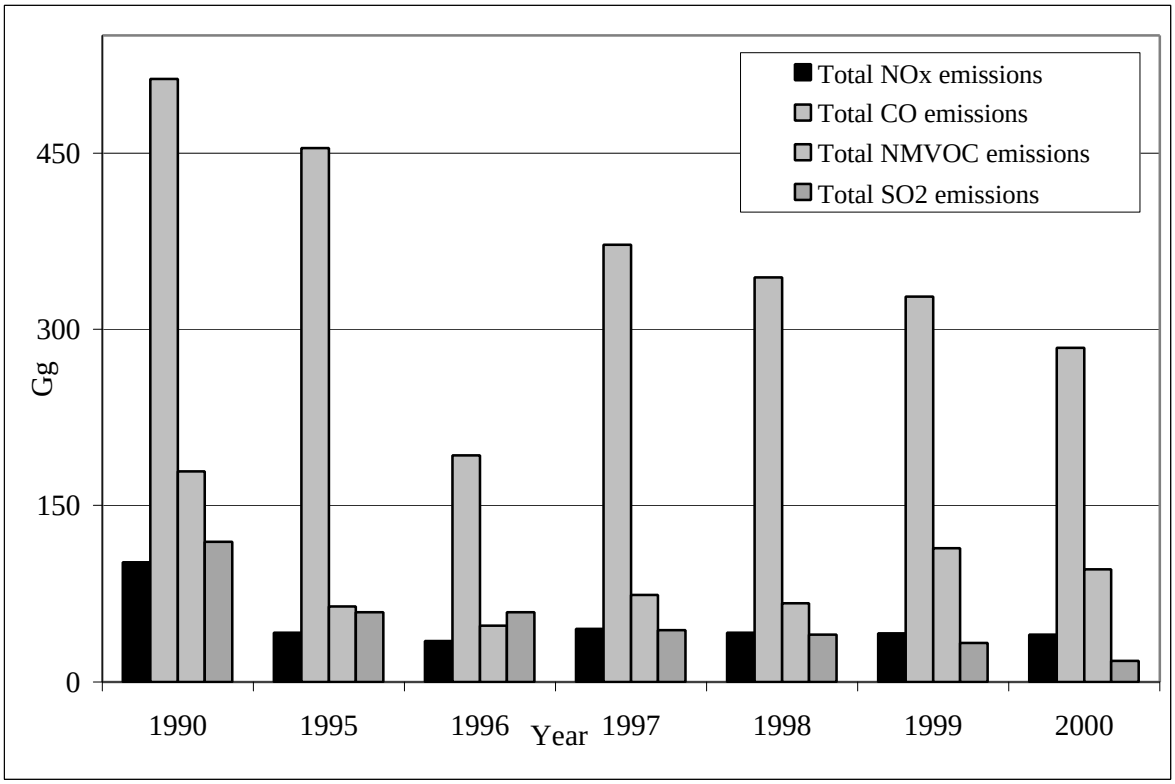


Figure 3.4. Indirect GHG and SO_2 emissions in 1990, 1995-2000

Emissions of indirect GHG and SO_2 by sectors from 1990 till 2000 are presented in Annex 2. More detailed information on indirect GHG and SO_2 emissions in different sectors is given below.

3.4.1. Energy (1A,B)

Energy sector was the main source of indirect GHG and SO_2 emissions in 1999. Transport emitted 60% of total NO_x and 45.5% of CO emissions. Losses of gasoline in the process of distribution and consumption were the only item accounted for in leakage of fugitive emissions from oil products, i.e. NMVOC emissions in this sector equal to 3.9% of total energy sector emissions. With regard to SO_2 emissions, energy sector was the biggest source of emissions producing 99.7% of total emissions.

3.4.2. Industrial processes (2A,C,D)

Industrial sector had the biggest production of NMVOC in 1999 (57.2%). NMVOC emissions have substantially gone up compared to the preceding years. Total NMVOC emissions from industrial sector equal to 65.13 Gg, where production of mineral products gives 95.7%, food industry – 4.3% and steel production – 0.03% of emissions.

When there was estimation of NMVOC issued by asphalt pavement in 1999 it was impossible to get information about the length of newly covered roads. Therefore data of the produced outputs of asphalt were used in the calculation. Estimation was done according to the method provided in IPCC guidelines.

Small part of other indirect GHG (NO_x, CO) and SO_2 emissions is produced by steel industry.

3.4.3. Use of solvent and other product (3)

Data of 1999 report shows that only a very small part – 6.60 Gg (5.8%) of NMVOC emissions is caused by the use of paints.

3.4.4. Land use change and forestry (5B)

CH_4, N_2O, CO and NO_x emissions are calculated as on-site burning of treetops and branches. It is assumed that tops and branches constitute 15% of total biomass of wood. Half of this mass is left in the forest after cutting and the remaining part is burnt on-site or used for energy generation purposes. Expert's opinion is that between 1995-1999 approximately 1/3 of earlier mentioned 50% was used as fuel and the rest was burnt on-site (see Annex 4).

In the calculation of indirect GHG emissions, annual amount of biomass burnt on-site and the part of oxidised fraction are accounted for. Average density of dry wood is assumed as 0.5 t dry matter/m^3 and C content as 0.5 t/t dry matter. Emission factors for indirect GHG calculations are based on IPCC guidelines.

NO_x and CO emissions in the sector of land use change and forestry by respective years are presented in Table 3.4.

Table 3.4

NO_x and CO emissions in land use change and forestry sector in 1990, 1995-2000, Gg

Emissions	1990	1995	1996	1997	1998	1999	2000
NO_x	0.39	0.5	0.5	0.5	0.5	0.86	0.88
CO	14	17.50	17.50	17.50	17.50	31.82	32.45

As it is shown in the Table 3.4 indirect GHG emissions in 1999 and 2000 had dynamic growth, which is explained by increase of forest felling amounts and the consequent burning of wood residues.

3.5. Aggregated emissions of GHG

CO_2, CH_4 and N_2O may be expressed in the aggregated form in CO_2 equivalents, using their GWP values for the time horizon of 100 years (respectively, 1, 21 and 310).

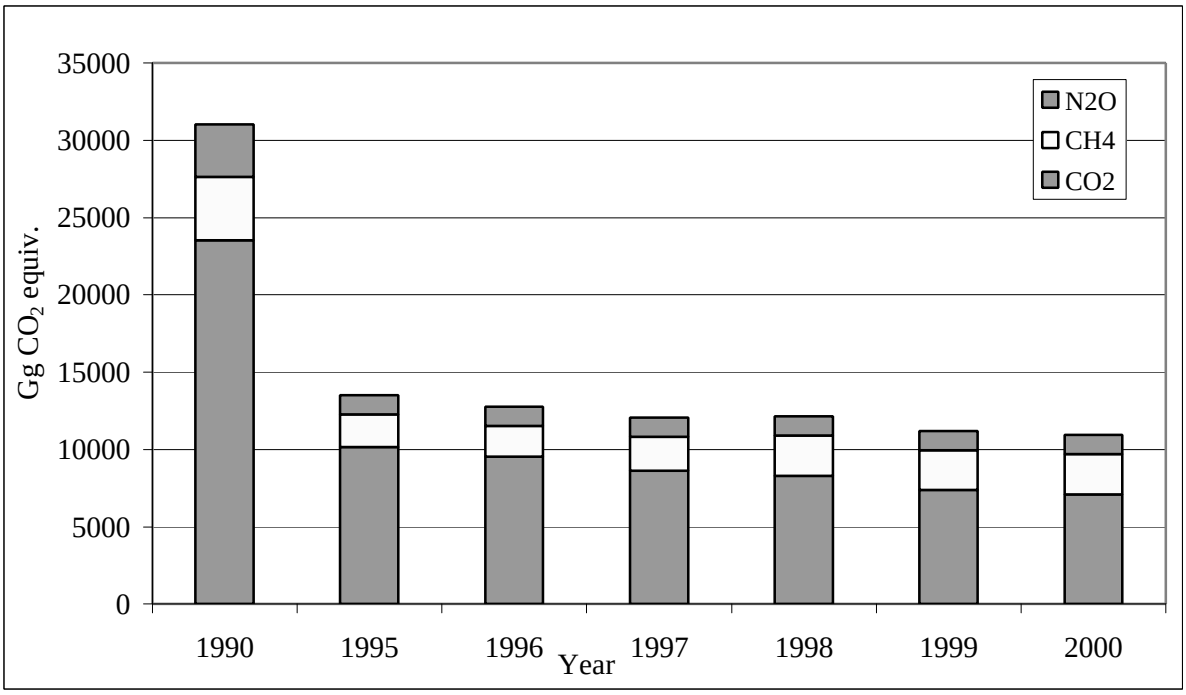


Figure 3.5. Aggregated emissions of GHG in 1990, 1995-2000

Figure 3.5 shows that aggregated emissions of GHG in 1999 have gone down by 16.8% compared to 1995. This is mainly attributed to reduction of CO_2 emissions (-27%). As a contrast, N_2O and CH_4 emissions have gone up by, respectively 7 and 28%. This means that the structure of direct GHG emissions has changed. If in 1995 CO_2 emissions constituted 75.8%, in 1999 they equalled to only 66.3% of total direct GHG emissions. At the same time the share of N_2O and CH_4 emissions has risen, respectively, from 8.6% till 11.05% and from 15.6% till 22.6%.

Table 3.5.

The share of sectors in aggregated emissions of GHG in 1990, 1995-2000 (%)[1]

Year	GHG emissions, Gg CO_2 equiv.	Energy	Transport	Industrial processes	Agriculture	Waste management
1990	31053.71*	59.1	20.3	1.8	17.2	1.6
1995	13434.35*	66.4	13.2	1	14.4	5
1996	12715.37*	65.4	13.4	1.5	14.6	5.1
1997	11986.66*	59.1	18.6	1.3	15	6
1998	12148.71	55.1	18.2	2	14.7	10
1999	11383.66	51.6	18.9	1.5	15.3	12.7
2000	10977.88	50.1	19.7	1	15.	13.3

* For the time period from 1990 till 1997 emissions are not re-calculated in CRF format, therefore there might be some discrepancies due to the round–up in the Annex 2

Looking at the GHG structure by sectors (Table 3.5) it can be concluded that in the period between 1995 and 1999 the share of energy sector has dropped by 14 percents with the increase of the share of transport and waste management sectors. Agricultural and industrial process emissions practically did not change their proportion.

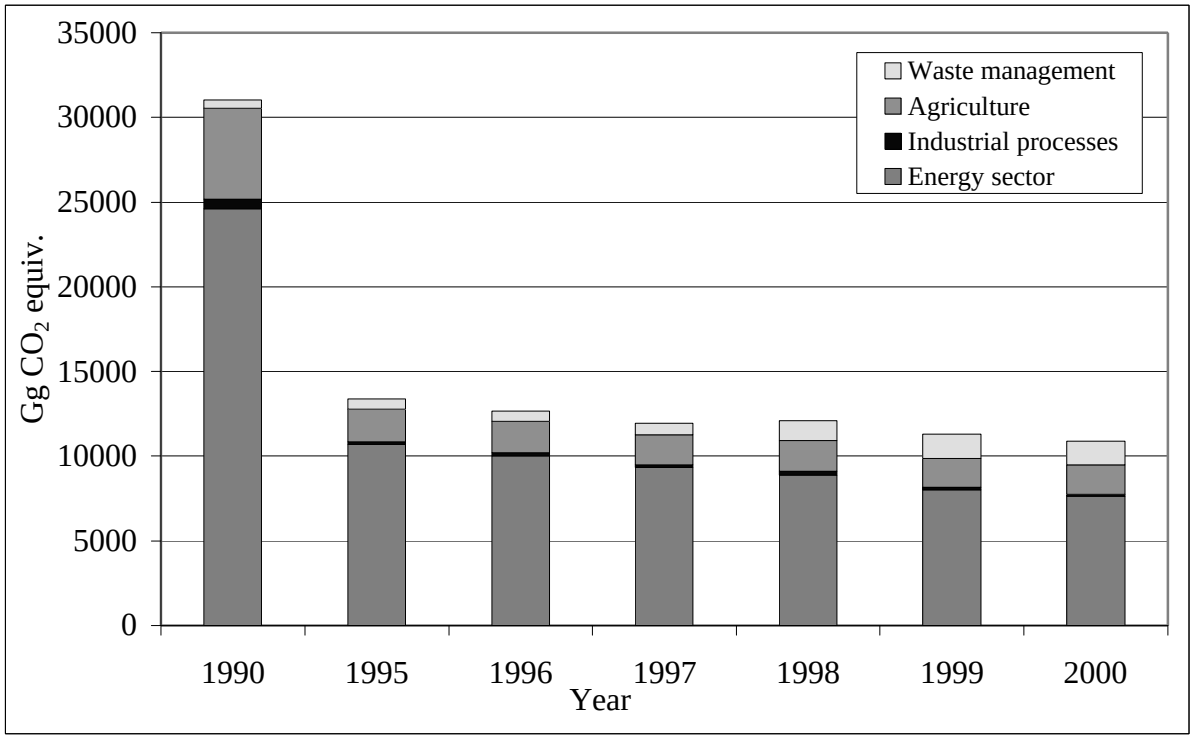


Figure 3.6. Share of sectors in aggregated GHG emissions in 1990, 1995-2000

Figure 3.6 shows that emissions from agriculture, industry and energy sectors are going down as a contrast to the waste management sector where emissions are growing. As mentioned before, this is explained by the fact that with the start of application of new emission factors in the waste management sector, emissions between 1998 and 2000 went up almost two times compared to 1995.

[1] Source: Latvian Environment Agency.

4. POLICIES AND MEASURES

4.1. Climate policy as a component of the sustainable development strategy of Latvia

Priorities of the policy of environment protection in Latvia are set forth in the Declaration on the Planned Action of the Cabinet of Ministers and implemented in the preparatory work for accession to the European Union.

The government of Latvia in the Declaration of the Planned Action has taken the commitment to continue work started by the previous governments. The goal is to accelerate the overall development of the country reaching the stage when improvement of macroeconomic indicators results in higher levels of welfare of each resident of Latvia.

To reach the goals established by the government in the area of environment protection, particular attention is devoted to investment projects in the area of: household waste, potable water and urban wastewater; elimination of hazardous waste and creation of the system of final disposal; promotion of the development of environmental projects and their implementation in the private sector; implementation of the integrated approach to pollution elimination and control; waste management and packaging; implementation of the National Program on Biological Diversity; further development of the monitoring system of environment protection in line with the respective EU provisions, development of environment education and environment communication program [17].

EU Accession Partnership 1999 in the area of environment sets priority tasks to complete transposition of environmental *acquis communautaire* in the following areas: directives on gas, waste, noise, water, chemical substances, nature protection, protection against radiation and main industrial risks [41].

Environment protection policy in Latvia is implemented by MEPRD. Environment Protection Policy Plan for Latvia (EPPP) was approved in 1995 forming the base for the Environment Protection Action Program (EPAP) and Investment Programs in the environmental sector.

The following economic tools are used by MEPRD to implement environment policy:

1. Natural resources tax.
2. Exemptions from the natural resources tax.
3. Latvian Environment Protection Fund investments.
4. Environmental Investment Fund investments [69].

Climate change problems, evidently, are not included in the list of environment protection priorities; nevertheless some individual measures of protection of air influence also GHG emissions. In 1997-1998 Climate Change Reduction Policy Plan was developed under the guidance of MEPRD for the first time and is being updated at the moment. Policy plan comprises goals and requirements of the UNFCCC Kyoto protocol, including, on elimination of GHG emissions in 2008-2012 till 92% of the 1990 level.

Questions related to climate change are addressed by MEPRD, Latvian Environment Agency, SHMB, Ministry of Economy, Ministry of Finance and Energy Department of the Latvian Development Agency (LDA ED) [41].

The most important, recently developed documents relating to the climate policy and sustainable development of Latvia are summarised in Annex 1.

4.2. International co-operation in the area of reduction of GHG emissions

Since the beginning of 1990s Latvia is taking active part in international environment protection and GHG emission reduction activities. Representatives of Latvia on a regular basis participate in work group meetings of the UN and UN Organisations, OECD, EU and European Commission bodies, world and European financial organisations, Baltic Environment Forum, informal EU organisations as well as international environment conventions. With the technical and/or financial support of these organisations Latvia implements projects directed at the development of the EU-compliant legislation and infrastructure improvement of specific economic sectors, increasing efficiency in energy generation and consumption sectors, reduction of waste, etc. Some international organisations, programs and most important international projects, which could influence the reduction of GHG emission in Latvia, are mentioned below (see also Annex 1).

Activities Implemented Jointly (AIJ)

Latvia has signed the Climate Convention, Kyoto Protocol of December 11, 1997. It foresees three mechanisms for GHG emission reduction of which two, in addition to attraction of additional financing, are applicable for Latvia. These mechanisms are joint implementation (JI) projects and emission trade. AIJ are the pilot phase of JI projects being one of the means of implementation of energy sector development programs in Latvia. Until now, joint projects with Sweden, Germany and Netherlands have been implemented covering following areas:

- Creation of new renewable energy sources using wind energy and biomass (16 projects);
- Rational use of environmentally adapted fuel in small capacity co-generation plants (2 projects);
- Raising efficiency in energy transmission by reconstructing centralised district heating networks (5 projects);
- Improvement of the final energy consumption efficiency by heat insulation of public buildings and introducing heat consumption regulation (4 projects).

The best joint implementation projects in Latvia are inter-sector projects in the area of energy, industry, and agriculture.

Monitoring of AIJ today in Latvia is fully carried out by countries donating money for implementation. The same problems, however, addressed by engineers and professors of Riga Technical University and an independent consulting company *Ekodoma* [10].

World Bank Prototype Carbon Fund (PCF)

World Bank PCF started its work in 2000. The Fund is financed by the member states and private enterprises. The goal of the Fund is, with the assistance of projects, to accumulate experience for introduction of mechanisms of the Kyoto climate policy. PCF is already operating and several projects have been accepted, including also Liepaja project in the use of biogas generated in the waste landfill (see Section 4.3.4.1).

Global Environment Facility (GEF)

GEF is an independent international financial institution. The UNDP, UNEP and the World Bank implement activities of GEF. Organization offers additional funding to such areas as preservation of biodiversity of different ecosystems, reduction of climate change, protection of international waters and ozone layer. GEF (Latvia has acceded to it in 1994) in Latvia provides partial funding to four projects mentioned below:

1. Modernisation project of Getlini waste landfill;

2. Efficient Lighting Program (ELI);
3. Regional Baltic wind energy program;
4. Project *Economically efficient use of wood waste in the local governments heating systems.*

EU Programs

There are several EU programs (PHARE, SAPARD and ISPA) that could provide financial resources to projects linked with climate change reduction in Latvia.

At present within the PHARE program EU co-operates with 14 partner states – Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Macedonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. This financial support is targeted at economic and political restructuring of the centralised system to assist countries in economic and political transition to get integrated both in the EU and the whole world. When ten of the former PHARE beneficiaries expressed their wish to join the EU, assistance priorities were slightly changed. Now they are more oriented towards improvement of administrative capacity of applicant countries to enable them implement EU legislation and develop infrastructure to come closer to the level of the EU member states. Latvia can benefit from this financial support since 1994.

Starting with 2000 till the day of accession EU PHARE program will be supplemented with two new support programs – SAPARD and ISPA. The aim of the programs is to improve economic situation in candidate countries and prepare potential member states for implementation of structural programs by developing administrative capacity and legislation. This support is envisaged till the day a candidate country joins the EU. After the accession the state will be eligible to benefit from support within the framework of the EU Structural Funds the same as other EU member states.

The aim of ISPA fund is to provide financial support to future member states in the sectors of transport and environment protection thus helping them to fulfil the requirements of the *acquis* in the area of environment protection.

Priority support areas of SAPARD fund are increase of market efficiency, activities of improvement of quality and health standards to promote creation of new jobs. SAPARD program, the same as funding from the Structural Funds, is based on the principle of complementary financing, which means that EU provides 75% of public support and the remaining 25% is given by a member state and a member state cannot reduce the level of previous expenditure for similar activities at the expense of the EU funding.

OPET network

Within the European Community OPET (*Organisation of Promotion of Energy Technologies*) program (1998–2002) activities of promotion of new technologies and dissemination of information both on renewable resources and rational energy have been accomplished and are still in progress. OPET network covers the whole Europe as well as countries of Asian, American and African continents.

PSO program

Since 1996 the co-operation between Latvian and Dutch enterprises is in progress within the scope of the Dutch government PSO (*Personnel Service Overseas*) program. At present four phases of PSO program have been already implemented in Latvia:

- 1st and 2nd phase was implemented as part off the first PSO program on the *Clean and Energy Efficient Technologies in Food Industry of Latvia* when co-operation between consultants of the two countries was established. Activities also covered work in food companies – developing business plans and installing new equipment.

- The next phase was implemented in Ludza by building a wood fuelled boiler house.
- The fourth phase of PSO program was aimed at efficiency and comfort rising in Ludza resulting in energy efficiency activities carried out in three buildings of Ludza town.

SCORE program in Latvia

SCORE program is the initiative of the government of Netherlands to solve energy conservation problems on the level of final users. The first three countries chosen for testing SCORE program concept were Latvia, Poland and Hungary. In Latvia the program was implemented between 1997 and 2000. SCORE program implementation from the side of the Netherlands was carried out by the Environment and Energy Agency of the Netherlands (NOVEM) and the partner in Latvia was *Vides projekti*. The latter worked at the development of activity strategy and preparation and implementation of concrete projects, as well as monitored results.

SCORE program was focussed on the following key directions:

- Selection and implementation of demonstration projects;
- Energy conservation campaign;
- Institutional activities (development of methodologies, creation of databases, etc.)

Danish Energy Agency

Danish Energy Agency since 1994 has been in charge of several assistance programs in the energy sector in the CEE countries, including also in Latvia. Until now, the Energy Sector Program in Latvia is directed at creation of the overall system and start of co-operation as well as at training and education on different levels both together with state institutions and organisations and private firms. Such projects will be continued. The new Energy Sector Program for 2001-2003 sets forth additional areas of support to:

1. Renewable energy resources;
2. Centralised heat supply and co-generation stations;
3. Energy saving with the final user [15].

Co-operation with the Swedish government

EAES Program (*Environmentally Adapted Energy Systems in Baltic States and Eastern European countries*) of the Swedish government implemented by the Swedish Energy Administration – STEM and started in the three Baltic States at the same time. The program was implemented as AIJ pilot phase. Various energy efficiency projects were implemented (boiler houses, heating networks and buildings) within the scope of the program. EAES implementation funding was shared as follows:

- Consulting services were covered from the Swedish government grant;
- Loans with low interest rates were used for technologies.

In the result of implementation of the Program Latvia acquired the experience of:

1) Development of technical and economic documentation of energy efficiency projects and their management set-up (~40 project applications);
2) Project implementation (loans were extended to 24 projects);
3) Expertise and monitoring of joint implementation projects;
4) New project applications.

4.3. Policies and measures to reduce GHG emissions

GHG emission mitigation in Latvia is not the primary goal of policies and measures but rather a side effect. This means that the Action Program for emission mitigation has not

yet been developed and adopted in Latvia.

The survey on the GHG emission reduction policies and main measures is given below. Policies and measures are grouped by sectors and, then, by each GHG. The presentation includes the title of each measure and a concise description of the present situation followed by the expected development as set forth in the relevant strategic documents or project scenarios. In addition, the presentation provides a quantitative or qualitative estimation of impacts of measures (changes in economic activity levels and/or GHG emissions/removals); brief description of the used estimation methodology. Information on measures pursuant to IPCC guidelines is summarised in Tables 4.5, 4.6, 4.7, 4.8 and 4.11.

4.3.1. Energy (1)

In 1999 energy sector generated approximately 70.3% of total GHG emissions in Latvia, of which 39.2% was contributed by energy generation and transmission, 14.5% – by manufacturing industry and construction, 26.8% – by transport, 14.9% – by other sectors (see Annex 2).

Pursuant to the government policy in the energy sector, the following measures related to climate change reduction are set as priorities:

- Raising energy efficiency and energy conservation;
- Use of renewable resources;
- Construction of new, ecologically acceptable power stations, including co-generation plants.

These problems are analysed in several recently developed programs and projects relating to energy supply and consumption. Furthermore, there are several laws, such as Law on Energy, Law on Natural Resources' Tax, Law on Excise Tax on Oil Products and other documents supporting solution of these problems (see Annex 1).

4.3.1.1. Policies and measures to reduce CO_2 emissions

In 1999 CO_2 emissions amounted to approximately 92.3% of all GHG emissions generated by the energy sector.

Energy generation and transmission (1A1)

Policy: Use of renewable resources in energy generation and transmission

Renewable energy resources in the energy balance of Latvia in 2000 equalled to 28.8%. Key measures to implement this policy in the context of reduction of climate change are presented below.

- ***Wider use of fuel wood for centralised district heating***

Description of the measure

Wood is the most significant local fuel in Latvia. Firewood produced from the cut round timber and partly also wood-waste are predominantly used for this purpose. Wood is used in centralised, local and individual heat generation. Levels of use of wood resources in Latvia at the moment are nearly exhausting for the potential of wood resources (47.7 PJ/year) exceeding the recommended amounts (37.9 PJ/year). Due to unfavourable economic conditions for wood suppliers at the moment, it is not possible to ensure the complete utilisation of wood-waste for the purposes of heat production [6]. The share of wood-waste in the total balance of primary energy resources of Latvia in 2000 was 22.2 %.

Objectives

Wood will retain its important position in the fuel balance of Latvia. However, if the amount of used firewood is not reduced and the amount of less effective wood, wood-waste and chips is not increased and, furthermore, if more efficient boiler equipment with higher coefficient of efficiency is not used – all this will support the reduction of overall wood resources in Latvia.

GHG affected

Wood fuelled boiler houses are less polluting than heavy fuel oil or coal fuelled boiler equipment. Main emissions coming from wood fuelled boilers are NO_x and CO, whereas CO_2 emissions are estimated as 0. Due to this reason, use of fire wood and wood-waste presents positive effects for the environment [28].

Type

Fuel switching projects (with the use of wood) are economically, ecologically and also socio-economically justified.

Status

First projects of modern technology, wood chip fuelled boiler installation in Latvia were implemented in 1993 in Malpils (gift of the Danish government) and in Balvi (within the EAES program of the Swedish government). The data from the CSB verify that now there are 126 wood-fuelled boiler houses in Latvia.

Implementing entity

Local governments.

Funding

14 projects funded from the low interest rate loans (5...8%) within the Swedish government EAES program. At present, such projects are continued with the support of the PIP, loans of the Nordic Investment Bank and Energy Efficiency Fund, etc.

- ***Renewal of small HPS***

Description of the measure

Since the beginning of 1990s an intensive reconstruction of regionally important small HPS is going on in Latvia as well as manufacturing of equipment of small HPS. At the end of the first six months of 2001 total installed capacity of small HPS was 3.9 MW. The amount of energy generated in small HPS in 2000 was 0.43% from total electrical power generation in Latvia [78]. The total unused potential of small HPS at the moment is estimated as 0.18 PJ.

According to the data of state JSC LATVENERGO, at present there are 89 operating small HPS and their number in the next few years might exceed one hundred (see Table 4.1).

Table 4.1.

Number of independent HPS in Latvia per year[1]

Year	**Number**	**Total capacity, kW**
1995	6	1447
1996	9	1175
1997	5	367
1998	14	1347
1999	20	1552
2000	18	2690
2001 (January-May)	17	3114
Total	89	11692
HPS applied for construction	74	18819

[1] HPS which do not belong to JSC LATVENERGO

Objective

Increase the specific weight of renewable resources in total energy balance.

GHG affected

Use of hydro energy potential providing opportunity for energy generation gives 0 GHG emission.

Type

Legislation stipulates support to small HPS with the capacity of less than 2 MW, which started operations before January 1, 2003. Excess energy produced in such plants should be bought at a double tariff.

Status

At present in Latvia there are 89 independent HPS.

Implementing entity

Joint stock companies.

Funding

Loans of commercial banks and equity of joint stock companies.

- ***Use of wind energy***

Description of the measure

Since the beginning of 1990s use of wind energy in Latvia has been restored, based on international know-how and relevant technologies. At the moment wind energy in Latvia is used in small quantities and according to the electricity balance of Latvia in 2000 equalled to only 0.07%[2]. Experts consider that theoretical potential of wind in Latvia varies in the range of 0.6-4.6 PJ [6]. However, in the part of the territory where it is technically possible to install wind farms there are various laws limiting business activity in force and therefore theoretical potential is estimated to go down by ~20% [6].

Till 2000 the biggest wind farms in Latvia were 2 Ainaži wind farms with the total installed capacity of turbines equalling to 1.2 MW, Ventspils region Užava wind farm with the capacity of 1 MW and a/s "Kursa" wind generator in Kurzeme region with the capacity of 150 kW, as well as 10 smaller wind farms [6]. Additional 13 enterprises were issued licences for the construction of wind farms with the capacity of over 1MW till the end of 2002. Their total projected capacity will reach 24.3 MW[3].

With the GEF funding, UNDP in 1999 started the project "Regional Baltic Wind Energy Program" which is the latest and most extensive study of the potential of wind energy in Latvia. Surveys on the situation with wind energy and analysis of wind energy use opportunities from the political, economic, legislative, meteorological, energy, environment protection and regional aspect are carried out during the project. Measurements of wind parameters in selected locations are made.

Objective

Increase the specific weight of renewable resources in total energy balance.

GHG affected

Use of wind energy generates 0 GHG emissions.

Type

Construction of wind farms is socio-economically and ecologically justified.

Status

Ainaži wind farms were installed in 1995. Užava and Kursa wind farms – in 1999. Construction of other wind farms is in the progress.

[2] Source: LDA ED

[3] Source: ERC

Implementing entity

Ainaži wind farms were built by the state JSC LATVENERGO; other joint stock companies rebuilt remaining farms.

Funding

Ainaži wind farms were subsidised by the German Federal government (60%) and LATVENERGO (40%). Loans extended by the Environmental Investment Fund were used to construct Užava wind farm. Loans or equity of joint stock companies are used in other projects.

- ***Bio diesel fuel as a internal combustion fuel in small scale co-generation plants (and/or transport)***

Description of the measure

Although bio diesel fuel in Latvia is not yet used, already now there is quite successful production of rapeseed and rapeseed oil in the countryside of Latvia. Taking into consideration the forecasted growth of areas under rapeseed there is a good reason to forecast that growth rates of production of bio diesel fuel could meet the following levels: 20.9 thous.t in 2002, 31.4 thous.t – in 2005, and, respectively, 60.7 thous.t in 2010. Experts predict that the support of the government of Latvia will be necessary to develop this sector and to ensure that bio diesel can compete with prices of fossil fuels [8]. Bio diesel fuel may be used in place of diesel fuel by transport and/or in small-scale co-generation plants [24].

Company SIA "Delta – Riga" in Valmiera region Naukšeni municipality is planning to start production of bio diesel fuel from rapeseed oil and alcohol. The company is planning in the first year of operation to produce 2 500 tons of fuel by processing 7 500 tons of rapeseed.

Objective

Production and use of bio fuel in Latvia till 2010 is prescribed in the National Program On Production and Use of Bio fuel in Latvia. One of the key priorities in this program is to organise bio diesel fuel production for diesel engine application, which should equal to 40% of total diesel fuel used in agriculture.

GHG affected

Main advantages of the use of bio diesel fuel are zero CO_2 emissions and small environment pollution with sulphur oxides compared to if fossil diesel fuels were used.

Type

A socio-economical project because it is assumed that bio diesel fuel production in Latvia will have a favourable impact on agriculture and that it will create new jobs.

Status

According to plans, the project in Naukšeni will be launched already in autumn 2001.

Implementing entity

Implementing entity of the project is SIA "Delta – Riga".

Funding

Project is fully financed by SIA "Delta – Riga".

Policy: To increase efficiency in the energy generation and transmission sector

Key measures to implement this policy in the context of climate change reduction are mentioned below.

Only a few measures will be mentioned to illustrate process of efficient increase in the energy generation and transmission process in Latvia. These are: district heating project in Riga and projects implemented by 13 local governments of Latvia.

- ***Wider use of co-generation***

Description of the measure

CHP plants combine producing heat and power at the same time. Thus, fuel is used much more efficiently (20-30% more efficiently than producing separately heat or electricity), which allows solving ecological problems in the cities by closing small, inefficient and treatment – unequipped boiler houses of district heating [37].

With the rise of prices of energy resources, conversion of small and medium capacity (above 10MW) boiler houses into CHP in cities is economically justified especially in places with sufficient concentration of heat load and developed district heating. CHPs of 14 companies with different capacities have been installed in Latvia. Licences for construction of CHPs are issued to another 7 companies. Judging from the interest of businesses to apply for a licence to build a CHP it is expected that in future the number of CHPs might go up[4]. Table 4.2 contains data on heat energy produced in CHPs.

Table 4.2

Heat energy produced by co-generation

Year	**Total produced heat energy, toe**	**Heat energy produced by co-generation, toe**	**% of total produced by co-generation**
1996	1312.4	419.7	31.98
1997	1111.8	391.0	35.17
1998	1024.1	342.3	33.42
1999	864.6	331.6	38.35
2000	761.3	285.1	37.45

Sources: CSB

Objective

More efficient use of fuel that simultaneously generates heat and electricity.

GHG affected

Mostly CO_2 emissions are reduced.

Type

Economically and socio-economically justified projects.

Status

5 small and medium capacity co-generation plants (under 5MW) were built in the last three years in Gulbene, Bauska, Jekabpils, Ogre and Riga.

Implementing entity

Local governments and energy service companies (ESCO).

Funding

Provided by Commercial bank loans and resources that implement entity.

Box 1. Methodology used

Regression analysis of electricity and heat energy generation and import data was accomplished with consideration of types of fuel, their consumption and efficiency of sources. Methodology used for estimations is described in expert conclusion on the pilot phase of the joint implementation project in two small-scale co-generation plants (in Adaži and Lielvarde). This allows estimating emission values for the base scenario, which is accepted as a reference point.

[4] Source: ERC

- ***Riga district heating rehabilitation project***

Description of the measure

The World Bank and Swedish International Development Agency (SIDA) in 1997 accepted the proposal of the Latvian party to support priority improvements in Riga district heating system. This resulted in signing the agreement with SIDA and a Swedish consulting company "FVB" on the development of Riga district heating rehabilitation project.

Riga district heating rehabilitation project envisages increasing efficiency of fuel use, reducing hazardous emissions including also GHG and lowering of operational costs. Rehabilitation program includes also liquidation of centralised heating nodes and construction of modern individual heating nodes in the buildings as well as partial replacement of heat networks [28]. 2 projects are discussed in greater detail below:

1) Increase of efficiency of boiler houses;
2) Improvements of operation of the energy supply system[5].

Project No.1 description

At present a/s "Rigas Siltums" operates in 40 hard fuel boiler houses of Riga municipality. Coefficient of efficiency of these boiler houses is approximately 50%; therefore 9 of them will be connected to the centralised district heating and the remaining will be switched for gas to increase heat energy generation efficiency. Use of gas fuel will allow raising efficiency by 10% and will also result in less hazardous emissions.

Project objective

To reduce GHG emissions from local boiler houses and install environmentally friendly energy technologies.

GHG affected

Implementation of this project will allow reducing CO_2 emissions.

Type

Economical and ecological type.

Status

Project was started in 1999 and it is planned for completion in 2002.

Implementing entity

A/S "Rigas Siltums".

Funding

Bank loan.

Project No.2 description

A/S "Rigas Siltums" carried out activities to improve operation of the energy supply system paying a lot of attention to reducing heat losses in heat transmission. Since 1996 the total of 125 km of heat networks have been exchanged including 37 km built with a non-channel technology using industrially insulated pipes equipped with a special signalling system, which allows to quickly and accurately detect the faulty place in the system and reduce leakage of the heat carrier. Installation of heat energy meters was completed in Riga in 1997 and now new, automated individual heating nodes in every building are installed allowing saving 10-15% of heat energy (it is planned to install modern heating nodes in all buildings in Riga by the year 2005).

Project objective

To raise energy efficiency of Riga heat supply system.

[5] Source: a/s "Rigas Siltums"

GHG affected

Implementation of this project will allow reducing CO_2 emission. The planned reduction of heat losses during 5 years after implementation of all aforementioned activities is estimated as 359 160 MWh.

Type

Economical.

Status

Project was started in 1997 and was planned to complete in 2005.

Implementing entity

A/S "Rigas Siltums".

Funding

Bank loan and a/s "Rigas Siltums" net revenues.

- ***Projects of the Local Governments' Crediting Fund***

Description of the measure

Situation in the local governments of Latvia remains rather complicated. Lately, the most entrepreneurial local governments have already implemented several measures of increasing efficiency in the municipal heat companies to reduce both loses in the heat transmission networks and buildings and fuel consumption or have replaced the type of fuel and passed over to a more environmentally friendly fuel. Losses in heat pipelines in some places reach even 30%, and some municipalities use coal as the main type of fuel burnt in equipment with low efficiency, besides being one of the most harmful fuels.

Local Governments' Crediting Fund was established by the instruction of the Ministry of Economy to manage loans issued to 34 municipal projects, of which 13 were linked with the energy sector. Since all the projects have been implemented the Local Governments' Crediting Fund has terminated its work and is liquidated.

Project objective

One of the key objectives of energy projects was to improve work of heat supply system and in some projects also to carry out effective heat insulation of buildings and radical reduction of energy consumption.

GHG affected

CO_2 emission reduction achieved in 13 projects is 22.9 Gg CO_2 equiv.

Estimation is based on the difference in CO_2 emissions before and after project implementation. Base scenario was estimated according to the data of local governments on fuel consumption and efficiency indices in the pre-implementation phase. In the post-implementation phase energy wood with zero CO_2 emissions was used in the majority of projects. In some cases CO_2 emission reduction was estimated using fuel after reconstruction.

Type

Projects are economically and socio-economically justified.

Status

Projects were implemented between 1997 and 2000.

Implementing entity

Local governments.

Funding

Loans extended by the World Bank.

Manufacturing industry and construction (1A2)

Policy: To improve efficiency of use of energy resources in industry

The key activities presented below are related to implementation of the policy in the context of climate change prevention. The examples of increase of energy efficiency in the

manufacturing industry sector are demonstrated with projects in dairy companies and bakeries.

- ***Increasing energy efficiency in dairy companies of Latvia***

Description of the measure

Audit of the consumption of energy resources in Latvian dairy enterprises carried out in 1996 and 1997 within the Dutch government program "*Clean Technologies and Energy Conservation in Latvian Food Industry"* provided information on the current situation in these enterprises. Energy in dairy companies is mostly used for technological needs as well as for heat and hot water production. It was estimated that energy intensity indicator (energy consumption per one unit of produced product) was 1.4 GJ/t, which is three times higher than the respective indicator in Denmark – 0.5 GJ/t. Main reasons for this is inadequate energy management and outdated low efficiency technological equipment.

Four Latvian milk-processing enterprises were chosen as a target group for the analysis. Each of them had a boiler house where heavy fuel oil was burnt. It was assumed that starting with 2000 energy consumption per one unit of production annually would go down by 3% [24].

Objective

To evaluate measures of energy efficiency in the dairy sector, the pilot project in the dairy enterprise a/s "*Limbažu piens*" was selected knowing that rising of energy efficiency in dairy enterprise is a mandatory pre-condition for retaining competitiveness of Latvian products in the EU market.

GHG affected

During the project its was concluded that the measure would have rather high GHG emission reduction costs and cumulative emission reduction between 2000 and 2020 would be 92 CO_2 equiv.

Methodology used (see Box 2)

Type

Economically justified projects as they provide the opportunity to increase competitiveness of enterprises.

Status

The measure was implemented in 1996 and 1997. At the moment other dairy companies also are implementing similar projects.

Implementing entity

Project implementers are Latvian and Dutch experts who performed energy audit within the scope of the Dutch government program *"Clean Technologies and Energy Conservation Latvian Food Industry"*. At the moment energy efficiency projects are implemented by enterprises.

Funding

The commercial bank credit and the donation of the Dutch government funded project in *Limbažu Piens*. Further projects are funded by loans of commercial banks and private capital of investors.

Box 2. Methodology used

A detailed bottom-up evaluation of individual technological processes was done. Opinion of experts was used as an instrument of analysis. The methodology described in "The Economics of Greenhouse Gas Limitation. Technical Guidelines" was used for the purposes of calculation. The methodology involves also estimation of costs and benefits of implementation of concrete technological processes. It also allows estimating annual GHG emissions from each activity in the time period from 2000 till 2020, cumulative emission

values for the years 2000, 2005, 2010, 2015 and 2020 as well as respective direct costs. Estimated results are compared with the respective values in the base scenario without considering possible interaction of all analysed measures.

- ***Energy efficiency increase in bakeries of Latvia***

Description of the measure

In Latvia there are 90 different operating bread production enterprises with high-energy consumption per one unit of production. This is linked with the fact that enterprises use old-fashioned technologies, narrowing of outputs and underestimated attention paid to energy management. Energy audits in 12 bakeries were carried out in co-operation with Dutch and Danish specialists who suggested starting putting in order energy management systems in these enterprises. The following energy efficiency measures were carried out in bakeries:

1) Company energy management systems established;
2) Baking ovens replaced;
3) Equipment for improvement of energy efficiency in the technological process was installed;
4) Boiler houses reconstructed;
5) Losses from pipelines, ovens and buildings reduced.

Objective

To raise competitiveness of bakeries by decreasing energy intensity per one unit of production.

GHG affected

Implementation of various energy efficiency measures resulted in small reduction of CO_2, NO_x and CO in bakeries.

Types

Economical projects, as reduction of energy consumption allows saving costs.

Status

Projects are continued. First measures were implemented in 1997 (Ventspils bakery) and in 1998 (Jelgava bakery). Tukums bakery will get a loan in 2001.

Implementing entity

Projects were started within the framework of the Dutch government PSO program and Danish Energy Agency program. At present, bakeries continue implementing ideas developed in the two projects and finance this work by them.

Funding

Commercial bank loans. Resources of Environmental Investment Fund, Energy Efficiency Fund and others.

Policy: To increase efficiency of use of energy resources in construction

The problems of raising energy efficiency in buildings have become the task of the national scale in Latvia. In order to solve the problem it is necessary to develop regulations linked with energy audit and certification of buildings, heat energy metering, heat technologies in buildings, etc.

Energy efficiency in Latvia, the same as in other CEE countries is 2-5 times lower than in the EU member states. In Latvia ~70% of the generated heat is used in residential houses and public buildings. Energy consumption in household sector between 1990 and 1995 has even slightly gone up and now households are the biggest final users of energy. Western experience shows that up to 70% of the total energy efficiency potential may reach

the level of final users. Therefore one of the best possibilities to reduce GHG emissions in Latvia is to improve energy efficiency in residential houses and public buildings[6].

Key measures for implementation of this policy in the context of climate change reduction are presented below.

- ***Heat efficiency improvement program in buildings***

Description of the measure

National Program on Construction is a set of activities to be accomplished by the government in the area of construction. Implementation of these activities is essential for the development of Latvian economy and they refer to construction of residential and public houses and production of building materials. One of the sub-programs included in the Program is *Improvement of Heat Efficiency in Buildings*. It includes characterisation of the existing situation, more accurate specification of opportunities to save energy resources in buildings, including public buildings and residential houses, analyses the necessary financial resources for raising energy efficiency in buildings and pay-off period of the investment.

Objective

The objective of the program *Improvement of Heat Efficiency in Buildings* is to analyse the existing general situation in the state in the area of heat retention, provide information on efficiency of heat insulation and heating opportunities and on activities of optimisation.

GHG affected

Heat insulation of public building of the central and local governments will allow to save heat energy of 2048 GWh/year, substantially bring down heating costs which will result in saving of costs in the budgets of central and local governments in the amount of ~35 mill.LVL per year already in the seventh year after heat insulation[7].

Type

The Program is an informative, research and educational document that might be used to perform regulatory functions aimed at reduction of heat energy consumption.

Status

It is planned to submit the Program to the Cabinet of Ministers in the fourth quarter of 2001 as a sub-program of the National Program on Construction.

Implementing entity

Construction department of MEPRD, Energy Department of the Ministry of Economy, local governments and private persons.

Funding

State budget resources earmarked for the development of normative acts [8].

- ***Reduction of heat losses in buildings***

There are several projects aimed at raising energy efficiency in buildings implemented recently in Latvia. The most important of them are:

1) Educational System Development Project funded by the World Bank;
2) Demonstration projects of SCORE program;
3) Demonstration projects aimed at improvement of energy efficiency implemented within the STEM program of the Swedish government;
4) Pilot project of PSO Program on Energy Efficiency in Buildings of Latvia.

[6] Source: MEPRD Construction Department, PPI
[7] Source: MEPRD Construction Department
[8] Source: MEPRD Construction Department

Description of **Project No.1**

Education System Development Project funded by the World Bank allows starting significant changes in the area of education in Latvia by carrying out renovation and energy efficiency increase activities in 116 educational establishments of Latvia. The project was initiated knowing that costs of heating and lighting of school buildings in Latvia per one resident is more than two times higher than in the EU member states with similar climatic conditions. Project is divided in 4 phases and the first phase has been finalised in 2001.

Objective

Objective of the project is to launch important changes in the educational sector by increasing cost efficiency in the first 116 educational establishments.

GHG affected

The expert of the Educational System Development Program has estimated that in the event of implementation of 25 sub-projects of the first phase the forecasted CO_2 emission reduction according to calculation assumptions will reach 186.58 Gg CO_2 equiv. There are no projections made in regard to the impact of other sub-projects on GHG emissions.

Type

Economical.

Status

The projected project implementation time is from 1999 till 2003.

Implementing entity

The Ministry of Education and Science developed project implementation plan. The local governments in charge of the respective educational establishment implement projects.

Funding

World Bank loan and resources of local governments.

Description of **Project No.2**

Increase of energy efficiency is to be achieved on three levels: energy generation, transmission and distribution. SCORE program is oriented towards solution of energy efficiency problems on the level of final consumers. Taking into consideration the structure of energy consumption in Latvia, the final user is a very important stage of improvement of energy efficiency.

SCORE program in co-operation with the Construction Department of MEPRD selected 8 energy efficiency improvement demonstration projects in schools, residential houses and production enterprises. After accomplishment of all the work there is a considerable improvement of comfort in all the premises.

Objective

The objective of the SCORE program is focussed on the solution of energy conservation problems on the level of consumers. It is aimed, with the help of demonstration projects, to show economic and technical utility of such measures and to encourage implementation of such projects also in future.

GHG affected

Project implementation resulted in smaller heat losses. Heat consumption and the amount of used fuel were also reduced, however the impact of the measure on GHG was not estimated.

Type

Economic and informative.

Status

SCORE program started to work in Latvia in 1997 and was completed on June 30, 2000.

Implementing entity

Implementers of demonstration projects were owners of buildings. Municipalities developed energy efficiency improvement plans of local government.

Funding

From the side of the Netherlands SCORE program, implementation was supported by NOVEM and the donation in the amount of 1/3 of project costs. Each project was given maximum 15 000 LVL. Project implementers financed the remaining part.

Description of **Project No.3**

Three energy efficiency improvement demonstration projects of public buildings were implemented within the scope of the Swedish government STEM program [3]. After surveying the houses and making engineering and economic calculations, such activities as heat insulation of roofs, installation of water-water heat exchangers, building of heating nodes, window packing, door reconstruction, etc. were accomplished.

Objective

To demonstrate opportunities for improvement of energy efficiency in public buildings in Latvia.

GHG affected

Estimated reduction of energy consumption is approximately 40% per year, potential reduction of CO_2 emission – approximately 360 t/year.

Type

Economical.

Status

Project was started in 1995 and completed in 1998.

Implementing entity

Saldus and Jelgava local governments.

Funding

Commercial bank loans with lower interest.

Description of **Project No.4**

A pilot project in Ludza was implemented within the framework of the Dutch government PSO program on *Energy Efficiency in Buildings in Latvia*. The pilot project demonstrated activities to be accomplished when implementing similar projects.

The pilot project comprised energy efficiency raising activities in buildings of Ludza town implemented in two apartment residential houses and the building of Ludza gymnasium (school).

Experience and conclusions derived during implementation of the pilot project will prevent shortcomings and mistakes in future projects related to energy efficiency when they are repeated in similar buildings. This project marked steps and ideas for implementation of the energy efficiency measures' model in Latvia [19].

Objective

The objective of the PSO program is to improve energy efficiency in buildings and to reduce the amount of environmentally harmful emissions by decreasing energy consumption [19].

GHG affected

Heat losses were reduced in the result of the implemented energy efficiency projects. Heat consumption and the amount of fuel used were also reduced. However, the impact of the measure on GHG was not assessed.

Type

Economical, informative, social.

Status

Project was started in September 1999 and finished in December 2000.

Implementing entity

The program was headed by the Dutch enterprise TEBODIN, with participation of Ludza municipality, Dutch and Latvian consultants.

Funding

PSO program donation and bank loans. World Bank loan and municipal resources were used for measures in the gymnasium.

Transport (1A3)

Key goals and development objectives in the transport sector are stipulated in various political documents, such as the National Program on Transport Development, law "On Excise Tax", Public Program on the Development of Cycling and other documents (see Annex 1).

The National Program on Transport Development contains the following main objectives aimed at GHG emission reduction:

- Perfection of the public transport network and interconnection of different types of public transport;
- Creation of environmentally friendly system of public transport and improvement of haulage of hazardous waste;
- Development of transport legislation – harmonised with the EU standards and perfection of the system of institutional regulations.

The most important activities of CO_2 emission mitigation in the transport sector are presented below. Two measures – improvement of the public transport system in Riga and development of cycling transport were chosen as examples to illustrate the general approach.

Policy: To restrict use of passenger cars in towns and cities

- ***Improvement of the public transport system in Riga***

Description of the measure

The number of transport vehicles in the streets of Riga is going up at a fast rate. In the last decade the number of registered cars goes up in the average by 7-9% every year. Moreover, the number of parked cars on the sides of the streets goes up as well, thus considerably reducing throughput capacity of streets in the downtown area. This results in higher levels of pollution created by transport. Riga Traffic Concept for 1999-2003 approved and developed by the Riga City Council in 1999 is one of the most important documents aimed at improvement of traffic situation.

Public transport fleet was practically not restored in 1990-1995. At present approximately one third of all busses have been changed. New buses driving in Riga after August 2001 will be equipped with EURO 3 standard-compliant engines, despite the fact that the measure was planned for implementation in Latvia starting from 2003.

In the majority of downtown streets it is either prohibited to park cars or there are commercial parking lots where parking is harmonised with the demand. The number of cars searching for a parking place in the centre of the city has been considerable reduced and there are increasingly more drivers leaving their cars outside the city centre zone and going by public transport.

Objective

One of the objectives of Riga Traffic Concept is to provide city passengers a comfortable, safe and integrated public transport system identifying public transport as a priority in comparison with other transport vehicles in the downtown area streets of the city. At the same time, public transport should be competitive with passenger cars, which is

possible with the adequate quality of service – speed, safety, regularity and comfort. Public transport should also be environmentally friendly [57].

GHG affected

Development of the public transport network in the city will result in the 15-20% reduction of CO, CO_2, nitric oxides and volatile hydrogen emissions in the central part of the city. Introduction of higher-class busses will also reduce NO_x emissions.

Type

Informative, socio-economic measure as comfort levels will grow.

Status

The measure has been started.

Implementing entity

Riga Council.

Funding

Riga Council, EU projects and credits, bilateral co-operation agreements.

- ***Development of cycling***

Description of the measure

The share of cycling on the total system of transport today is very small. Cycling is basically means of recreation and sport. Moreover, with the present flow of traffic in the streets, cycling is seriously endangered from the point of view of safety. No new cycling transport infrastructure elements were built in the last decade. The only cycling track Imanta–Jurmala is still being used but not regularly maintained.

In 2000 Ministry of Transport approved the *State Program on the Development of Cycling Transport*, thus creating the foundation for the development of cycling as an alternative means of transport. The cycling development concept for Riga has also been developed forming a separate chapter in Riga Traffic Concept directly linked with the Riga City Development Plan and Environmental Strategy of the Riga Council.

The first pilot project of a cycling track Imanta–Vanšu bridge (Old Riga) is being implemented in Riga.

Objective

Main objective of the *State Program on the Development of Cycling* is to include cycling transport in the general system of Riga transport and to convert cycling into a sustainable, equal to all other transports, safe and environmentally and human health friendly transport [68].

GHG affected

With the development of cycling the number of people using motor transport to get to their workplaces in the centre of the city would go down resulting, respectively, in lower level of exhaust gas emissions created by road transport. It is forecasted that automobile-created exhaust gas emissions in Riga in the result of this measure will go down by 5-8%[9].

Type

Economical and informative.

Status

The first pilot project is already in the implementation phase and will be transferred over for use in September 2001. The new bicycle tracks are planned in the following routes: Centre–Open-Air museum, Centre–Mežaparks. The joint project with the Danish Ministry of Transport on creation of the cycling route in the central part of the city has been prepared. This is a two-year project planned for completion in 2002.

[9] Source: Riga Council

Implementing entity

Riga Council.

Funding

Riga Council, Danish Ministry of Transport.

4.3.1.2. Policies and measures to reduce the rest of GHG emissions

The main policies and measures to reduce CO_2 emissions have been described in section 4.3.1.1. due to the fact that CO_2 emissions compose more than 90% of all emissions in energy sector. Policies and measures to reduce the rest of GHG – CH_4, N_2O, CO, NO_x and NMVOC – are codified below.

Key measures to implement the policies in the context of reduction of climate change in the transport sector and in the sector of leakage of volatile substances from fuels are presented below.

Transport (1A3)

In this section are shown different measures, which mainly are implemented with the aim to reduce CO, NO_x and NMVOC emissions. Few of the measures are tended to reduce as well CO_2 emission but in these cases that is not the primary aim. Description of measures to reduce CO_2 emission is given in section 4.3.1.1.

Policy: To implement technological measures for CO_2 emission reduction

- ***Use of bio fuel by road transport***

Description of the measure

Latol (mix of gasoline and ethyl alcohol in proportion of 95:5) was used in Latvia already in 1930s and some experiments are in the progress also today. Production and use of latol in Latvia till 2010 is carried out according to the National Program *Production and Use of Biofuel in Latvia* [8].

The government has supported state guarantee for credit to SIA "Jaunpagasts Plus" for the project *Complex Processing of Grain into Fuel and Food-Grade Ethyl Alcohol* implementation carried out in co-operation with the US company "Katzen International, Inc."

Building of a bio-ethanol production facility would support the development of grain production. The plant would need approximately 107 000 tons of grain per year. Additional 32 000 hectares of land would be tilled. The plant would also produce a side product – 31 000 tons of high quality animal feed. The state has also stipulated some exemptions: starting with January 1, 2003 gasoline with the addition of ethanol will be taxed at a smaller tax rate than just gasoline without ethanol. Production of fuel ethanol in Latvia is energetically cost-efficient.

Objective

The objective of the project is to develop production of bio fuel in Latvia by building ethyl alcohol plant with the capacity of 41 million l per year, of which 29.4 million l will be fuel ethanol and 12 million l – food-grade ethanol. This will leave a positive impact on agriculture and the overall economic development of Latvia and will improve ecological situation in the state.

GHG affected

The National Laboratory of the US Energy Department in 1977 concluded that the use of ethanol reduced GHG emissions by 33-46% in comparison with the traditional gasoline. The US Association of the Renewable Fuel indicates that use of ethanol in transport fuels reduce emissions of toxic substances: CO – by 25%, VOC by 12%, NO_x – by 3% [8].

Type

Economical and socio-economical type for the enterprise and the related sectors will create approximately 6 000 – 7 000 new jobs.

Status

It is planned that the new plant might start operating in 2003.

Implementing entity

Implementing entity is SIA "Jaunpagasts Plus" in co-operation with the US enterprise "Katzen International, Inc.".

Funding

It is not yet clear will the project benefit from the state guarantee to the credit equalling to 80% of total amount. The remaining part will be paid by SIA "Jaunpagasts Plus" from company resources and from different funds (PHARE, SAPARD etc.).

Policy: Stricter control of the technical condition of transport vehicles

- ***Construction of technical check-up stations***

Description of the measure

In Latvia, at present, there is a lot of road traffic vehicles with a rather high average age. Build-up and technical condition of these vehicles require regular and reinforced inspection. New system of evaluation of technical condition of transport vehicles was introduced in 1995 substantially reducing the presence of transport vehicles of inadequate technical condition in the general traffic [12].

Technical standards compliant with the EU regulations will be introduced in Latvia. However, taking into account the specificity of structure and wear of Latvian road vehicle fleet and the existing fuel standards, implementation of all EU directives could essentially hinder functioning and development of national economy. Therefore, introduction of EU technical requirements will take place on a step-by-step basis respecting differentiated transition phases. Regulations of emissions from second-hand vehicles at the moment differ very slightly from the provisions of the EU directives. Smoke index of diesel engines till the end of 2001 is allowed to be by 0.5 higher than the one adopted in the EU as all transport vehicle check-up points were equipped with smoke meters only during the last two years and complete implementation of the EU requirements would have resulted in too rapid transition. Due to lack of compliance with the fuel standards to the EU standards, the catalyst-equipped vehicle owners till the final co-ordination of standards are issued a warning if exhaust gases do not correspond to the EU requirements for automobiles with catalysts and norms for automobiles without catalysts are applied.

At present in Latvia there are 30 transport vehicle technical check-up points (stations) equipped with gas control systems to check both spark ignition and compression ignition engine exhaust gases.

In line with the provisions of the Directive 2000/30/EC of the European Parliament and European Council on the "Technical roadside inspection of the roadworthiness of commercial vehicles circulating in the Community", starting with 2003 it is planned to introduce in Latvia inspection of technical condition of transport vehicles, including also control of exhaust gases, on the roads.

Objective

Improvement of quality of control on technical conditions of automobiles by constructing technical check-up stations [63].

GHG affected.

Impact of the technical control of transport vehicles on the environment has not been assessed. Experts have passed the following evaluation: reinforcement of control has lowered fuel consumption and, respectively, CO_2 emissions by 3-5 %. Introducing EU requirements

for cars with catalysts, NO_x emissions will go down at least by 3-5 %, bigger reduction might be reached in the event of increasing of the number of catalyst-equipped cars.

Type

The measure is economical.

Status

The measure was started already in 1995; it is planned for completion in 2004.

Implementing entity

Road Traffic Safety Department (RTSD).

Funding

Revenues of RTSD collected for the provided services finance establishment of the network of technical check-up stations and their modernisation. The measure is also financed by private companies, which have entered into joint ventures operating in the new check-up centres.

- ***Introduction of type approval procedures for new automobiles***

Description of the measure

All new cars registered in Latvia in the period from October 1, 1999 till January 1, 2001 will have to gradually undergo the procedure of type approval in line with the provisions of the EU directives. Requirements in regard to emissions will also be gradually harmonised with those set forth in the EU directives. Because of the lack of compliance of fuel standards with those accepted in the EU, implementation of new provisions of EU directives is slightly delayed. Thus implementation of EURO 3 requirements is temporarily postponed till the beginning of 2003. Type approval procedures, however, have stopped bringing into Latvia cars with out-dated construction and environmentally less friendly new automobiles.

Objective

Improvement of technical condition of cars by raising requirements for new cars.

GHG affected

Introducing EU requirements in regard to new cars compared to the period without such requirements will result in reduction of NO_x emissions from new cars not less than by 30% as introduction of requirements will mean the use of cars equipped with exhaust gas neutralisers. As it is planned to introduce EU standards in full, in later years reduction will correspond to the change of EU standards.

Type

Economical.

Status

The measure was started already in 1999 and is planned for completion in 2003.

Implementing entity

RTSD.

Funding

Finances from revenues of RTSD collected for provided services.

Policy: Creation of environmentally friendly transport system

Description of the measure

At present transport infrastructure of Latvia, transport vehicles and cargo haulage processes do not correspond to environmental quality requirements accepted in the developed countries. This is proved by the observed deterioration of the air quality in Latvia and increase of noise in places with intensive traffic. Ministry of Transport has developed the National Program on Transport Development to solve the aforementioned problems.

Objective

One of the objectives of the National Program on Transport Development is creation of a well-planned, environmentally friendly transport system by balancing availability of transport for economic and social needs and environmental opportunities and resistance. The key measures highlighted in the program are the development of environmentally friendly transport infrastructure, regulation and optimisation of transport types and flows.

GHG affected

In the result of implementation of the subprogram the negative impact caused by transport on the environment and human health will be reduced. It is projected that air pollution with NO_x, CO_2, CO and VOC will go down [63].

Type

Socio-economical for it will result in creation of new jobs in the transport sector and improvement of air quality.

Status

Started.

Implementing entity

Ministry of Transport and the subordinated institutions.

Funding

State subsidies.

Leakage of volatile substances from fuels (1B2b)

- ***Reduction of volatile substances from fuels arising from the storage of oil products***

Description of the measure

The Cabinet of Ministers (CM) passed regulations No.269 "On Environmental Quality Regulations for Fuel Filling Stations, Oil Storage Facilities and Mobile Fuel Tanks". The regulations stipulate environmental quality standards and environment protection requirements to be observed by fuelling stations, oil storage facilities and mobile fuel tanks and the obligations of state institutions and enterprises to fulfil these requirements.

The present number of oil storage facilities (depots) in Latvia and the number of those who meet the above said requirements is presented in Table 4.3.

Table 4.3

Number of oil storage facilities (depots) complying or non-complying with the provisions of Regulations No.269 of the CM

Average amount of fuel (tons/year)	Number of oil bases complying with Regulations No.269	Number of oil bases non-complying with Regulations No.269 (year when compliance has to be ensured)	Total number of oil bases
More than 150000	2	4 (2003)	6
25000-150000	1	10 (2004)	11
Less than 25000	2	42 (2009)	44
Total	5	56	61

Table 4.3 shows that only 5 of 61 oil storage reservoirs are equipped in line with Regulations No.269 of the CM. As well as only 147 of 615 gasoline filling stations are subsequent to the same regulations.

Objectives

One of the objectives is to establish the order how all oil storage bases of Latvia built before March 1, 2000 should install steam collection and processing equipment.

GHG affected

Volatile organic compounds.

Type

Economical.

Status

In the oil bases where the amount of fuel exceeds 150 thous.t per year, steam collection and processing equipment should be installed by January 1, 2001. In the oil storage bases where the amount of oil exceeds 25 thous.t per year equipment should be installed by January 1, 2004 and in oil bases with less than 25 thous.t per year – by January 1, 2009.

Implementing entity

Owner of the oil storage base.

Funding

The owner of the storage site finances installation of the equipment.

- ***Reduction of natural gas leakage from pipeline systems***

Description of the measure

Total natural gas supply system in Latvia consists of transport (main) pipelines; Incukalns underground gas storage site and gas distribution system.

Leakage of the natural gas into environment may be created:

- During filling gas into gas pipelines;
- During repair works and replacement of technological equipment;
- Carrying out technological maintenance works;
- Gas leakage from non-tightened places in gas systems;
- Failure of gas pipelines, defective equipment.

In the time period between 1995-2001 a/s "Latvijas Gaze" has already implemented and funded measures of reduction of methane emissions, such as:

- Installation of the remote-control system of transport (main) pipes operating in the event of failure of valves; the planned modernisation of gas regulation stations is also in the process;
- The planned reduction of inter-column gas leakage in Incukalns underground storage site is being implemented and replacement of closing devices is carried out;
- High sensitivity gas indicators for leakage search in the gas supply system have been purchased and used.

Objective

The planned activities of a/s "Latvijas Gaze" are linked with the adopted "Planned Investment Program for 2002 – 2005" foreseeing continuation of gas system modernisation and reconstruction resulting in reduction of CH_4 emissions into environment.

GHG affected

CH_4 emissions between 1995 and 2000 equalled to 2 808 tons, including those from Incukalns underground gas storage site - 2 580 tons.

Type

Economical.

Status

Measures aimed at reducing CH_4 emissions have been started and are continued.

Implementing entity

A/S "Latvijas Gaze".

Funding

Resources of a/s "Latvijas Gaze".

4.3.1.3. International activities

This section provides an overview of information on international activities carried out in Latvia that are financed only from grants and donations of foreign countries. Three measures: Efficient Use of Energy in Agencies of Latvia supported by the Danish Environment and Energy Sector program and two GEF – funded projects – Economically cost effective use of wood-waste in local governments' heating systems and Efficient Lighting Program were selected as examples to illustrate the general approach.

"Efficient use of energy in agencies of Latvia" supported by the Danish Environment and Energy Sector Program

Description of the measure

Dramatic rise of energy costs in the residential sector of Latvia in the recent years resulted in difficulties with attraction of capital investments for reconstruction and exploitation of residential houses and energy generation and transmission systems. Energy prices in Latvia in the nearest years will almost reach the level of world prices, which will make the cost situation in regard to the consumed energy even more complicated. Therefore under such circumstances, it is important to consider investment of resources in energy conservation measures as an urgent priority task.

4 educational establishments were included in the project that was realised in 1998-1999. Energy audit, standard measures of energy saving and monitoring (systematic registration of energy consumption during the heating season) were accomplished in these educational establishments. In parallel, "Energy Conservation Manual" was also prepared as well as seminars to inform the public about the issue were organised.

Objective

The formulated project objective was to improve energy efficiency in institutions and reduce environmental impacts on the local, regional and global scale.

GHG affected

The project resulted in saving of heat energy within the range of 16 till 61%, electrical energy – from 6 till 36%. Table 4.4 illustrates the amount of saved energy in each of four institutions involved in the project [18].

Table 4.4

The amount of saved energy

Institution	**Saved heat energy**		**Saved electrical energy**		**Total saving**	
	MWh	%	KWh	%	MWh	%
Antuži	384	31	7000	6	393	29
Suntaži	309	16	76000	36	3385	18
Kalupe	352	30	40000	28	392	30
Naujene	648	61	28000	25	676	58

Type

Economical and informative project.

Status

Completed in June 2000.

Implementing entity

Project was implemented in close co-operation between Danish and Latvian partners coming from the Danish Energy Institute and Danish Technology Institute and Latvian Energy Agency and Energy Efficiency Centre of the Institute of Physical Energy of Latvia.

Firms “Dansk Energi Management A/S” and SIA “Nams” and other specialists also implemented project.

Funding

Donation of the Danish government was used for project implementation.

Economically cost-effective use of wood-waste in the local governments' heating systems

Description of the measure

The construction design of the new boiler house in Ludza was worked out with the support of the Netherlands governmental agency – *Senter International* within the framework of the PSO program. A new boiler house, basically fuelled with wood waste was built instead of the old heavy fuel oil boiler house.

Taking this pilot project as the base it was decided to encourage dissemination of similar projects in Latvia. Such dissemination could be achieved if the existing technical, legal, institutional/logistical, informational and financial barriers are eliminated on the basis of experience and information gained during the first pilot project in Ludza.

Objective

After successful implementation of the project, objectives of GEF project were put – to increase administrative capacity of Ludza municipality and continue with implementation of similar projects in Latvia.

GHG affected

CO_2 reduction till June 2001 was 5 000 t (5 Gg CO_2 equivalent). The projected average CO_2 emission mitigation every year will equal to 12 000 t CO_2 (12 Gg CO_2 equivalent).

Type

Economical and informative.

Status

Construction of the boiler house was started in 2000. It is planned to finish in autumn 2001. Continuation of the project was started in February 2001 and it is planned to finish the project till December 31, 2003.

Implementing entity

Construction of the boiler house was headed by the Dutch power utility “Essent”. Further proliferation of the project will be entrusted to state non-profit company SIA “Vides projekti”.

Funding

Construction of the boiler house was funded by the Dutch energy utility “Essent”. Further development of the project is funded by GEF.

Efficient lighting program

Description of the measure

Information about modern lighting technologies is very scary in Latvia. Economical light bulbs consume 4 to 5 times less energy than traditional bulbs. But, they are expensive and therefore enter the residential and public and commercial sector very slowly. This is the reason for implementing in Latvia the international program – *Efficient Lighting Initiative* (ELI) focussed on the following problems:

1) Raising efficiency of street lighting;
2) Raising efficiency of lighting in the residential sector;
3) Introduction of international lighting standards and regulations;
4) Efficient training program on lighting;
5) Establishment of ESCO for introduction of efficient lighting.

Objective

To reduce the impact of lighting on climate change by creating the market of modern lighting technologies in Latvia.

GHG affected

ELI program forecasts two types of CO_2 reduction:

- Direct reduction of 2 722 t CO_2 during implementation of the ELI program (till the middle of March 2002);
- Indirect reduction of 47 684 t CO_2 in the post-program phase (till 2010) [21].

Methodology used (see Box 3)

Type

Economically (in some specific projects), socio-economically and ecologically justified project.

Status

ELI Program in Latvia was started in March 2000 and will be finished in March 2002.

Implementing entity

The International Finance Corporation (IFC) manages ELI program in seven countries of the world. In Europe the program is co-ordinated by the Danish consulting company "Danish Power Consult" (DPC). In Latvia the engineering and consulting company "Ekodoma" implements the program.

Funding

ELI program is funded by GEF.

Box 3. Methodology used

Forecast of GHG emission reduction was done according to a uniform methodology in all seven ELI program countries. Calculation model is based on figures of official statistics and assumptions derived from experience of experts. The forecast was developed for two time periods:

- Direct CO_2 reduction during implementation of ELI program;
- Indirect CO_2 reduction for the timer period of 10 years after the beginning of ELI program.

Table 4.5

Summary of policies and measures in the sector of energy

Name of policy or measure	Objective	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by GHG, Gg in CO_2 equivalent.		
						1995	2000	2005
Energy generation and transmission (1A1)								
Policy: Use of renewable energy resources in energy generation and transmission sector								
Wider use of fuel wood for centralised district heating	To increase share of wood in the fuel balance earmarked for district heating	CO_2	Economic, socio-economic	U	Local governments	NE	NE	NE
Renewal of small HPS	Increase the specific weight of renewable resources in total energy balance	CO_2, N_2O, NO_x, CO	Economic, socio-economic	U	Enterprises	NE	NE	NE
Use of wind energy	Increase the specific weight of renewable resources in total energy balance	CO_2, N_2O NO_x, CO	Socio-economic	U	Enterprises	NE	NE	NE
Bio diesel fuel as a internal combustion fuel in small scale co-generation plants	To reduce CO_2 emissions by replacing diesel fuel by bio diesel fuel in small capacity co-generation equipment internal combustion engines	CO_2, CO	Socio-economic	U	Enterprises	NI	NI	+3.9*
Policy: To increase efficiency in the energy generation and transmission sector								
Wider use of co-generation	To increase installed capacity of co-generation plants and the amount of energy produced by co-generation, as well as efficiency of use of energy resources	CO_2	Economic, socio-economic	U	Local governments or enterprises	NE	NE	NE
Riga district heating rehabilitation project	Project No.1 – increase of efficiency of boiler houses Project No.2 – improvement of work of energy supply system	CO_2, N_2O, NO_x, CO	Economic	U	Local governments	NI	NE	NE
Projects of the Local Governments' Crediting Fund	To improve operation of the heat supply system, in some projects – to carry out efficient heat insulation of buildings and radical reduction of energy consumption.	CO_2	Economic, socio-economic	I	Local governments	NI	-22.9	-22.9

Name of policy or measure	Objective	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by GHG, Gg in CO_2 equivalent.		
						1995	2000	2005
Manufacturing industry and construction (1A2)								
Policy: To increase efficiency of use of energy resources in industry								
Increase of energy efficiency in dairy companies of Latvia	Staring with 2000 annual 3% increase of efficiency in dairy enterprises	CO_2, N_2O	Economic	A	Enterprises	NI	-0.4	-2.2
Increase of energy efficiency in bakeries of Latvia	Increase of competitiveness of bakeries	CO_2, N_2O, NO_x, CO	Economic	A	Enterprises	NI	NE	NE
Policy: To increase efficiency of use of energy resources in construction								
Heat efficiency improvement program in buildings	To study the general situation in the country in the area of heat keeping of buildings, provide information on opportunities and efficiency of heat insulation, as well as on the activities to be accomplished for optimisation of situation	CO_2, N_2O, NO_x, CO	Informational research, educational	P	MEPRD Construction Dpt., ME Energy Dpt., etc.	NI	NI	NE
Reduction of heat losses in buildings. Project No.1. Educational system development project	To start important changes in educational system by increasing cost-efficiency of educational establishments	CO_2, N_2O, NO_x, CO	Economic	A	MES and local governments	NI	-186.6	NE
Project No.2. 1997-1998 SCORE program demonstration projects	Solving energy conservation problems on the level of consumers	CO_2, N_2O, NO_x, CO	Economic	I	Owners of buildings	NI	NE	NE
Project No.3. Energy efficiency improvement demonstration projects implemented within the Swedish government STEM program	To demonstrate economic and technical usefulness of energy conservation	CO_2	Economic	I	Local governments	NI	-0.36	-0.36
Project No.4. Pilot projects of the PSO program “Energy Efficiency in Buildings of Latvia”	Raising energy efficiency in buildings, reduction of environmentally harmful emissions by reducing energy consumption	CO_2, N_2O, NO_x, CO	Economic	I	Local governments	NI	NE	NE

Name of policy or measure	Objective	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by GHG, Gg in CO_2 equivalent.		
						1995	2000	2005
Transport sector (1A3)								
Policy: To restrict use of passenger cars in cities								
Improvement of the public transport system in Riga	To improve public transport system	CO_2, N_2O, NO_x	Informative, socio-economic	A	Riga Council	NI	NE	NE
Development of cycling	To include cycling transport in the general transport system of Riga	CO, CO_2, N_2O, NO_x	Economic, informative	A	Riga Council	NI	NE	NE
Policy: To introduce technological measured for CO_2 emission reduction								
Use of bio-fuel by road transport	To replace gasoline by gasoline-ethanol mix in automobile engines	CO, GOS, NO_x	Economic, socio-economic	P	Enterprises	NI	NI	NE
Policy: Stricter control of the technical condition of transport vehicles								
Construction of technical check-up stations	To improve quality of control of technical condition of motor vehicles	CO_2, CO, NO_x	Economic	A	RTSD	NI	NE	NE
Introduction of type approval procedures for new automobiles	Improvement of technical condition of automobiles by raising requirements to new cars	NO_x	Economic	A	RTSD	NI	NE	NE
Policy: Creation of environmentally friendly transport system								
Creation of environmentally friendly transport system	Creation of a targeted, environmentally friendly transport system by balancing availability of transport for economic and social needs and environmental opportunities and resistance	NO_x, CO and GOS	Socio-economic	A	MT and the subordinated institutions	NI	NE	NE
Leakage of volatile substances from fuels (1B2b)								
Reduction of volatile substances from fuels arising from the storage of oil products	To establish the order how all oil depots of Latvia should install steam collection and processing equipment	GOS	Economic, legislative	A	Oil base owner	NI	NE	NE
Reduction of natural gas leakage from pipeline	A/S “Latvijas Gaze” plans to continued gas system modernisation and	CH_4	Economic	A	A/S “Latvijas Gaze”	NI	NE	NE

Name of policy or measure	Objective	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by GHG, Gg in CO_2 equivalent.		
						1995	2000	2005
systems	reconstruction resulting in reduction of methane emissions into environment.							
International activities								
Efficient use of energy in agencies of Latvia	To improve energy efficiency in institutions and reduce environmental impacts on the local, regional and global scale.	CO_2, N_2O, CO, NO_x	Economic, informative	I	Danish and Latvian specialists	NI	NE	NE
Economically cost-effective use of wood-waste in the local governments' heating systems	To separate heat source from the remaining system and replace heavy fuel oil by another environmentally friendly fuel. To develop the potential of Ludza municipality and to continue similar projects in other locations of Latvia.	CO_2	Economic, informative	A	Dutch energy company "Essent" and "Vides Projekti"	NI	NI	-12
Efficient lighting program	To decrease the impact of lighting on climate change, reforming modern lighting technologies market in Latvia	CO_2	Economic, socio-economic	A	DPC, Ekodoma	NI	NI	-4.6

Explanations:
I – implemented, A – adopted, P – planned
NE – impact of the measure is not estimated
NI – the measure has no impact
* Increase of GHG emissions is explained by the start of intensive land management whereby accumulation of carbon in the soil has stopped.

4.3.2. Industrial processes (2)

The most important source of GHG emissions in industry of Latvia is production of cement and lime, steel, asphalt as well as chemical and pharmaceutical preparations. Part of information on production outputs in industry is confidential; therefore it is possible to estimate only total GHG emissions (see Annex 2).

Pursuant to the declared fundamental positions of Latvian industry [45], at present there are two priority directions for industrial development in Latvia:

- Creating favourable environment for industry;
- Formation of efficient and competitive structure of industrial sectors as well as high technology-based industries as foreseen in the National Innovation Concept [54].

Measures of GHG emissions in this sector in Latvia at the moment are mainly linked with raising energy efficiency of technological processes and recycling of materials.

4.3.2.1. Measures of GHG emission mitigation

Policy: Introduction of the environment management system and clean manufacturing practice pursuant to ISO 14001 requirements

Danish Agency for Trade and Industry (DATI) finances the program "Environmental Management in Eastern Europe" aimed at improvement of environmental management system (EMS). "Environmental Management in Eastern Europe" is a wide program comprising several individual environmental management projects in various industries. At present Latvia implements projects in food and pharmaceutical industry. Projects are also started in chemical industry and metal production and processing. It is planned to gradually introduce EMS in other sectors of industry. Enterprises participating in projects have the right to receive an international ISO 14 000 certificate. The new EU Environmental Management and Audit Scheme (EMAS) will gain effect in 2001. To registered for EMAS, ISO 14 001 based EMS is needed [72].

The goal of EMS is proper management of environmental performance indicators of the enterprise, their control and on-going perfection. EMS is a management system covering both the resources (raw materials, chemicals, fuel, etc.) and emissions (wastewater, air, waste, etc.). EMS is an effective instrument for bringing together interests of business and environment.

Cleaner production (CP) is an integrated part of EMS with the basic principle to eliminate pollution at source. CP is introduced together with the good manufacturing practice, some technical modifications of processes and products and bigger investment in cleaner technologies, products and/or best available technologies.

Examples of implementation of this policy in the context of reduction of climate change are discussed below.

- ***Introduction of the EMS and CP in pharmaceutical industry of Latvia***

Description of the measure

Environmental aspects/impacts on the environment in the pharmaceutical industry may be summarised as follows [73]:

- Production and processing of active substances;
- Relatively big consumption of chemical agents, including solvents;
- Relatively big consumption of filling substances;
- Small quantity of finished products in comparison with the consumption of raw materials;

- High diversity of types and content of emissions;
- Relatively big quantities of hazardous wastes.

The Latvian enterprises that took part in the project were: "Olainfarm", "Grindeks", Riga Pharmaceutical Plant, State Centre of Blood Donors and Baltic Therapeutically Service (BTS), of which only "Olainfarm" in February 2001 got ISO 14 001 certificate and other companies (except BTS) plan to receive this certificate in 2001-2002.

Objective

The objective of enterprises is to integrate EMS in other management systems (quality, health and safety at work).

GHG affected

Leakage of nitric oxide (a/s "Olainfarm") was eliminated; energy consumption reduced by ~58000 kWh/year, reduction of electricity consumption ~8000 kWh/year (a/s "Grindeks").

Type

Voluntary as ISO certificate is not mandatory, economical, and informative.

Status

Project was implemented from April 1999 till February 2001.

Implementing entity

Danish Technological Institute (DATI) acted as the project organiser. Latvian Pollution Prevention Centre (LPPC) granted practical support.

Funding

The project was funded by DATI.

- ***Introduction of the EMS and CP in the chemical industry of Latvia***

Description of the measure

Following the initiative of the DATI the Danish enterprise "RAMBØL" developed a project application "Chemical industry/Latvia". The project foresees implementation of EMS in different chemical enterprises of Latvia operating in the following areas:

- Production of chemical agents;
- Production of pesticides and agro-chemical preparations;
- Production of paints, solvents, etc.;
- Production of soaps, cleaning substances, perfumes, etc.;
- Production of other chemical compounds, including synthetic fibres.

Objective

The objective of the project is to integrate EMS in 4-6 chemical enterprises of Latvia and to achieve that at least one enterprise gets ISO 14 001 certificate or EMAS registration.

GHG affected

The impact of the measure on GHG is not yet assessed.

Type

Voluntary, as ISO certificate is not mandatory, economical, and informative

Status

Invitation for companies to apply for participation in the project has been announced. The project will last 2 years.

Implementing entity

"RAMBØL" has selected two co-operation partners in Latvia – Business Consulting Group (BKG) and LPPC who will, respectively assist in solving business and environment related questions.

Funding

The project is funded by DATI.

Table 4.6.

Summary of policies and measures in industry

Name of policy or measure	Objective	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by GHG, Gg in CO_2 equivalent.		
						1995	2000	2005
Chemical industry (2B)								
Policy: Introduction of the EMS and clean manufacturing practice pursuant to ISO 14001 requirements								
Introduction of EMS and CP in pharmaceutical industry of Latvia	The objective is to integrate EMS in other management systems (quality, health and safety at work) of enterprises.	CO_2, N_2O, CH_4	Voluntary, economic, informative	I	Company management	NI	NE	NE
Introduction of EMS and CP chemical industry of Latvia	The objective of the project is to integrate EMS in 4-6 chemical enterprises of Latvia and to achieve that at least one enterprise gets ISO 14 001 certificate or EMAS registration.		Voluntary, economic, informative	P	Company management	NI	NI	NE

Explanations:
I – implemented, A – adopted, P – planned
NE – impact of the measure is not estimated
NI – the measure has no impact

4.3.3. Agriculture (4)

Agricultural sector in 1999 emitted approximately 15% of total GHG emissions in Latvia, including 7.9% were emitted from agricultural soils (see Annex 2).

The foundation of the policy and strategy of the sector in Latvia is established in the following legal documents:

- Law on Agriculture;
- Concept on the Development of Agriculture;
- Program fundamentals of the development of agriculture and agricultural sectors;
- Annual development program of agriculture.

The basic agricultural development tasks identified in the documents are [52]:

- Provision of residents with qualitative food made from local agricultural products;
- Competitive income earning possibilities to people employed in agriculture;
- Rational use of the natural resource – land.

There are no special measures for GHG emission reduction planned to implement in the agricultural sector of Latvia in the present conditions. Priorities for agricultural sector in the nearest future are fulfilment of conditions of good agricultural practice and accession of Latvia into the EU.

- ***Rural Development Program***

Description of the Program

The government of Latvia has started implementation of the rural development program approved by Saeima in June 1998. The basic goal of the agricultural sector of Latvia stipulated by the program is to ensure efficient agricultural production able to integrate in the common European market after the accession to the EU and producing EU regulations-compliant high quality agricultural products. The program foresees financial support to rural development. The legal base for granting such support is the State Program for Agricultural Subsidies for 2001 approved by the CM. Since economic possibilities to stimulate agriculture are on the whole rather limited the priority sectors for support such as dairy farming, grain production, pig rising, fruit and vegetable production are identified [77].

Objective

Subsidies for priority sectors of agriculture in 2001 are targeted at improvement of productivity of milking cow and pig herds and, partly, at raising revenues of grain producers and field vegetable farmers, at encouraging rational used of covered areas, compensation of energy price rise in covered areas and ensuring the domestic demand for vegetables produced in Latvia [44].

GHG affected

Implementation of the subsidy program could result in increase of the number of cattle and, consequently, also CH_4 emissions could slightly go up created by digestion of ruminants and released from decomposition of manure in anaerobic conditions.

N_2O emissions from the use of organic and synthetic fertilisers and agricultural soils could also become bigger.

Type

Measure is economic.

Status

Program of agricultural subsidies is approved for every year. The State Subsidy Program for Agriculture in 2001 was approved on December 27, 2000.

Implementing entity

The whole set of activities is co-ordinated by public institutions and local government

organisations, implemented – by producers of agricultural products.

Funding

20-30% of project costs targeted at attainment of program goals are covered from the state budget. The remaining part paid by subsidy beneficiaries (farmers' own resources or credits).

- ***SAPARD rural development program***

Description of the program

In future the EU pre-accession SAPARD program (*Special Accession Programme for Agriculture and Rural Development*) could become the most important instrument to support rural development. Projects in the following areas will be financed within the scope of this program [39]:

- Investment into agricultural enterprises (land surveying, modernisation of agricultural equipment and buildings, afforestation of agricultural lands);
- Improvement of rural infrastructure;
- Environment protecting agricultural methods (biological diversity and preservation of rural landscape, biological agriculture);
- Improvement of processing and marketing of agricultural and fishery products;
- Diversification of rural economy by encouraging alternative sources of revenue;
- Perfection of training.

Objectives

Overall program objectives are the following:

- Introduction of agriculture-related EU *acquis communautaire*;
- Competitive and sustainable agriculture, well-developed and sustainable countryside, diverse and sustainable rural environment [39].

GHG affected

Implementation of the measure could result in increase of CH_4 and N_2O emissions and increased CO_2 sequestration in the result of afforestation of agricultural lands (see Section 4.3.4).

Type

Economic measure.

Status

It is planned that first projects eligible for SAPARD co-financing will be evaluated starting from October 2001[10].

Implementing entity

The measure is administered by Rural Support Service (RSS) and implemented by agricultural producers.

Funding

The principle of co-financing means that 47% of project costs will be covered by the implementing entity, 40% – by SAPARD and the remaining 13% will be paid from the Latvian governments subsidies to agriculture.

- ***Good agricultural practice***

Description of the measure

Good agricultural practice (GAP) refers to the main areas of agricultural activity, potentially causing pollution of water, air or soil and provides advice how to eliminate or at least reduce the pollution.

[10] Source: Ministry of Agriculture, Republic of Latvia

Objective

The objectives of good agricultural practice are:

- To lessen the negative impact on environment caused by business activity, to eliminate depletion and irrational use of fundamental natural resources – land, water, plants, animals, rural landscape;
- To respect in agricultural production regulations adopted in the developed countries of Europe and the world, to eliminate barriers for Latvian products to enter foreign markets and make Latvian rural environment attractive for tourists [29].

GHG affected

N_2O emissions from the use of organic fertilisers and agricultural soils might go down with the improvement of methods of cultivation.

Type

GAP regulations have an advisory nature therefore implementation is voluntary.

Status

The implementation of the measure has been already started. Good agricultural practice farms are awarded subsidies[11].

Implementing entity

Agricultural producers (mainly peasant farms) are implementers of the measure.

Funding

Agricultural producers.

- ***Processing of animal-origin waste***

Description of the measure

An important agricultural measure referring to environment protection is the planned construction of high and low-risk animal waste processing plant. Total construction costs of the plant including 3 waste collection points, equipment and transport vehicles, equal to 7-10 million LVL.

Objective

Construction of high and low- risk animal origin waste processing plant is needed to implement provisions of the EU legislation.

GHG affected

CO_2 emissions could increase in the result of implementation of the measure.

Type

Regulatory and economical.

Status

At the moment assessment of the necessary amendments to legislation to implement the measure is in the process.

Implementing entity

Not yet known.

Funding

Not yet identified.

[11] Source: Ministry of Agriculture, Republic of Latvia

Table 4.7.

Summary of policies and measures in agriculture

Name of policy or measure	Objective	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by GHG, Gg in CO_2 equivalent.		
						1995	2000	2005
Agriculture (4)								
Rural development program	To improve productivity of milking cow and pig herds and partly raise revenues of grain producers and field vegetable farmers, encourage rational used of covered areas, compensate energy price rise in covered areas and ensure the domestic demand for vegetables produced in Latvia.	CH_4, N_2O	Economic	A	Public institutions, local government, agricultural producers	NI	NE	NE
SAPARD rural development program	To introduce agriculture-related EU *acquis communautaire*; to create competitive and sustainable agriculture, well developed and sustainable countryside, diversified and sustainable rural environment	CH_4, N_2O, CO_2	Economic	P	RSS and agricultural producers	NE	NE	NE
Good agricultural practice	To lessen the negative impact of business activity on the environment and to respect agricultural production regulations adopted in the developed countries and Europe and the world	N_2O	Voluntary	A	Agricultural producers	NI	NE	NE
Processing of animal-origin waste	Processing of animal-origin waste	CO_2	Regulatory, economic	P	Not identified	NE	NE	NE

Explanations:
I – implemented, A – adopted, P – planned
NE – impact of the measure is not estimated
NI – the measure has no impact

4.3.4. Land use change and forestry (5)

Sustainable forest management, respecting the place of forest ecosystems in local and global processes, ensuring continuous availability of wood resources, increasing usability of wood resources and especially use of wood waste are fundamental preconditions in CO_2 emission reduction and removal policy of Latvia.

Principles of sustainable forest management have been analysed in several programs and projects developed in the last few years. Forest Law and the subsidiary CM regulations (see Annex 1) define implementation of these principles.

4.3.4.1. Measures to increase CO_2 removals

Annual CO_2 sequestration estimated in the last National Communication in 1990 equalled to 10 960 Gg. However in 1999 Latvian forests removed only 5321.7 Gg CO_2. Consequently, net CO_2 sequestration has declined 2 times. This is mainly attributed to the increased harvesting and the fact that emissions for the period between 1990 till 1997 have not been re-calculated according to the IPCC common reporting format used for estimations starting with 1999.

Changes in forest stock (5A)

Policy: Sustainable management of forests and forestland

In the context of Latvia forest policy the word "sustainable" means the use of forests and forestland to preserve their biological diversity, productivity, reproduction capacity, vitality and the potential ability to perform important ecological, economic and social functions today and in future. The referred policy contains the following main principles relating to forests and forestland:

- To establish limitations to forestland transformation;
- To encourage afforestation of abandoned agricultural and otherwise not used land with the assistance of incentives offered the state [40].

Adherence to these principles would allow increasing the share of forestland till 48-52% of the territory of Latvia during the next 20-25 years and, respectively, increasing CO_2 removals.

Objective

- To avert narrowing of the existing forest area by setting limitations to forestland transformation;
- To ensure preserving and increase of forestland productivity and value;
- To encourage afforestation of the abandoned agricultural and otherwise unused lands with the assistance of incentives at a disposal of the state [40].

Type

The Forest Policy is implemented with the help of regulatory documents.

Status

CM adopted Forest Policy on April 28, 1998. Implementation is being started now.

Implementing entity

Ministry of Agriculture

The key measures of forest policy to be implemented in the context of climate change mitigation are presented below.

- ***Targeted afforestation of abandoned agricultural land***

Description of the measure

Because of the land reform started in 1990, the area of cultivated agricultural lands in Latvia has become smaller, which by the year 2020 could result in approximately 580 thousand hectares of abandoned; naturally overgrown lands [25]. Targeted afforestation of the abandoned agricultural land provides good opportunity to increase usefulness of these lands as this will also provide raw materials to wood industry, pulp production, energy sector. Pursuant to the currently affective legislation, afforestated land is exempt from real estate tax payment during the age of young stands (see Annex 1). State aid for land afforestation is not offered.

The afforestation project of the abandoned agricultural land with the total area of 7 000 ha has been chosen for the purposes of this analysis. The project will be implemented within the SAPARD program. Results of the analysis were taken from the survey [25].

Taking into consideration the limited agricultural production opportunities in Latvia, this project could be a good example of alternative land use, especially if foreign investment and state subsidies become available. The impact of the newly afforestated land on biological diversity is not yet know, however, it could be positive as it provides living space for wild animals, birds, insects. Economic, social and ecological gains of this project could be more completely evaluated in the full period of forest stand rotation, i.e. 80 – 100 years.

Objective of the measure

The objective is to encourage rational use of abandoned agricultural and otherwise not reclaimed land, thus expanding forest-covered areas.

GHG affected

It is estimated that between 2000 and 2006 the measure would result in the removal of 300 Gg CO_2 [39].

Methodology used (see Box 2.)

Type

Voluntary.

Status

The measure has been started. The continuation is planned within the SAPARD program.

Implementing entity

Owners and users of land.

Funding

At present, funding is made available by landowners and users. In future – also SAPARD funds will be used.

- ***Increasing of forest productivity***

Description of the measure

A great variety of forestry methods aimed at improved forest productivity are used in long-term forestry practice. Forest regeneration, thinning, forest selection measures, drainage and other measures are among the most important.

Forest policy and Forest Law stipulate obligation of forest owners to regenerate forest after felling. Forest areas, in most cases, are able to regenerate naturally in Latvia, however, it is in the best interests of both the state and pwners to regenerate forest as quickly as possible and in quality that ensures unceasing production of wood. This kind of action has both economic and ecologic implications.

The purpose of thinning is to create ecologically stable and productive forest stands that also fulfil environmental protection function. One of aims of thinning is to increase forest productivity.

The objective of forest selection is to increase productivity of forests. Pine in the recent years is planted using only selected seed material. This ensures increase of pine stands productivity by 10-20%, according to scientific research. Importance of selection of birch seeds today has increased. According to studies carried out in Finland, trees bred from selected seeds have by 26% higher increment. Selected birch plants can be used for regenerating felled areas, afforesting abandoned agricultural lands and for establishing fast growing birch plantations.

Forest drainage in Latvian circumstances, where there are many wet soil types, is one of the most effective measures to increase productivity of forest. It is possible to gain in the average 3.4 m^3/ha increment per year in satisfactory dried areas. Additional increment in state owned forests in the eighties was 1 million m^3 per year obtained in the result of drainage. Now, drainage works have almost stopped due to economic and polictical reasons. However, it is planned to restart drainage works in future, as there is a need to renovate drainage equipment and to build forest roads. This also follows from forest management plans of SJSC "*Latvijas valsts meži*" prepared for a ten-year period.

Last century the above forest management practices, as well as other measures have facilitated almost doubling of average growing stock volume per ha of forest stands. Targeted forest management activities continue this trend.

Objective

Increase of forest productivity.

GHG affected

Additional CO_2 sequestration and abatment of C loss in forest sector

Type

The measure is economical and legislative.

Status

Implementation is being started at the moment.

Implementing entity

Land owners and lawful possessors.

Funding

Land owners and lawful possessors, the state – tax exemptions for forest regeneration and young forest stands.[12].

[12] Source: MA

Table 4.8

Summary of policies and measures in the sector of land use change and forestry

Name of policy or measure	Objective	GHG affected	Type of instrument	Status	Implementing entity	Estimate of mitigation impact, by GHG, Gg in CO_2 equivalent.		
						1995	2000	2005
Changes in forest stock (5A)								
Policy: Sustainable management of forests and forestland								
Targeted afforestation of abandoned agricultural land	To encourage rational use of abandoned agricultural and otherwise not reclaimed land thus increasing forest-covered areas	CO_2	Voluntary	A	Land owners and users	NI	+2.7*	-7.8
Increase of forest productivity	To increase forest productivity	CO_2	Economic, legislative	I	Land owners and lawful possessors	NI	NE	NE

Explanations:
I – implemented, A – adopted, P – planned
NE – impact of the measure is not estimated
NI – the measure has no impact
* Decline in CO_2 removals in 2000 is explained by the absence of natural afforestation of the abandoned agricultural lands and the targeted afforestation has just started.

4.3.5. Waste management (6)

In 1999 waste sector produced almost 12.5% of total GHG emissions in Latvia, of which the biggest part – 10.7% was contributed by solid household waste landfills (see Annex 2).

Priority targets in the waste sector are:

- Reduction of waste generation in the place of origin and lowering dangerousness;
- Waste processing;
- Energy generation and recycling of materials contained in waste;
- Safe disposal of non-recyclable and not suitable for energy generation waste and waste from energy production.

These targets have been highlighted in several programs and projects developed in the last few years. These documents are, for example, State Strategy for Household Waste Management in Latvia (1997-2010), National Household Waste Management Program "500-" etc. There are also several laws fostering attainment of the formulated targets such as the Law On Natural Resources Tax, the Law on Waste Management, the Law on Pollution, Regulations No.56 of the Cabinet of Ministers of February 9, 2000 "On Construction, Management and Closure of Household Waste Disposal Sites", etc. (see Annex 1).

A rather big part – 25-75% of household waste in countries of Europe is incinerated [6]. This possibility was also studied in Latvia. The study shows that at the beginning it would be possible to burn 20-25% of household and industrial waste and the potential CH_4 emission reduction would be 187 Gg CO_2 equivalent [24]. However, in the nearest 20 years it is not planned to incinerate waste for the purposes of energy generation due to high costs and low purchasing power of people. Therefore, this variant is not discussed in this communication.

4.3.5.1. Measures to reduce CH_4 emissions

CH_4 emission in 1999 equalled to 94.8% of all GHG emissions generated by the waste management sector (see Annex 2.).

Household waste landfills (6A)

Policy: Reduction of waste in landfills

Reduction of the amount of waste and waste recycling is one of the key tasks of household waste management strategy. Implementation of the strategy is based on "The National Household Waste Management Program 500-", adopted by the CM in 1998.

- ***Waste recycling***

Description of the measure

Possibilities of household waste recycling in Latvia are on the whole rather limited. To be able to recycle waste and later use it as a raw material proper – sorting of waste is needed. At the moment there are only several small waste sorting pilot projects launched in Riga, Jelgava, Valmiera and Liepaja.

The sorting of waste carried out in Riga municipal waste landfill "Getlini" includes separation of cardboard, glass containers, ferrous and non-ferrous metals, and polyethylene – these materials are later pressed together and transferred for recycling. "Getlini" transfers only approximately 2% of total disposed waste for further recycling.

In March 2001 in Valmiera the first in Vidzeme region waste acceptance – sorting area was opened where sorting of glass, plastics, paper scrap, metal, tyres and other materials is carried out [59].

It is technically possible to recycle glass and hard plastic containers (packaging materials), polyethylene products, paper and paper scrap, car tyres, metal scrap, etc materials in Latvia. Recycling of these materials is in the process of development [70].

Objective

The objective of the measure is to reduce the amount of waste in waste disposal sites.

GHG affected

Paper waste recycling is important for reduction of CH_4 emission, as the biologically degradable part in paper constitutes 72% of total mass [61].

Type

Economical.

Status

Project has been started.

Implementing entity

Joint stock companies.

Funding

Environmental Protection Fund organises open tenders to receive state subsidies for enterprises working with recycling of environmentally hazardous goods or products. The amount of subsidies is established in the Regulations of the CM. Waste management enterprises finance separated collection of waste.

- ***Biogas generation***

Description of the measure

One of the possibilities to process organically degradable waste is production of biogas. Biogas may be used as a source of energy – directly (for generation of heat and electricity) or it may be sold to other users (after purification). The presently obtained quantity of biogas in Latvia is approximately 1.776 million m^3 per year, potential production capacity – 170 million m^3 per year [7]. Two projects are presented in greater detail below:

1) Modernisation project of "Getlini" – Riga municipal waste landfill [61];
2) Waste management project in Liepaja.

Project No.1 Modernisation project of "Getlini" – Riga municipal waste landfill

Objective

The project foresees generation of biogas from waste and its further use for energy generation. It is planned to install five generators, each with the capacity of 1 MW. The first generator could start operating in March 2002. Table 4.9 presents the planned biogas outputs from 2001 till 2027. Yet, because of the delayed implementation, project deadlines now are prolonged for approximately one year[13].

Table 4.9

The projected biogas generation outputs in 2001-2026 [61]

Year	Landfill, nm^3	Energy cells, nm^3	Total gas generation, nm^3
2001	20876174	0	20876174
2005	12992314	24244972	37237286
2010	7695935	26448190	34144125
2015	4859606	26448190	31307796
2020	3224489	26448190	29672679
2025	0	26448190	26448190
2027	0	26448190	26448190

[13] Source: SIA "Getlini-Eko", [6]

GHG affected

The potential reduction of CH_4 emissions in 2005 will be 268.4 Gg CO_2 equiv.

Type

Economical measure.

Status

The project was started in 1997 and planned to complete in 2004.

Implementing entity

The measure is implemented by SIA "Getlini-Eko".

Funding

Total project costs are 14.5 million LVL, of which part is paid from the World Bank loan [61].

Project No.2 Waste management project in Liepaja

Objective

The project is aimed at creation of a modern waste management system meeting requirements of the day, with the focus on the maximal use of the generated biogas, groundwater protection, waste sorting and other problems. The biogas produced from waste will be used for energy generation. It is planned to install two generators with total capacity of 1.3 MW [6].

GHG affected

The projected reduction of emissions during the period of the project is estimated as 105.8 thous.t carbons equivalent. Minimal emission reduction in 2005 will be 35.57 Gg CO_2 equivalent.

Type

Economical measure.

Status

The project was started in 2000 and planned for completion till 2006.

Implementing entity

SIA "Liepaja RAS".

Funding

The resources to this project will be contributed by the PCF (see Section 4.2). Total project costs are approximately 16.970 million USD. The projected PCF financing to this project is 2.220 mill.USD equalling to 23% of total investment. The agreement made between PCF and the republic of Latvia foresees to sell PCF the minimal emission reduction (105.8 thousand tons carbon equivalent) for 2.477 mill.USD. Annual minimal emission reduction is presented in Table 4.10.

Table 4.10

Annual minimal emission reduction in Liepaja landfill in 2002 – 2012

Year	The projected minimal emission reduction, tons C equivalent	The projected minimal emission reduction, Gg CO_2 equivalent*
2002	4 800	17.6
2005	9 700	35.57
2010	11 100	40,7
2012	11 300	41.43

*The conversion index from tons C and Gg CO_2 equivalent is 3.67

Table 4.11

Summary of policies and measures in the sector of waste management

Name of measure or policy	Objective	The GHG affected	Type of instrument	Status	Implementing entity	Estimate of mitigation impact, by GHG, Gg in CO_2 equivalent.		
						1995	2000	2005
Solid waste landfills (6A)								
Policy: Reduction of waste in landfills								
Waste recycling	To reduce the amount of household waste in landfills	CH_4	Economic	A	Enterprises	NE	NE	NE
Biogas generation Project No.1. Modernisation project of "Getlini" – Riga municipal waste landfill	To produce biogas from waste and later use it for energy generation	CH_4	Economic	A	SIA "Getlini-Eko"	NI	NI	-268.4
Project No.2. Waste management project in Liepaja	To create a modern waste management system and to use the produced biogas for energy generation	CH_4	Economic	A	SIA "Liepajas RAS"	NI	NI	-35.57

Explanations:
I – implemented, A – adopted, P – planned
NE – impact of the measure is not estimated
NI – the measure has no impact

4.4. Measure no longer in place

Introduction of the consumption analysis and control system of energy resources: installation of heat meters, multi-tariff electricity meters and gas meters

This measure mentioned in the Second National Communication in 2001 has been already implemented.

5. PROJECTIONS AND TOTAL EFFECT OF POLICIES AND MEASURES

The primary objective of this section of the national communication is to evaluate future trends in GHG emissions and removals, given current economical and social development levels and implemented and adopted policies and measures. Only the impact on direct GHG – CO_2, CH_4, N_2O, HFC and SF_6 was assessed when giving an indication of the relation between the measure and GHG emissions.

5.1. Projections

According to the IPCC guidelines for drafting national communication, this section offers a more detailed description of one development scenario or the scenario "with measures" compared to the scenario "without measures" or the baseline scenario. The scenario "with measures" is based on the long-term economic development forecast for the time period of 2000 till 2020 (see Table 5.1 and Figure 5.1). This projection is the base of modelling future path of GHG emissions in key sectors of economic activity.

Table 5.1

Basic indicators used in macroeconomic forecasts in 1996-2020, % (average annual growth rates)

Indicator	1996-2000	2001-2005	2006-2010	2011-2015	2016-2020
Growth rates of gross domestic product	4.7	5.4	5.2	6.0	5.4
Private consumption	6.4	5.5	5.5	5.5	5.5
Changes in outputs, including					
- Agriculture	-1.2	2.5	4.2	4.5	4.2
- Industry	4.6	5.8	4.5	5.2	4.6
- Services	5.8	5.5	5.7	6.5	5.9
Annual average number of residents, thous., in the final year of the period	2373	2343	2290	2200	2165

Long-term macroeconomic projections are developed on the basis of long-term economic development forecasts of the Ministry of Economy devised according to the structural macroeconomic model (see details in Section 5.3). The model is based on the following assumptions:

1. In regard to the internal growth capacity of the national economy:
    - Attractive environment for business is in the process of establishment. This includes substantial improvements of infrastructure, streamlined and stable legislation, competitive taxation system;
    - Competitive structure of sectors is being formed – productivity levels are going up, both in traditional and new sectors of economy, the share of high technology sectors in economy is rising;
    - There is a balanced regional development, unemployment rate is approaching the natural level, there is social harmony in the society;
    - There is an efficient environment protection system in place.

2. In regard to external environment:
    - World economy develops at an even pace – there are no explicit periods of recession;
    - Latvia accedes to the EU not later than in 2010;
    - Medium fast EU economy growth rates in the period after enlargement;
    - Stable political and economic situation in Russia. Russia is a stable trading partner.

Macroeconomic proportions in the event of such development scenario could be described in the following terms:

- Medium high GDP growth rates (5-6% in the first half of the period, 3-5% in the second half). Annual growth rates in the second half of the period will decline as, alongside with the rise of GDP, there should be the process of natural equalisation of growth rates with the potential growth rates of the developed countries;
- Lowering unemployment till its natural level (approximately 5%) in the course of 15 years;
- In the first 5 years there should be a rather substantial increase of budget expenditure that potentially may cause budget deficit. This aspect is one of key risks of this scenario able to influence its consistent implementation. When this period is over, state finances will start to gradually stabilise;
- Rapid growths of exports, at the same time the needed investment and budget deficit increase demand for imports. Therefore, at the beginning of the period the decrease of the deficit of the current account will not be fast, yet this should not cause instability of the balance of payments. The measures to improve business environment and favourable economic development will create additional opportunities for Latvia to attract foreign capital, mainly in the form of debt non-generating flows. After 7-8 years the deficit of the current account may start reducing rather substantially due to growth of internal saving;
- Infrastructure improvement measures will result a more even distribution of production all over the country, thus significantly lessening social and economic problems linked with low economic activity in many regions;
- Timely attention paid to social problems will raise competitiveness of Latvia in the area of attraction of labour, which is especially important in the EU post – accession period in the conditions of free movement of labour;
- Growth of the share of high technology sectors in economy will lessen the risk of intensification of resource-depleting sectors.

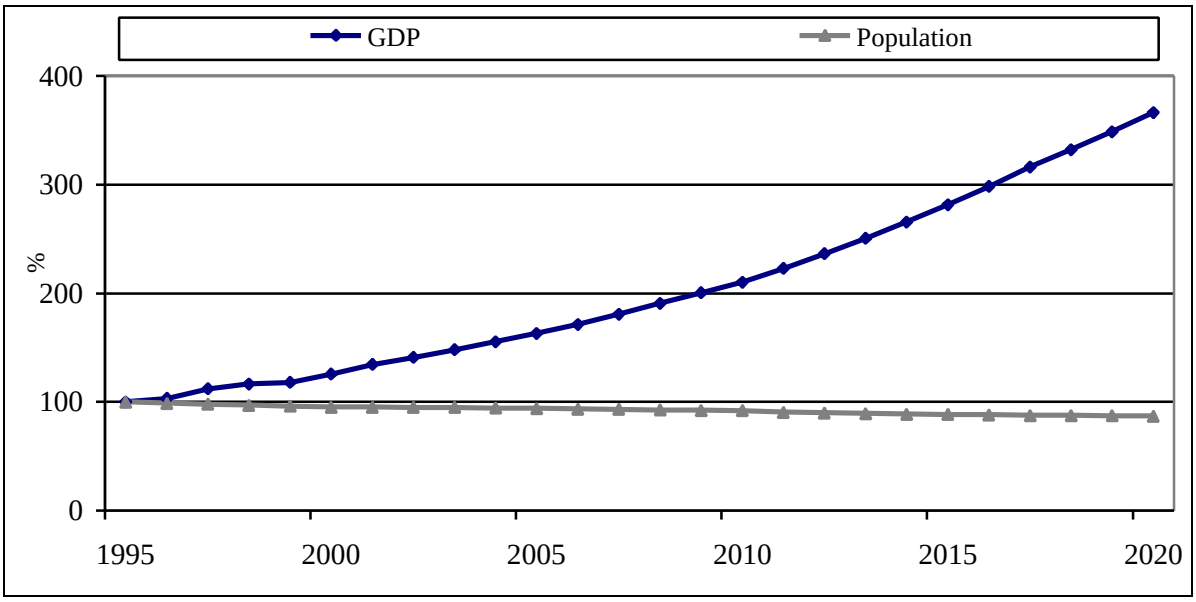


Figure 5.1. GDP growth and change in the number of population in 1995-2020 (1995=100)

5.1.1. Energy (1 A,B)

Development projections of the energy sector were assessed with the MARKAL optimisation model (see more detailed description in Section 5.3). Energy demand is directly linked with economic development. Long-term macroeconomic forecast was used as the base of forecasting the demand for energy. Results of modelling are presented in Figures 5.2 and 5.3.

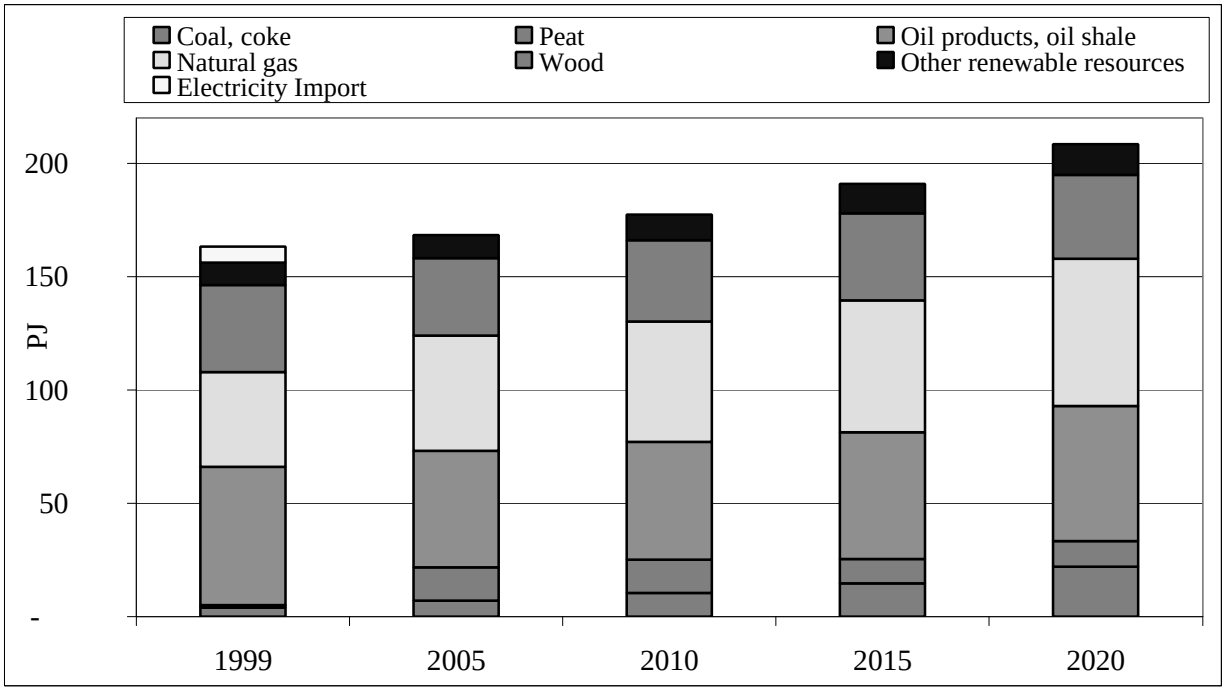


Figure 5.2. Primary energy consumption in 1999-2020

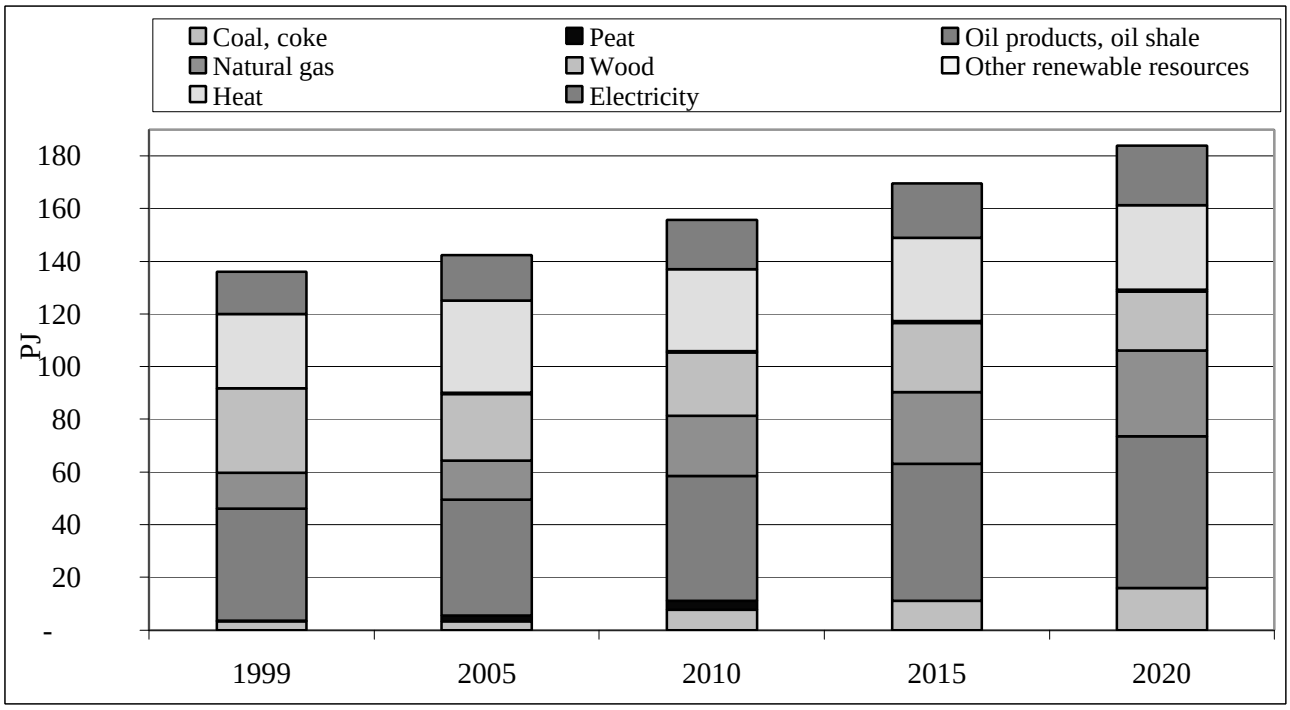


Figure 5.3. Final energy consumption in 1999-2020

Energy scenario "with measures" comprises the following measures (see Section 4.3.1):

- Wider use of fuel wood for centralised district heat generation;
- Renewal of small HPS;
- Use of wind energy;
- Bio diesel fuel as a internal combustion fuel in small scale co-generation plants (and/or transport);
- Wider use of co-generation;
- Rehabilitation of centralised district heating;
- Increase of energy efficiency in dairy companies of Latvia;
- Reduction of heat losses in buildings;
- Economically cost-effective use of wood-waste in local governments' heating systems;
- Efficient lighting program.

Projections of fuel consumption in transport are based on fuel consumption statistics for 1990-2000 and the existing tendencies in transport in Latvia. Although fuel consumption statistics approximately correspond to trends observed in transport it must be noted that the business environment and, consequently, also accounting and statistics have considerably changed during the last few years making the comparison of data obtained in different time periods rather difficult. To describe changes in the number of cars – the number of registered cars was not used (as a certain number of not used cars still remain on registration files). Estimation is based on the number of cars that have gone through technical inspection and those that are covered by the civil liability insurance. Statistical data shows that the total growth of energy consumption is smaller than increase in the real number of transport vehicles, which in the time period between 1998 and 2001 was approximately 4.5% a year (similar statistics was not collected in the previous years). This is because the new (added to the total number) transport vehicles are considerably more economical. As improvement values of the average efficiency of consumption of automobile fuel is estimated

between 1.5% till 2.5% per year, growth of energy consumption, if there are no dramatic changes in economic processes, may be estimated as 2.5% per year.

Energy consumption, lately, has gone down also in the railway transport. This is because of the decline in the overall haulage in the last few years. According to expert evaluation, haulage will go up. The estimation is based on the 3% annual energy consumption growth in the sector.

Statistics on air transportation are rather varied. A rather conservative 2% growth assumption was used in the estimation. The present trends in transport were respected in projections by separate types of fuel.

Scenario "with measures" comprises the following measures and policies in the transport sector (see Section 4.3.1):

- Use of bio fuel by road transport;
- Improvement of the public transport system;
- Development of cycling;
- Construction of technical check-up stations;
- Introduction of type approval procedures for new automobiles;
- Creation of environmentally friendly transport system.

Direct GHG emission projections in the energy sector were made taking into consideration primary and final energy consumption forecasts. Estimations were made according to the Revised IPCC guidelines. CO_2, CH_4, N_2O and aggregate GHG emission projections are presented in Table 5.2 and Figure 5.4.

Table 5.2

CO_2, CH_4, N_2O and aggregate direct GHG emissions in 1990-2020, Gg

	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
CO_2	22964.29	10017.90	6999.20	8767.95	9241.26	9886.12	11185.65
CH_4	63.69	29.10	25.20	26.07	27.97	30.25	31.64
N_2O	1.05	0.26	0.32	0.39	0.42	0.44	0.48
Aggregate direct GHG emissions, Gg CO_2 equivalent	24628.24	10710.30	7627.90	9436.32	9958.83	10657.77	11998.89

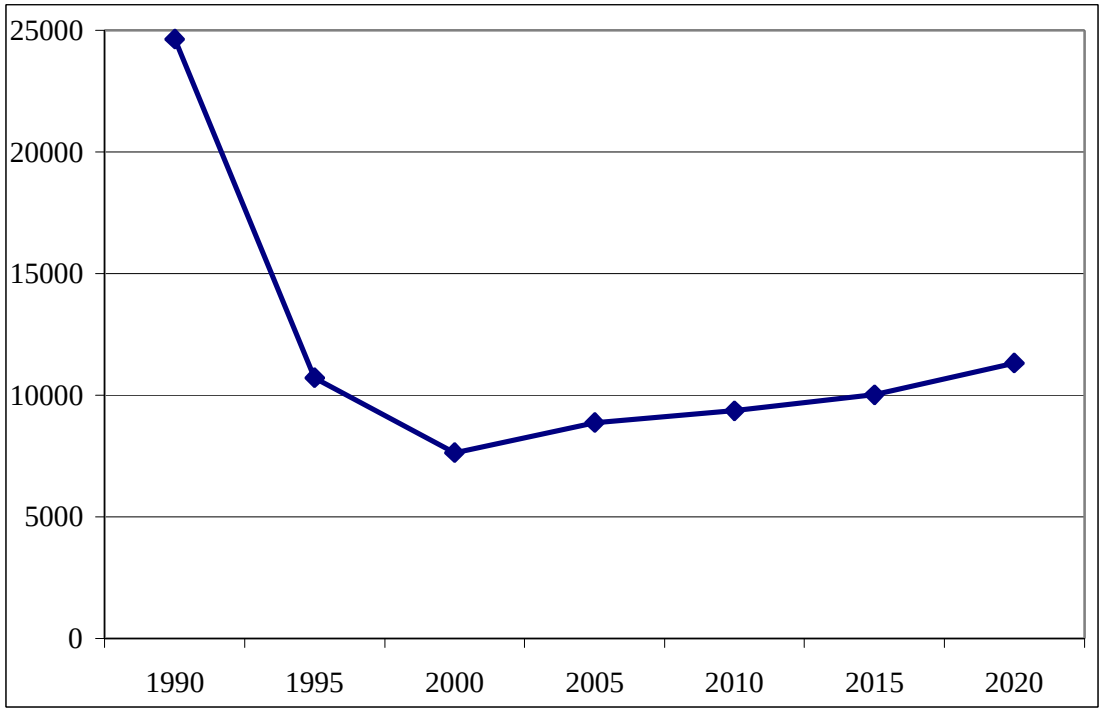


Figure 5.4. Aggregate GHG emissions in energy sector in 1990-2020, Gg CO_2 equivalent

5.1.2. Industrial processes (2 A,C,D)

To estimate direct GHG emissions from industrial processes, projections of outputs of those products that generate GHG emissions in the process of their production or consumption were made according to IPCC guidelines in regard to estimation of GHG emissions from industrial processes (see Section 5.3).

Energy efficiency increase measures in dairy companies and bakeries were taken into consideration in the industrial scenario "with measures" (see Section 5.1.1). However, due to the shortage of data, the measures of introduction of environment management systems and cleaner production in pharmaceutical and chemical industry were not included (see Section 4.3.2). CO_2 emission projections are presented in Table 5.3.

HFC emission projection from industrial processes

According to the IPCC guidelines, also HFC emissions refer to industry. HFC are generated in the process of production of different freezing equipment where HFC is used as filling in this equipment. Since such equipment is not produced in Latvia, the potential emissions from imported freezing equipment were estimated (see Table 5.3).

SF_6 emission projection from industrial processes

SF_6 in Latvia is used in JSC "LATVENERGO" high voltage distribution equipment. The company by the year 2010 plans to replace all high voltage distribution equipment produced in former USSR by modern SF_6 gas filled equipment. Therefore, it is predicted that by 2010 the amount of SF_6 will go up by 500 kg every year. After 2010 this growth will slow down as it is planned to gradually exchange vacuum switches. Potential SF_6 emissions are presented in Table 5.3.

Table 5.3

CO_2, HFC and SF_6 emissions in 1995-2020

	1995	**2000**	**2005**	**2010**	**2015**	**2020**
CO_2, Gg	127.40	100.86	105.85	116.82	128.28	141.24
HFC, kg	NO	NO	NO	2287	8500	9200
SF_6, kg	NO	0.86	1.61	2.36	2.89	3.19
Total, Gg CO_2 equivalent	127.40	100.88	105.89	119.85	139.40	153.28

Aggregated forecast of direct GHG emissions from industrial processes is presented in Figure 5.5.

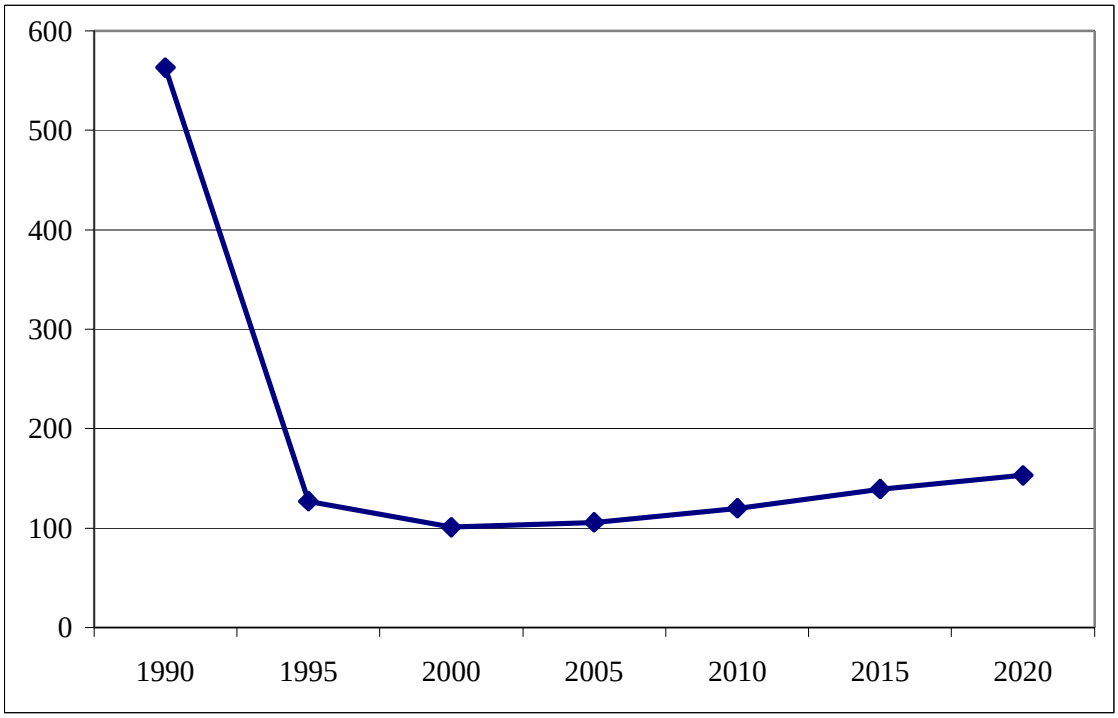


Figure 5.5. Aggregated direct GHG emissions in industry in 1990-2020, Gg CO_2 equivalent

5.1.3. Use of solvent and other product (3)

The only direct GHG emissions in this sector are N_2O from the laughing gas used in anaesthesia. The projection is based on the assumption that import of laughing gas will stay on the level of the preceding years – that is approximately 10 t per year.

5.1.4. Agriculture (4 A,B,D)

The same method (as the one used for industry) was also employed to estimate CH_4 and N_2O emission forecasts in agriculture, i.e. forecasts were made in regard to production of the agricultural products from which GHG emissions in agriculture are estimated (see Annex 3). These forecasts take into consideration the development of agricultural sector provided that rural development and SAPARD rural development programs are implemented and requirements of good agricultural practice are respected.

Since these measures have other objectives and impact on GHG is only a side effect, activities in agriculture were not taken into account in identifying the total outcome of implementation of measures. CH_4, N_2O and aggregated emission forecasts are summarised in Table 5.4 and Figure 5.6.

Table 5.4

CH_4, N_2O and aggregated direct GHG emissions in 1990–2020

	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
CH_4, Gg	111.27	44.64	30.64	28.89	30.60	32.88	35.15
N_2O, Gg	9.67	3.22	3.53	3.78	4.40	4.64	5.16
Direct SEG total, Gg CO_2 equivalent	5334.70	1933.95	1737.17	1778.49	2006.60	2128.88	2337.75

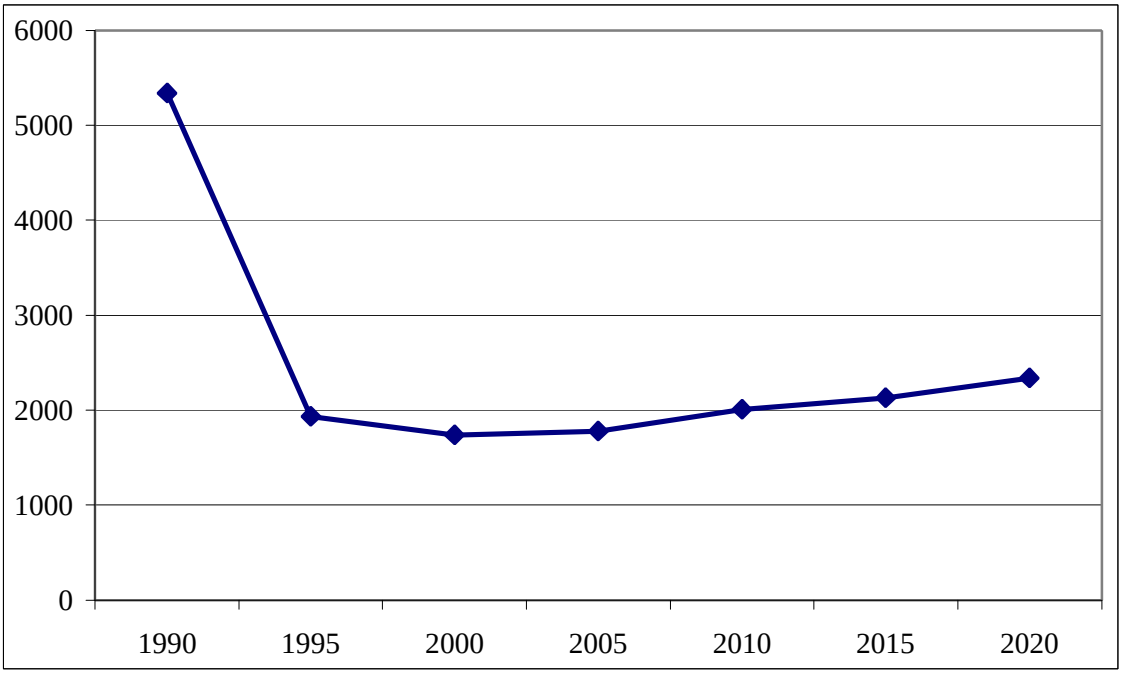


Figure 5.6. Direct GHG emissions in agriculture in 1990-2020, Gg CO_2 equivalent

5.1.5. Land use change and forestry (5 A,B,D)

The area of managed forests, according to forecasts, between 2005 and 2020 will grow. Furthermore, annual forest harvesting between 2005 and 2010 will decrease and will start going up again after 2010. Therefore, annual CO_2 sequestration in future will go up despite the decline in 1999 and 2000. This is explained by the fact that in 1990 the amount of cut wood was two times smaller than in 1999 and 2000 (see Annex 4) as the beginning of 1990s was the period of general depression in national economy and due to this reason comparison with the results of this period would not be appropriate. The forecast makes the assumption that this trend will not continue in future.

The following measures were taken into consideration in the scenario “with measures” in the sector of land use change and forestry (see Section 4.3.4):

- Targeted afforestation of abandoned agricultural land;
- Increase of forest productivity.

Projections of direct GHG emissions and CO_2 removals are summarised in Table 5.5.

Table 5.5

CH_4, N_2O and CO_2 emissions and removals in the sector of land use change and forestry in 1990-2020, Gg

	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
CH_4	1.6	2	3.71	2.99	3.24	3.59	3.71
N_2O	0.011	0.014	0.03	0.02	0.02	0.02	0.03
Net CO_2 emissions, including:	-10825.58	-10483.55	-4290.19	-9602.96	-9664	-9919.54	-11939.7
Changes in forest stock	-10960	-10600	-4384.88	-9720.99	-9791.01	-10052.26	-12072.59
CO_2 emissions and removals in soil	134.42	116.45	94.69	118.03	127.01	132.72	132.89
Direct GHG emissions and CO_2 removals, Gg CO_2 equivalent	-10788.57	-10437.21	-4204.57	-9533.66	-9589.14	-9836.71	-11854.04

5.1.6. Waste management (6 A,B)

The permanent figure of waste – 250 kg per one resident per year – was assumed for the purposes of estimation of direct GHG emissions in the waste management sector. The forecast of the number of population was taken from the long-term macroeconomic development forecast (see Table 5.1). Projections are also based on the assumption that in 2015 and 2020 unmanaged waste landfills will no longer exist, as all waste will be buried in organised waste disposal sites.

Biogas generation (see Section 4.3.5.1.) was the only measure taken into consideration in the waste management sector scenario "with measures". To estimate CH_4 emission reduction linked with the production of biogas, total CH_4 estimated emissions in the waste management sector do not include the amount of gas that will be used in the energy sector.

Table 5.6

CH_4 emissions in the waste management sector in 1990-2020, Gg

	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Estimated CH_4 emissions	19.39	25.60	64.23	46.62	44.99	43.18	52.75
CH_4 used in energy sector	0	0	0	14.22	14.13	11.34	10.69
CH_4 emissions	19.39	25.60	64.23	32.40	30.86	31.84	42.06

Growth of CH_4 emissions in 2000 presented in the Table 5.6 is linked with the change of estimation methodology (see details in Section 3.4.2).

Since biogas generation from waste does not have an impact on N_2O emissions, the projected N_2O emissions in the waste management sector are dependent only on the change in the number of population (see Table 5.7).

Table 5.7

Waste management N_2O and aggregated direct GHG emissions in 1990-2020

	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
N_2O, Gg	0.27	0.25	0.24	0.23	0.23	0.22	0.22
Total direct GHG, Gg CO_2 equivalent	491.1	615.1	1423.11	753.10	718.99	737.46	951.00

5.1.7. GHG emission projections expressed in the aggregated format

Figure 5.7 illustrates CO_2, CH_4 and N_2O emissions for the national economy scenario "with measures" in the time period from 1990 till 2020 expressed in an aggregated format, respecting GWP values for the time horizon of 100 years.

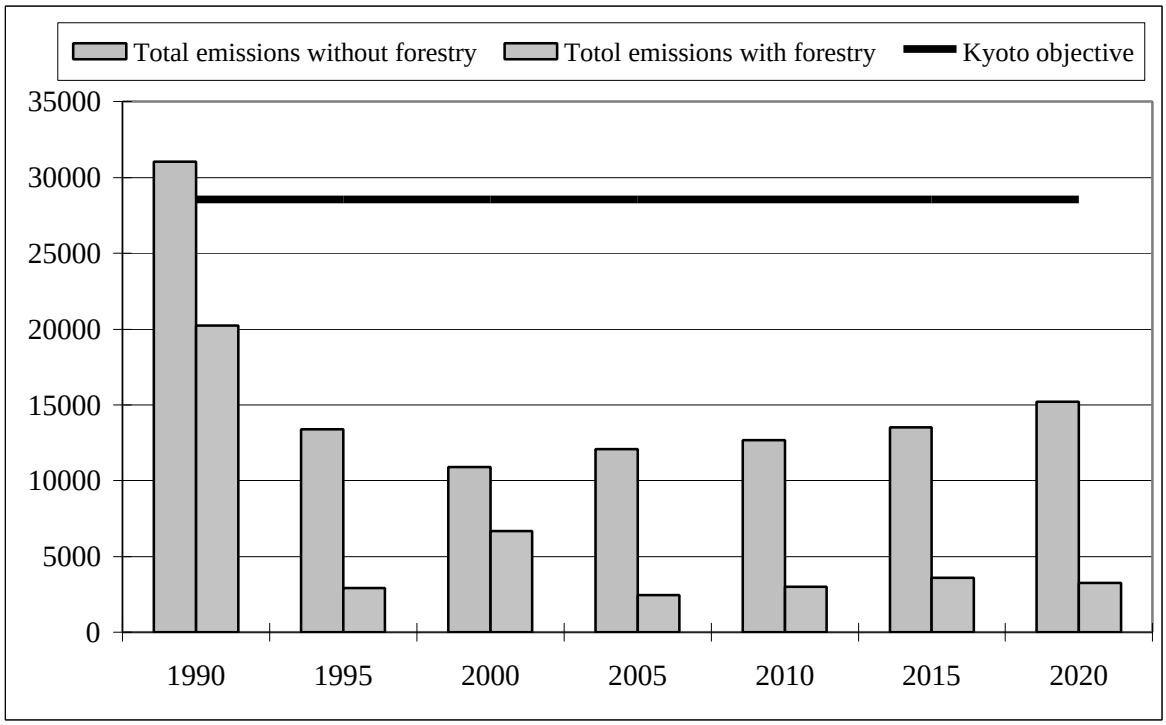


Figure 5.7. Direct GHG emissions in the aggregated format in 1990-2020, Gg CO_2 equivalent

Looking at the distribution of direct GHG by sectors (see Table 5.8), the projections show that the share of energy sector will go up from 70% in 2000 till 79.4% in 2020 with the share of industry staying unchanged – approximately 1%. The share of agriculture will decline from 13.5% in 2010 till 12.7% in 2020, the share of waste management sector – from 13.1% in 2000 till 6.3 % in 2020.

Table 5.8

The share of sectors in the aggregated GHG emissions in 1990-2020, %

Sector	1990	1995	2000	2005	2010	2015	2020
Energy sector	79.30	79.80	69.47	77.67	77.68	77.51	77.25
Industrial processes	1.80	0.90	0.92	0.87	0.94	1.01	0.99
Solvent and other product use	0.00	0.00	0.03	0.03	0.02	0.02	0.02
Agriculture	17.20	14.40	15.82	14.66	15.17	15.50	15.06
Land use change and forestry	0.10	0.30	0.79	0.57	0.58	0.59	0.56
Waste management	1.60	4.60	12.97	6.20	5.61	5.37	6.12
Total (without CO_2 from land use change and forestry)	100	100	100	100	100	100	100

5.2. Assessment of aggregate effects of policies and measures

GHG emission reduction is not the primary objective of the measures described in the Chapter on Policies and Measures but is rather a side effect of their implementation. Therefore, development scenarios of the sector cover only those activities where it was possible to evaluate the impact on GHG. Knowing that the majority of measures do not have an effect on CO_2 emissions, impact of all measures is expressed on the CO_2 equivalent basis. The communication does not contain estimates on the impact of measures on indirect GHG – CO, NO_x, NMVOS and SO_2. The aggregate effect of implementation of measures was estimated as the sum of outcomes of all measures (see Table 5.9).

Table 5.9

GHG emission reduction generated by measures in 2000-2020, Gg CO_2 equivalent

Measure	2000	2005	2010	2015	2020
Energy transformation	*-210.26*	*-21.56*	*-20.48*	*-22.84*	*-25.44*
Bio diesel fuel as a internal combustion fuel in small scale co-generation plants	NI	3.9	NE	NE	NE
Projects of the Local Governments' Crediting Fund	-22.9	-22.9	-16	-16	-16
Increase of energy efficiency in dairy companies of Latvia	-0.4*	-2.2*	-4.12*	-6.48*	-9.08*
Reduction of heat losses in buildings	-186.96	-0.36	-0.36	-0.36	-0.36
Transport		*-94.37*	*-148.72*	*-234.18*	*-486.91*
Use of bio fuel in road transport	NI	-23.59	-54.08	-78.06	-149.82
Improvement of the public transport system	NO	-11.80	-27.04	-46.84	-112.37
Development of cycling	NO	NO	NO	-15.61	-18.73
Construction of technical check-up stations	NE	-47.19	-40.56	-31.22	-18.73
Creation of environmentally friendly transport system	NE	-11.80	-27.04	-62.45	-187.28
International projects		*-16.6*	*-12*	*-12*	*-12*
Economically cost effective use of wood-waste in the local governments' heating systems	NI	-12	-12	-12	-12
Efficient lighting program	NO	-4.59	-9.24	NO	NO
Land use change and forestry	*2.7*	*-7.8*	*-14.78*	*-14.78*	*-14.78*
Targeted afforestation of abandoned agricultural land	2.7	-7.8	-14.78*	-14.78*	-14.78*
Waste management		*-298.62*	*-296.73*	*-238.14*	*-224.49*
Biogas generation	NI	-298.62	-296.73	-238.14	-224.49
Total GHG emission reduction	-207.56	-438.94	-501.95	-521.94	-763.62

* Source: [25]

GHG emission reference (baseline) scenario is given for the purposes of comparison. Estimation of GHG emissions in the baseline scenario is based on the assumption that none of the measures described in Section 4.3 are implemented and the share of coal, peat and oil resources in the consumption structure of energy resources goes up. Results of estimations and Kyoto objectives are presented in Figure 5.8.

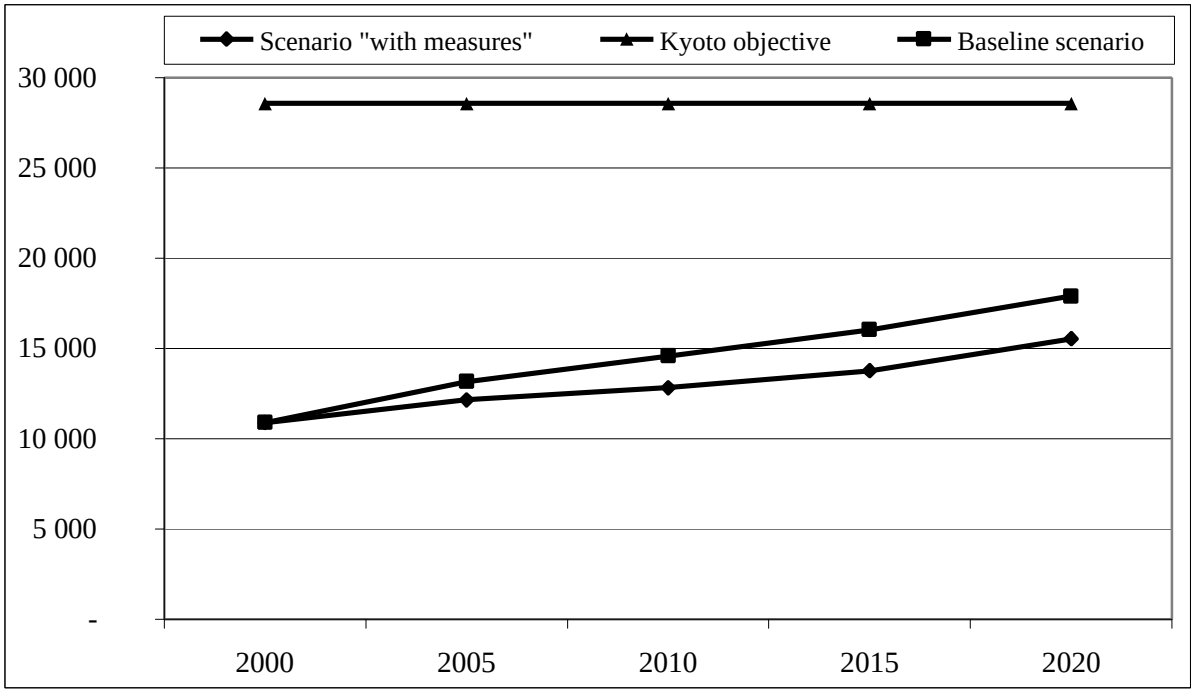


Figure 5.8. Aggregated GHG emissions in 2000-2020, Gg CO_2 equivalent

GHG emission ceilings prescribed in Kyoto protocol equal to 92% of the level in 1990 or 28 569.9 Gg CO_2 equivalent. Figure 5.8 illustrates that GHG emissions in the baseline scenario in 2010 will equal to 45% below the 1990 level but in the scenario "with measures" – 51% below the 1990 level. This means that Latvia will be able to fulfil the international commitments arising out of the Kyoto protocol of the UNFCCC also in the situation if no measures at all are implemented. However, it should be also noted that GHG emission projections could considerably change if the pulp plant is constructed in Latvia. The final decision on the construction of the pulp plant pursuant to the agreement between the shareholders a/s "Baltic Pulp" has to be made by December 31, 2002. And also, emissions could considerably go up if a new energy intensive industry starts developing in Latvia.

5.3. Methodology

GHG emission estimation scenario "with measures" is developed according to the IPCC common reporting format. It serves as a base for forecasting emissions in each sector taking into consideration the measures described in chapter 4. Different estimation methodologies were applied in each sector; therefore brief description of each method is presented below.

5.3.1. Long-term macroeconomic projections

Long-term macroeconomic projections are based on the long-term macroeconomic forecasts developed by the Ministry of Economy using the structural macroeconomic model. There are four main blocks in the macroeconomic model that are interrelated with each other: production (added value by aggregated sectors), GDP expenditure (private and government consumption), external sector (export and import of goods and services) and employment (employment and unemployment).

Four macroeconomic forecasts are developed by the Ministry of Economy to match four development scenarios. Forecasts are devised respecting two basic trends of growth conditions. Growth conditions may be divided into two main groups: one is linked with the internal growth capacity of the national economy and the other one – with external conditions. Internal growth capacity of the national economy depends on the success of economic policy of the state and the consistency of its implementation in order to:

- Create favourable conditions for functioning of the economy;
- To stimulate formation of efficient and competitive sectoral structure;
- To lessen socio-economic disproportion and risks.

External environment, in turn, will determine the ability of Latvia to use the internal potential of the country. This may be described by following terms:

- The nature of global development processes – is the growth going to be smooth, without profound financial and economic shocks;
- The degree of integration of Latvia in Europe and the EU, how harmonious the development of EU will be after the enlargement;
- Development of political and economical situation in Russia –it will result in the economic growth of the country.

5.3.2. Energy

MARKAL is a dynamic linear programming model used for flexible optimisation of the state energy system. The model was created to assess the interaction of the energy systems with the environment. The International Energy Agency (IEA) within the scope of Energy Technology Systems Analysis Programme – ETSAP developed the model.

MARKAL is a technologically oriented "bottom-up" model addressing both the supply with energy resources and the demand for them. MARKAL also allows modelling energy carrier flows in an energy system. MARKAL selects the most optimal structure of the energy system in each period of time optimising costs and respecting different restrictions.

Main assumptions for modelling are:

- Calculation for the dynamic, partially balanced energy technology markets for 9 periods, direct costs minimised (investments, variable and fixed costs);
- Length of a period is 5 years;
- The reviewed time period covers 45 years;
- Periods are centred on 1994, 1999, 2004, …, 2034;
- Discount rate is 7%;
- There are no restrictions on import of fuel and investment;
- There are restrictions on imports of electrical energy.

Table 5.10 presents assumptions of prices of energy resources and energy demand 5.10. Results of modelling are contained in Annex 3.

Table 5.10

Indicators used in primary and final energy consumption forecasts in 1994-2019

	1994	**1999**	**2004**	**2009**	**2014**	**2019**
Annual growth of usable energy consumption, %	NE	-5.9%	1.4%	1.5%	1.7%	1.7%
Elasticity (% consumption growth/ % GDP growth)	NE	-1.85	0.25	0.28	0.30	0.30
Energy capacity, MJ/USD1993	62.1	39.2	32.0	26.7	21.9	18.2
Prices for energy resources USD1994/GJ:						

	1994	1999	2004	2009	2014	2019
Gasoline	NE	6.08	6.29	6.55	6.74	6.85
Diesel fuel	NE	4.38	4.81	5.04	5.26	5.48
Liquefied gas	NE	3.74	4.11	4.31	4.50	4.89
Heavy fuel oil	NE	2.82	3.32	3.59	4.04	4.20
Natural gas	NE	2.62	2.91	3.15	3.37	3.60
Milled peat	NE	2.38	2.46	2.73	2.89	3.03
Block peat	NE	2.51	2.38	2.66	3.11	2.85
Coal	NE	1.94	1.94	1.94	1.94	1.94
Wood	NE	0.96	1.01	1.06	1.11	1.15

5.3.3. Transport

Projections of fuel consumption in the transport sector are based on statistical data on fuel consumption and the present trends in the transport sector of Latvia. Projections for each type of transport (road transport, railway, air, water, pipelines) and for various types of fuel (gasoline, diesel fuel, jet fuel, liquefied gas, natural gas, bio fuel) were added together, estimating annual change in the consumption. According to the judgement of experts, not all fuel consumed by transport is recorded as transport fuel because of tax consideration (it is higher taxed). Therefore, with the perfection of tax collection and fuel record system the amount of emissions from the transport sector might go up faster. These values are not included in forecasts as another application is indicated for the majority of fuel not recorded as fuel used for transport. Increase of efficiency of use of fuel consumption was also respected in energy consumption change estimation.

5.3.4. Industry

Each of the projected kinds of industrial production has its own specificity and difference in the general situation. Therefore, different methods and approaches to forecasting were used when developing projections in regard to each specific product group. The general forecasting in each of the product groups was carried out in the following phases:

- Collection of information and statistical data;
- Quantitative analysis of the object;
- Selection of the most appropriate forecasting method and/or model;
- Making long-term projections.

Taking into account the transition phase in the economy of Latvia after regaining of independence, it must be noted that the majority of the reviewed industrial products did not have an adequate statistical base that could be used in statistical trend models. Therefore in the majority of cases, estimation was based on the expert judgement, experts being persons possessing good orientation in the given sector (enterprise representatives, representatives of sectoral associations, business consultants who have worked with enterprises belonging to the reviewed sectors, specialists from the LDA and ME).

Latvian customs statistics was used in the projection of potential HFC emissions describing imports of the freezing equipment between 1995 and 2000. According to the results of the survey of suppliers and service providers, the warranty time for such equipment is from 12 to 15 years. Therefore it is assumed that starting from the day of the start of operation of equipment till the 11^{th}–13^{th} year of operation technological leakage of HFC is possible and the equipment is liquidated in the 14^{th} year after the start of operation. Possible

HFC emissions in the last three years of operation of the equipment are from 0.4 till 3% and in the process of liquidation (regeneration) – from 15 till 30% depending on the type of equipment.

Potential SF_6 emission forecast is based on the guarantees extended by suppliers of high voltage equipment saying that SF_6 leakage is not higher than 0.03% of the total amount used.

5.3.5. Agriculture

Data of the official Position Paper of Latvia in accession negotiations to the EU (see Annex 3), Chapter 7 on Agriculture were used for making projections in agriculture. The chapter defines maximum quotable production outputs. The projection also includes numeric evaluation of possible changes in trends (expert judgement).

5.3.6. Land use change and forestry

Forecasts in the sector of land use change and forestry (see Annex 3) were made on the basis of models developed by the Latvian State Forest Science Institute "Silava", data base on "Forest Fund" and judgement of experts. The following assumptions were made:

- It is assumed that forest area till the year 2020 will increase till 3.4 mill.ha and the distribution of the dominant tree species will not essentially change. The area with shrubs will also not change substantially, yet areas of cuttings and unfinished afforestation will increase because of expansion of forestland areas and forest use (forest harvesting) activities.
- Projections of annual (current) increase of forest stock are estimated in proportion to the growth of forestland and content of species. Increment of shrub wood is assumed as 1 m^3/ha per year. Average current forest stock increment in Latvia (weighted with the area under the dominant tree species) at the moment is 6.2 m^3/ ha per year. In total terms, annual increment of wood in all forest territories of Latvia is 16.5 mill.m^3.
- Annual natural die-off of wood is expected to slow down in future because of timely and adequately intensive implementation of forest management cutting.
- Data on the total forest stock is derived from forest inventory materials [65] and forecasts are made in proportion to the growth of forest areas assuming that productivity of forests will stayed unchanged for the nearest 20 years.
- Annual maximally admissible forest cutting volume is estimated with the help of the database on "Forest Fund " and a universal algorithm applicable to any age structure of forest stock. This algorithm is based on the principle of sustainable and non-depleting forestry. The methodology of estimation of admissible harvesting volumes is based on the classical principle of continuous, homogeneous and unrestricted use of forest. This means that the maximum allowable felling amount should not be bigger than the maximally possible usable quantity and should also not exceed the limit after which the amount of future forest felling will start decreasing in comparison with the present amount.

In line with the IPCC methodological guidelines, estimation of CO_2 removals should not include the areas of protected forests where all business activities are prohibited. Therefore a separate projection for the protected forest areas was prepared. Basic assumptions for the projections in regard to protected forest areas:

- The inventory of natural values is carried out at the moment in Latvia. According to the judgement of experts, this inventory will result in increase of the area of especially protected natural territories. It is also expected that the zones under strict regime where prohibitions of forestry business activities are in place will also expand.
- According to the provisions of the forestry certification standards (FSC and PEFC), approximately 7% of each forest farm area should be kept as forest biotopes. Any forestry activity will be prohibited in the biggest part of these biotopes. Introduction of this certification provision is voluntary, yet there is a good reason to forecast that the area of natural biotopes of protected natural forests will gradually come close to the ideal 7% level.

6. CLIMATE CHANGE IMPACTS, VULNERABILITY ASSESSMENT AND ADAPTATION MEASURES

6.1. Climate change impacts

Studies of seasonal and multi-annual dynamics of climatic indicators (air temperature, aggregate precipitation, wind, air humidity, snow cover, cloudiness, radiation balance, etc.) are essential aspects of the global warm-up impact assessment [58].

Direct climate change indicators in Latvia may be obtained from meteorological and hydrological observations carried out by the SHMB. SHMB observations testify that air temperature in Latvia is rising. In the second half of the 20th century also precipitation has increased. Mean annual temperature in Riga in the last 100 years has risen by approximately 1ºC. Such sharp increase, in part, is linked with the urban effect. During the same time, temperature outside cities has gone up by approximately 0.5ºC. Annual temperature variation range becomes smaller and variations tend to be more equalised (especially in winter and spring) [31]. Figure 6.1 shows annual mean temperatures in Rīga and Liepāja in the last 100 years.

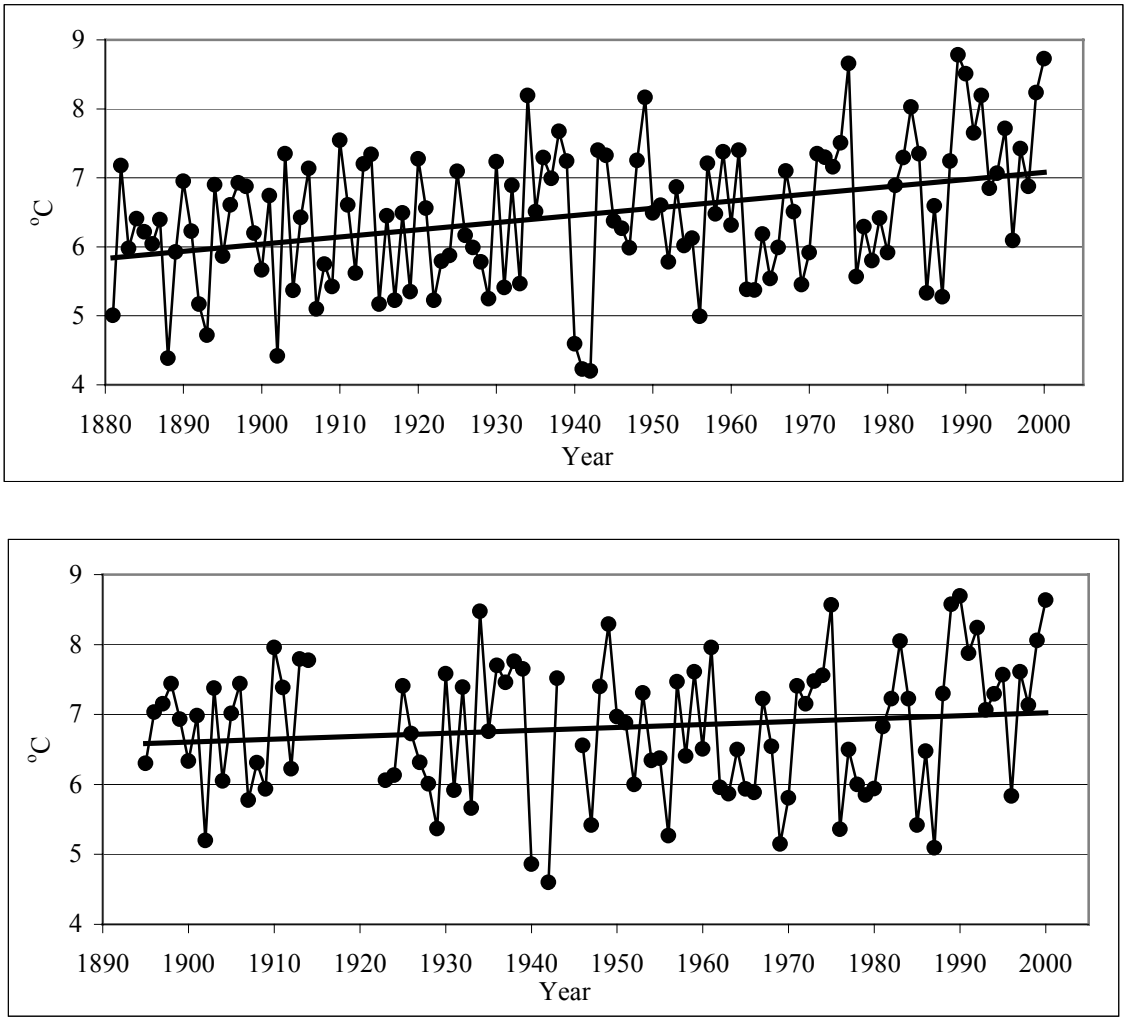


Figure 6.1. Annual mean temperature in Rīga and Liepāja

Data of SHMB surveys testify that there are observed both seasonal and long-term changes of hydrological indicators in Latvia (changes of through-flow in watersheds and water level changes in water basins). In the context of climate change assessment, one should note that water through-flow change in Latvia has been studied for more than 150 years and Latvia has old traditions of surface water and run-off regulation.

Detailed surveys of credibility and type of data obtained in temperature and precipitation observations are needed to interpret the identified meteorological and hydrological changes in the context of global climate change. Therefore, the insofar assessment should be treated as tentative.

Climate changes may be confirmed or denied by dozens of indirect observations. These are observations of processes in the sea, watersheds and coastal area, monitoring the dynamics of forest vegetation, statistics of the development of agriculture and fishing.

Integrated indicators of climate changes are widely used alongside with direct and indirect indicators characterising both the direct impact of climatic factors and reaction of the environment to changes. Studies of ground water levels and chemical composition, dendro-hydrology, anthropological data on adaptation of humans to environment conditions, soil formation and geo-chemical observation of soils and their bedrock have been carried out in Latvia and based on multi-annual data [58].

Specialists consider that in future under the impact of the greenhouse effect the snow-covered period will become shorter, vegetation period will be longer, rivers will develop different through-flows and distribution of precipitation will change. Temperature rise caused by the global warm-up promotes melting of Arctic and Antarctic glaciers and expansion of thermic water resulting in the raise of water level in the World Ocean. Consequences of this phenomenon will be also felt in Latvia. Considerable regional changes of weather conditions are expected in the Baltic region resulting from the projected sharp temperature rise by 4-5°C. Storms will become stronger and more frequent. Therefore, significant devastation in the coastal area might be expected. Storm-borne changes of water level (1-3 m) in the coastal zone of Latvia in future will become the most important risk factor [58].

6.2. Vulnerability assessment

6.2.1. Change of the coastal zone

Total length of Latvian coastal zone is 494 km [47]. It mainly consists of sandy beaches and dunes. Gravel, pebble or boulder covered beaches are less frequently met and steep coast – hardly ever. In the areas of sand accumulation, 1-4 m high pre-dunes are with the typical vegetation are in the process of shaping. The belt of grey dunes and forest-covered coastal dunes with domination of pine tree forests follows these. In the hollows between dunes there are plant communities of meadows, shrubs and even low swamps. Dry meadow and pine forest vegetation is met further away from the sea in the dunes [9].

Geographical situation predetermines vulnerability of Latvia to weather conditions and changes of water level in the World Ocean. Water level variations in the Baltic Sea and Riga Bay are mainly dependent on the wind-borne ebbs and flows of tides through Zunda strait. Water mass during strong storms in the coastal zone and especially in bays may reach the height of even 2-2.3 m as it happened during the hurricane in autumn 1969.

Studies of Latvian coastal processes are carried out in the Faculty of Geography and Land Science of the University of Latvia and SHMB. Studies have identified that water level rise in the open Baltic Sea in the west of Kurzeme in the last year 100 years has not exceeded 10-15 cm. Faster level rise was observed in the southern part of Riga Bay between 1875 and

2000. Yet, this is mainly predetermined by local factors – sinking of the earth crust, pumping of ground waters and crowding of water mass under the impact of strong north-west winds [58]. SHMB stations located in the coastal area of the Baltic Sea and Riga Bay (Liepāja, Ventspils, Kolka, Daugavgrīva, Salacgrīva) have recorded the following water level observations (see Figure 6.2).

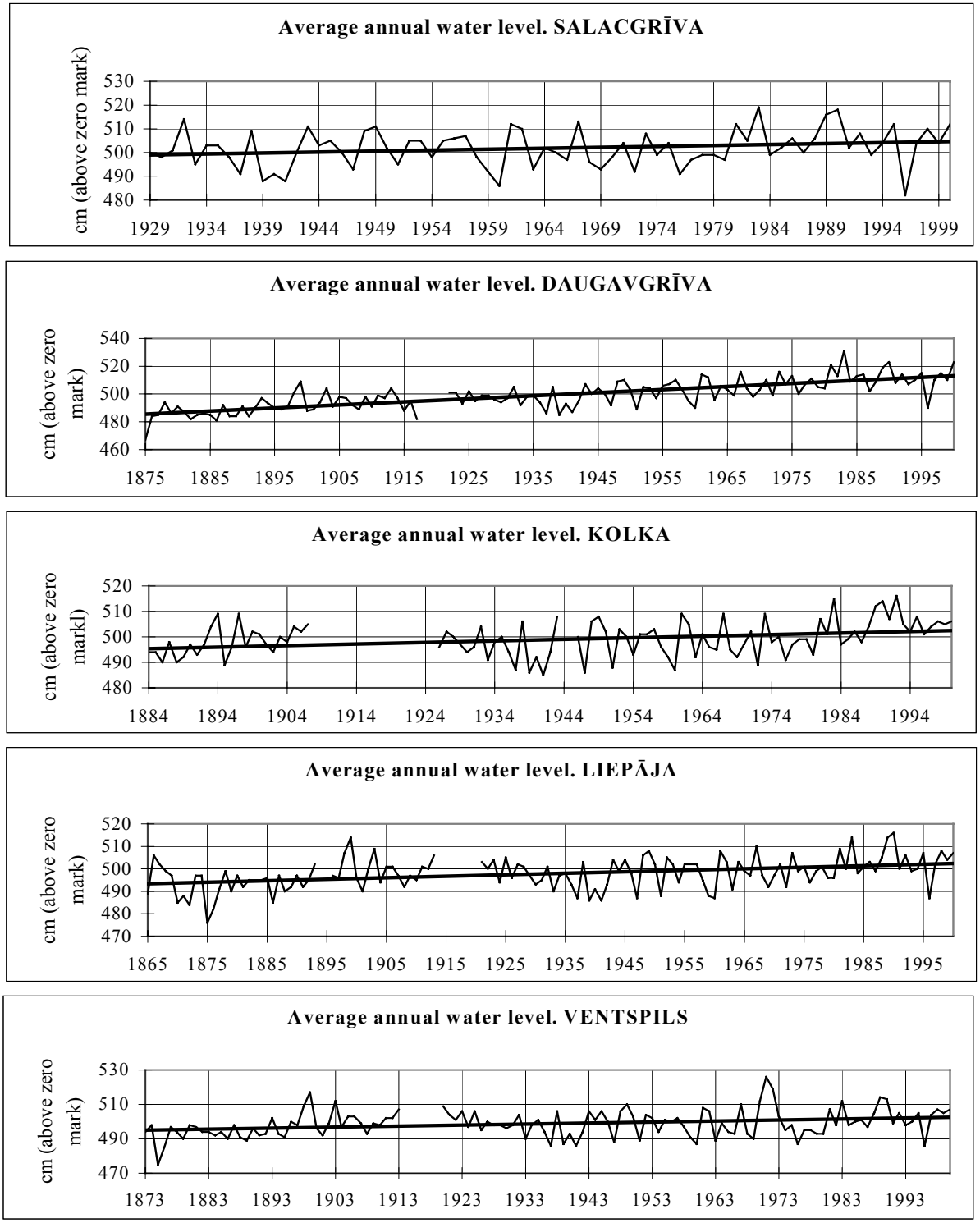


Figure 6.2. Changes of sea water levels in Latvia [1]

[1] Source: SHMB

If the mentioned phenomena are correctly assessed and the trends will be kept also in future the groundwater level in the lowest coastal zone of Riga Bay could rise by approximately 50-70 cm. Risk of floods in the lower reaches of the big rivers (Lielupe, Daugava, Gauja) will become higher. Ground water elevation may cause serious problems to people living in lower settlements in the coastal zone where the height above the sea level is 0.7-2 m. Over bogging of these territories is quite possible, the same as flooding of basements and basement floors and certain deformation of foundations of the buildings.

Changes in the water level are one of the reasons for higher intensity wash-off of the shore in the coastal zone of the Baltic Sea. The most important coastal erosion in the coastal zone of Latvia is observed in 130-140 km long area. The most intensive erosion is near Kurzeme coast (near Bernāti and Jūrkalne) where the coast during the year may step back by up to 20-30 metres. Seriously endangered is also the western coast of Riga Bay because of the concentration of housing in historical villages of fishermen [58].

Observations show that in the last 50-60 years the average wash-off of coasts in approximately 30% of total length of the coastal belt of Latvia reached 30-50 m, the maximal wash-off being 100-200 m. In the 80s and 90s of the 20th century the pace of coastal wash-off went up 2-5 times. During the strong winter storms in the last decade there was 40-50 m wide and several km long wash-off of forest and meadow area in Pape–Bernāti and Liepāja–Šķēde neighbourhood. More than 60% of total Latvian coastal line is storm erosion endangered. On the basis of the mentioned statements and assumptions it is forecasted that [58]:

- The location of the key risk areas of coastal wash-off will be determined by the direction of wind during the strong storms, their duration, frequency and crowding of water mass in the coastal zone.
- With climate becoming warmer, the number of storms caused by southern, south–west and western winds will go up. Baltic Sea coastal zone from Nida till Ovīši and Kurzeme coast of Riga Bay will be subjected to the risk of flooding and wash-off. During very strong and lengthy north–west storms the whole coastal zone of Latvia will most probably be subjected to wash-off.
- Approximately 100-150 living houses, household buildings, roads, cemeteries, beacons and other constructions will be found in the high-risk area of coastal wash-off. The biggest number of housing properties affected by wash-off will be located between Kolka and Jūrmala.
- In the nearest 40-50 years the width of the basic coast wash-off will occasionally reach 100-300 m. Considerable areas of pine forests in coastal dunes, natural meadows and agricultural land will be lost.

6.2.2. Change of vegetation

At present Latvian vegetation is undergoing intensive change mainly under the impact of changes of atmospheric sedimentation, climate and land use. Changes of Latvian vegetation are studied in the Faculty of Geography and Land Science of the University of Latvia and Latvian State Forest Science Institute – "Silava". Studies show that plant communities are becoming on the whole unstable, there is aggressive proliferation of many alien species [30, 31]. There are approximately 1700 vascular plant species in the Latvian flora of which almost one third are non-indigenous species that have spread because of human activities. Main routes of plant migration in Latvia are the Baltic Sea coast and river valleys (especially Daugava). Motor roads, railways and seaports are also important for arrival of

alien species. The naturalised non-indigenous species have mainly originated from South and south–east Europe, Middle East and America.

Consequently, this provokes changes in the structure of geographical elements of the flora: the share of boreo-temperate species is going down and the share of sub-meridional and meridional species is going up. There are also changes in the content of wood plants. The share of coniferous tress, especially pines (boreal forest element) is going down and the share of broad-leaved species – oak, ash, maple, elm (nemoral forest element), alongside with the secondary foliage trees, is going up (see Figure 6.3).

Presently, pine stands in Latvia are stable only in sandy and poor soils as well as in wet oligotrophic peat soils. These facts testify about the gradual transition of macro geographic vegetation structure (biomes, vegetation zones) from south to north. Despite changes in vegetation, forest stock growth trend in Latvia in the last 60 years has been positive and stable (see Figure 2.7). Climate changes – growth of precipitation and mean annual air temperature, increased CO_2 content in the air – are factors fostering faster growth of forests. At the same time one could predict higher risks of pest-caused devastation, forest diseases and forest fires as well as lessening of stability of the forest ecosystem.

Notably, the changeable economic, technological, social and political conditions have caused much more transformation in Latvian vegetation than potential changes of climatic conditions.

Business activity (forest use, forest renewal, land reclamation, forest fires) for already several centuries significantly influence forests, composition of forest species, their build-up and distribution over the territory of the state. Pine is the dominant tree species at the moment in Latvia, yet without a purposeful formation of the culture pine proliferation would be much smaller as natural regeneration of pines in Latvia is rather limited.

Forestland reclamation is among the most efficient forest productivity support activities in Latvian conditions: productivity of forest stands in drained areas goes up 2-4 times. Ecological conditions in the forest essentially change after reclamation – aeration of soil improves, intensive mineralization of ground litter and peat takes place. There is a rather fast process of change of the content of species, especially in the ground litter of the forest.

Forest suffers in fires that break out in dry periods. The number of forest fires has gone up during the last years and the area burnt in one fire tends to become smaller. Baring of mineral soils creates favourable conditions for the renewal of coniferous species, especially pines.

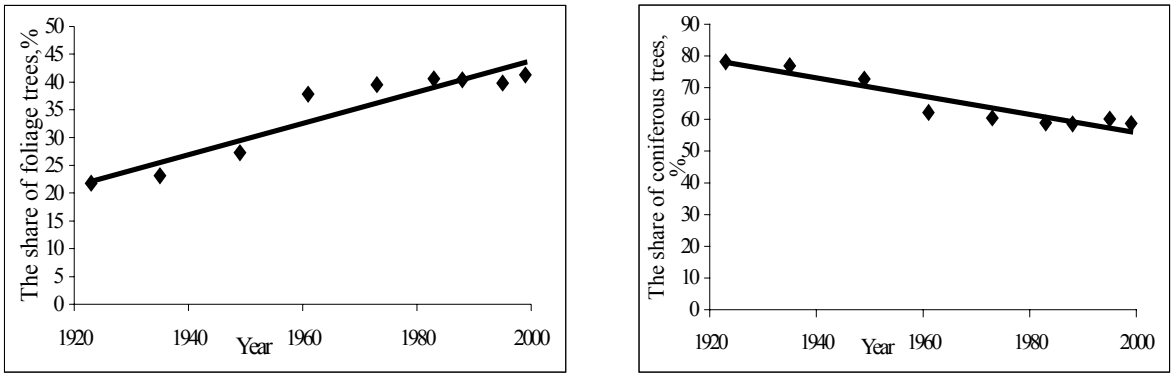


Figure 6.3. Dynamics of foliage and coniferous trees [31]

6.3. Adaptation measures

Latvia has reached awareness of the issue on the impact of climate change for environment and national economy, yet the problem is not studied to the end.

Monitoring and research may create preconditions for the development and implementation of adaptation measures. The National Program on Biological Diversity contains the conclusion that by observation of natural processes and accumulating information as well as by studying individual indicator species or ecosystems it is possible to justify the need of different environment protection measures and even change sectoral development policies, develop corresponding legal acts and economic activities [9].

Special studies should be carried out in the endangered areas of the coastal zone to assess and follow the extent of possible changes. These data should be taken into consideration in all territorial planning activities to timely foresee and prevent material losses.

The currently effective Law on Protective Belts (see Annex 1) stipulates 300 m wide coastal dunes protective belt for coastal protection in the Baltic Sea and Riga Bay and 5 km wide limited business activity area. Several specially protected nature territories have been established for protection of natural coastal values (Slītere National Park, Ķemeri National Park, North Vidzeme Biosphere Reserve, several nature sanctuaries and nature parks). Planting especially resistant plants reinforces dune sands.

Agriculture and forestry are the sectors of economy that are most of all vulnerable to climate change. Long-term changes in ecosystems result in change of productivity and influence the development of these sectors. Projections of climate change should result in the development of policies and strategies of adaptation measures to changes. Targeted efforts should be made to develop new species and to improve their growing technologies. Results of forest monitoring should be also taken into consideration when planning forest plantations and afforestation. Scientists deem that, forestry should focus more on stands of foliage trees and spruce, predicting that pine growing will be prospective and economically beneficial only in poor soils [31]. Wood industry should be also adjusted accordingly.

The actions within the National Program on Biological Diversity envisage the development of sustainable forestry action plan, follow proliferation of alien species in forests and support elimination of expansive species as well as to carry many other activities aimed at keeping biological diversity [9].

Post-ice period geological, especially palinological studies show that vegetation of Latvia has changed with changes of climate and these natural changes should be regarded as regularity [16]. One may assume that in the time period when climate change proceeds faster, ecosystems become more vulnerable to various side factors. At present, the task of the research community is to assess, if at all and how the human business activity provokes certain changes that are harmful and hazardous to humans and nature. This would allow modifying the sectoral development policy and economic and legal instruments in the way allowing Latvian economy and people to get timely adjusted to climate changes.

The contribution of Latvia in international activities aimed at promotion of sustainable development, preservation of natural diversity, assessment of the impact of climate changes and development of adaptation measures is as follows:

- Participation in international conventions ("On Climate Change", Rio de Janeiro, 1992, "On Biological Diversity", Rio de Janeiro, 1992, "On Preservation of European Wild Plants, Animals and Their Natural Habitats", Bern, 1979, "On Preservation of Wild Animal Migratory Species", Bonn, 1979, "On Protection of Wetlands", Ramsar, 1975 etc.);
- Work in the Intergovernmental Panel on Climate Change (IPCC);
- Participation in the *World Weather Watch programme* and other programs (see chapter 7).

7. RESEARCH AND SYSTEMATIC OBSERVATION

7.1. Policy and funding

Surveys on climate and climate change, environmental communication and education problems and their importance in Latvia are reflected in various documents: Environment Protection Policy Plan of Latvia, Environment Awareness and Education Strategy and Action Plan, national legislation. These instruments are important to fulfil international commitments and integrate in the EU.

Surveys and programs dealing with climate and climate change related problems, possibility of reduction of climate change and impact of climate change on ecological and social and economic systems in Latvia are carried out by several organisations:

- Academic: University of Latvia (LU), Riga Technical University (RTU), Latvia University of Agriculture (LUA);
- Research institutions, such as Latvian State Forest Science Institute – *Silava*, State Forest Inventory Institute, Institute of Physics and Energy, Institute of Microbiology and Biotechnology and others;
- Ministries and agencies: MEPRD, LDA, Latvian Environmental Agency;
- Governmental environment institutions: "Vides projekti", SHMB;
- Scientific research and consulting companies;
- Non-governmental organisations.

A major part of research linked with climate and climate change problems in Latvia is integrated in national or international research or monitoring programs. Funding for research is very scarce and it comes from different sources:

- Internal resources in the state: government budget (grants of the Latvian Research Council), PIP, Latvian Environment Protection Fund and budgets of different enterprises of Latvia, for example, LATVENERGO;
- From international programs and projects: projects funded by PHARE program, funding of pilot phase activities of joint implementation projects to set up expertise and monitoring systems as well as networking, inter-state programs, such as research program on reduction of climate change of the Netherlands and Latvia.

7.2. National and International Research

7.2.1. Research on the impact on climate and climate change

Being a party to the Convention on the World Meteorological Organisation (WMO) Latvia has been involved in implementation of various international programs and projects connected with observation of weather conditions and climate. World Weather Watch program is the main program of WMO targeted on aggregation, processing and exchange of global meteorological, hydrological and the related data and information. The program consists of the *Global Observing System, Global Telecommunication System* and *Global Data Processing System*. The aim of the program is to provide data and information about the observed and expected weather conditions to programs and projects of the WMO member states as well as to international environmental organisations. World Weather Watch program provides also basic information about the global climate change research. Latvia takes part in

this program with the results of meteorological, oceanological and related observation in the national observation network (see Section 7.3).

BALTEX (*Baltic Sea Experiment*) project started in 1992 embraces research institutions, universities and national agencies from 10 countries of the Baltic Sea region. The project addresses problems outlined in the WCRP (*World Climate Research Programme*), GEWEX *(Global Energy and Water Cycle Experiment*) subprogram. Basic program, which should be accomplished to successfully implement the project, includes aggregation of the measurement and satellite information, secondary analysis of the existing data sets, creation of a uniform data base, numerical experiments and joint modelling, process investigation, including field experiments. The objective of Latvia within this program is to aggregate hydro meteorological data and create a united database.

The Faculty of Geography and Land Science of LU and SHMB carry out research of coastal processes in Latvia. An example of such research is *The Marine Coastal Processes and Their Anthropogenic Changes* funded by the Latvian Research Council.

International research:

- PHARE funded project *Integrated Coastal Management Project*, MEPRD, 1999-2000;
- Latvian–Danish co-operation project *"Pape–Jurkalne Management Plan"*, MEPRD, 1999-2000.

Changes in Latvian vegetation because of dynamics of environment are studied in the Faculty of Geography and Land Science of LU where the Biogeography Laboratory was established in 1998 [31]. Biogeography at the moment is one of the most prospective branches of natural geography. This to a great extent is predetermined by the rapid migration of biota in the unbalanced environment and the insofar-complicated predictability of impact of this change on the human living space. These global problems are extremely important also for Latvia encouraging the establishment of the mentioned Biogeography Laboratory in the Faculty of Geography and Land Sciences in the LU.

Problems related to forestry are studied in the Latvian State Forest Science Institute *Silava* and Forest Faculty of LUA. Research covers forest ecology, afforestation and genetics, efficiency of forest renewal and silviculture, forest monitoring, forest policy and economy, etc. Some of the programs and studies funded by the Latvian Research Council are mentioned below:

- *Biocenotic Parameters as Indicators of the Long-Term Changes of Ecosystem's State* (LU, Institute of Biology)
- *The Ecology and Geography of the Vegetation of Latvia: Classification and Dynamics of Plant Communities and Biotopes* (LU)
- *Geographical and Ecological Aspects of the Transformation of Agricultural Lands to Forest Land Use* (LU)
- *Theoretical Models of Multifunctional Ecological Forestry* (Institute of Forest Science *Silava*).

International research and programs:

- PHARE funded project *Institutional Support to Private Forestry in Latvia*;
- *Jaakko Pöyry Consulting AB* jointly with the Latvian project group developed projects to support sustainable forestry in Latvia: *On Perfection of Forest Protection System* and *Forest Biotopes'Inventory Project*;
- *ICP Forest Regional Monitoring Program*. Latvia takes part in this program since 1990; main objectives of the program: to monitor changes in forest ecosystems, to follow dominant trends and identify main factors influencing them.
- *Integrated Co-operative Program on Integrated Monitoring*.
- *Monitoring of impact of air pollution on ecosystems in Rucava and Taurene*.

Protected territories in Latvia are very important for the purposes of monitoring of nature and environment, scientific research, educating and raising awareness of the community. At present in Latvia there are 246 specially protected nature territories covering 8.7% of the total area of the state. The most important of these are: North Vidzeme Biosphere Reserve established in 1990 which occupies 475326 ha created to promote sustainable development of the region and preserve natural and cultural history values. In 1997 the council of the UNESCO program *Man and Biosphere* awarded this territory the status of Biosphere Reserve of international importance. More detailed information on specially protected natural territories in Latvia is available on the home page of the Latvian Environmental Agency [49].

7.2.2. Research in the area of technologies of GHG emission reduction

Latvian Research Council (LRC) provides regular funding to various researches directly or indirectly addressed to technological aspects of GHG emission reduction. Problems addressed in such research materials are mainly focussed on optimisation of technologies (as one element) or systems (as a set of elements). For instance, the following studies were included in the LRC 2000 and 2001 research program:

- Optimisation of Latvian heat energy generation and use systems.
- Optimisation of Latvian transport system.

On the other hand, LRC also annually provides grants for studies of specific technological processes and equipment linked to the reduction of impact from climate change. Professors and research workers of Energy and Electro technical Faculty (EEF), Faculty of Chemical Technology, Faculty of Mechanics and Construction of Riga Technical University provide significant contribution in the area of implementation of these studies.

RTU EEF has an extensive co-operation with JSC LATVENERGO – the main producer and supplier of electrical energy in Latvia. In 2001 LATVENERGO ordered EEF a 5-year long contract-based study *On the Development of the Intellectual Control Method of Electrical Energy Systems and Objects and Optimisation of GHG Emission Reduction.*

Joint Latvian–Dutch project – *On Policy and Activities to Eliminate GHG Emissions and Increase of Removals in Latvia* was implemented in 1998-2000 in Latvia under the guidance of MEPRD [24, 25]. The project was funded by the government of Netherlands and developed by the experts invited by MEPRD and Dutch research workers. The project presents the developed “business-as-usual” reference scenarios for sectors of economy from 2000 till 2020. Each scenario contains a brief description of the present situation and priority directions of economic development as well as GHG emission forecasts. Activities to lessen GHG emissions are analysed based on a detailed bottom-up evaluation approach of individual technological processes. Each activity is supplemented with calculated implementation costs, GHG emissions and other parameters and these figures are compared with the respective values given in the reference scenario.

Various environment research projects are implemented in Latvia for already several years, which, among others, also focus on the analysis of reasons causing global climate change. Such projects are: Baltic Sea project (co-ordinated by the Ministry of Education and Science in co-operation with the UNESCO), project *Air Researchers Web* (co-ordinated by the LU Ecological Centre), international GLOBE project as well as the project – *School Network for Sustainable Development* (co-ordinated by the Children Environmental School) addressing in its scope also analysis of opportunities of schools and local governments in the area of implementing sustainable development principles on the local level.

LU Microbiology and Biotechnology Institute, RTU and LUA in 1999 continued work at the joint research program *Bio fuel Production Technology and Implementation Possibilities in Latvia.*

7.3. Systematic Observation

7.3.1. Climate observation

Meteorological observations in Latvia, within the scope of the World Weather Watch program, are done in 22 stations. Measurements include main physical condition of atmosphere in ground interface as well as elements characterising land surface, such as temperature of air, air humidity, wind direction and speed, atmospheric pressure, meteorological visibility, cloudiness, atmospheric precipitation, parameters of snow cover, atmospheric phenomena, soil surface condition and temperature. Observations are made 24 hours. Every three hours and in extreme circumstances – immediately – information is transmitted to the SHMB and through Global Telecommunication System – to other WMO member states. Besides observations in the stations, there are 60 points that monitor atmospheric precipitation and snow cover.

Information on physical parameters of higher levels of atmosphere (till the height of 25 km in the average) – air temperature and humidity, atmospheric pressure, wind direction and speed is provided by the so-called aerologic (atmosphere probing) observations of Riga Meteorological Station. Also results of these observations are sent to SHMB and through Global Telecommunication System – to other WMO member states. This information is used to identify and investigate atmospheric formations – cyclones and anti-cyclones, their origination and movement and also to develop weather forecasts and to plan optimal, safe and economic flights. Levels of atmospheric radiation are measured with a special probe. However this is done only if there is information about emergency leakage of radioactive substances.

Within the scope the *World Climate Data and Monitoring Programme* sub-project CLICOM – (*CLImate COMputing*) results of annual meteorological observations in the Latvian observation network are aggregated in the CLICOM data summary and processing system. CLICOM operates in meteorological services of about 150 WMO member states. The system ensures the possibility of exchange and use of meteorological data in a single computerised format. Observations made in several observation points for 100 years and longer aggregated in the electronic database provide information about main tendencies of Latvian climate parameters.

7.3.2. Sea level observation

Baltic Sea level observations in the coastal area of Latvia were started in 1841 in Daugavgriva, using water level measuring lath. Later measurements with laths were started in Liepaja in1865, Ventspils in 1873, Kolka in 1884. At present sea level observations are made in 7 points in the coastal area of Riga Bay (Salacgriva, Skulte, Daugavgriva, Jurmala, Mersrags, Roja, Kolka) and in 3 points in the eastern side of the Baltic Sea (Ventspils, Pavilosta, Liepaja) (see Figure 6.2). Since 1946 in all territory of Latvia sea level is calculated as level above Kronshtadt measuring lath zero point in the so-called Baltic system.

All sea level observations are kept in the form of tables in SHMB. Database for sea level observation has been developed in 1961-2000. Manuals on *Water Level Observations in*

the Latvian Coast of the Baltic Sea in 1961-2000 have been compiled for points in Skulte, Daugavgriva, Jurmala and Liepaja. Manuals contain information on average daily, monthly, annual water level values, maximal and minimal values as well as extreme and standard deviation values. Linear trend with the respective equation was used to make annual average water level estimations. These manuals are the official aid and a fundamental publication of SHMB. The manuals are targeted to the wide network of economic and research organisations.

7.3.3. Ice condition in the Baltic Sea and Riga Bay

Co-operation between the Baltic States in the *Baltic Ice Meeting* is based on the use of the united Baltic ice code and exchange of ice observation data to ensure navigation in the Baltic Sea in winters.

Ice cover or area under ice at a certain period of time is one of the main indicators characterising ice conditions in the sea. Ice conditions in the Baltic Sea and Riga Bay considerably differ from year to year. SHMB has data on the maximal annual ice cover in the Baltic Sea depending on 5 possible types of winter conditions (very mild, mild, medium severe, very severe).

7.3.4. Databases of the Latvian Environmental Agency

Latvian Environmental Agency tests quality of environment, undertakes methodological guidance of this work in Latvia, develops sets of methods to analyse the environmental quality and maintains a united environment data information system.

INTERNET home page of the LEA provides a description of the existing databases (see Table 7.1) and the needed information is made available upon request.

Table 7.1

Databases of the Latvian Environmental Agency [49]

Data bases	Aggregated information
Water protection	• State statistical report “2-Water” (on water in-take, use, discharge and residual pollution) • Water use permits • Lake passports
Atmosphere protection	• State statistical report on the protection of air “No.2-Air” • Greenhouse effect causing gasses
Land ecosystems	• Species of protected plants • State statistical report on emission of hazardous substances “No.3-BA” • Especially protected nature territories
Spatial databases	• Digital map of Latvia (Scale 1:500000) • Digital map of Olaine (Scale 1:10000) • Digital map of Latvia (Scale 1:200000) (without distribution right!) • Digital map of Latvian soils (Scale 1:400000) • CORINE LAND COVER digital map (Scale 1:100000) • Thematic maps on environmental loads in 1998 (Scale 1:2000000)

Data bases	Aggregated information
Other databases	• Reports of regional environmental boards, accident reports and business restriction records • Latvian watersheds • State statistical report on use of chemical substances and products “No.4-KP”
On-line databases	• Search of integrated environment information about enterprises • Water information system • Air information system • Information system on protected territories • Information system on hazardous waste • Information system on natural resource • Meta data information system

8. EDUCATION, TRAINING AND PUBLIC AWARENESS

8.1. Main political tools for education, training and creating public awareness about the environment

Efficiency of solving environmental problems is directly dependent on the level of knowledge of people involved in the process, their sense of responsibility and possibility to provide input in elimination of global climate change. This also involves comprehension that global climate change problems may become more topical in future – therefore, they should be understood and taken into account already today. Most important means of creating public awareness about environment are environmental education and access to information.

To encourage development of co-ordinated and effective environmental awareness and communication system in Latvia and to respect provisions of Arhus convention [4], Strategy on Environment Communication and Education and the Action Plan were developed in 1998-2000 [76]. The goal of these environmental policy documents is to form the knowledge and understanding in the society about environmental regularities, problems and possibilities of their solution, as well as about activities resulting in global climate change and to encourage co-operation between different target groups in the society in the area of environment-related decision making and development of environmentally friendly public awareness. Concrete actions are planned to reach the set goals thus promoting efficiency of environment information exchange, development of types and content of environmental education in the formal and informal education, encouraging participation of the society and each individual in preparation of environment-related decisions and general decision making as well as creation of environmentally-friendly actions and new models of behaviour. Main target groups of environmental communication and education can be classified as follows:

- Public administration institutions;
- Local governments and their representative organisations;
- Residents;
- Business organisations;
- Public organisations;
- Mass media;
- Organisations of public education;
- Research and technologies, higher educational establishments.

8.2. Primary schools, secondary schools and higher education

Realisation of environmental education in primary schools and secondary schools is stipulated in the Environmental Education Guidelines approved by the Ministry of Education and Science of Latvia defining environment education as an inter-disciplinary topic and emphasising the necessity to integrate environment education in the content of other subjects. Resources used in learning process play an important role. With the development of information technologies and foreign language proficiency materials available on Internet may be used increasingly often. With the support of PHARE program the book *Our Ecological Footprint* by M.Wackernagel and W.E.Rees was translated, published and distributed in all schools in 2000. This book can be used as a method for analysis of local and global environmental processes and their interconnection. Also *Heating in Private Houses* by B.Davin offers solutions and alternatives for setting up environmentally friendly heating.

Since 1997/1998 schools every year organise project weeks when school students individually or in teams develop projects, among them also on the possible alternatives of energy conservation in schools, alternative means of transport and other topics related to the global climate change.

Olympiads of environmental projects in Latvia are held since 1995 organised by the Ministry of Education and Science in co-operation with MEPRD. Although topics chosen for projects in the majority of cases refer to the closest neighbourhood, problems and possible solution there, quite often when analysing local environment problems students come to the conclusion that their local problems were caused by global environment problems. Students, then, are better able to understand the idea behind the principle "Think global, act local".

JSC "LATVENERGO" organises annual competitions "Vatinš" held between the schools already several years. One of the main aspects of the competition is rational energy use and its connection with the reduction of environment pollution.

Environment education plays an important role in the secondary vocational education. The 120-lesson course on Environmental Science is a compulsory minimum to be learned by any student of a secondary vocational school. Part of the course is focussed on global climate change and the related transformation of the environment.

Data of the Ministry of Education and Science of Latvia show that environmental education may be mastered in 4 vocational education schools: Olaine College of Mechanics and Technology, Kazdanga, Viški and State Priekuli Technical School of Agriculture.

Various bachelor, engineering, master and doctor degree programs in various environmental science and management areas are implemented in Latvia since 1992. At the moment the most active and focused on climate change problems study programs operate in LU: in the Environmental Science and Management Studies Institute, Faculty of Chemistry, Faculty of Geography and Land Science; in RTU – Faculty of Energy and Electrical Engineering and Faculty of Chemical Technologies; in LUA: Faculty of Rural Engineers and Technical Faculty. Bachelor and master degree programs include chapters on global climate change analysing their impact on both local environmental processes and also global influences.

8.3. Public information campaigns

Community information actions are implemented with the assistance of both state institutions and public and non-governmental environment organisations. The role of the latter is even more important. NGOs organise actions, rallies, campaigns etc. other activities aimed at attraction of attention of people (see Sections 8.6 and 8.7).

Information actions and campaigns are implemented within the scope of various co-operation programs. These in the majority of cases are linked with promotion and introduction of new environmentally friendly technologies. Three last information actions in Latvia linked with new energy technologies and reduction of the impact on climate change were as follows:

- Energy conservation campaign was implemented within the scope of the Dutch-Latvian SCORE co-operation program. The campaign included surveys of opinion of people, clarification of their attitude and knowledge about various kinds of energy conservation, preparing a brochure *How to Save Energy and Money* and *Energy Conservation Newsletter*. A week of energy conservation – *Saving Box of Light* was implemented in schools. Energy conservation campaign was realised with the aim to create interest in people about rational use of energy, provide information about energy and energy saving possibilities, motivate and involve residents in energy conservation activities. The campaign also includes implementation of a subsidy

program to Latvian NGOs, preparing environmental stories and producing educational film “Megavatenis” (Mega Wadded Jacket) in co-operation with the Environmental Film Studio. The prepared stories were shown on LTV 1 program “Environmental Facts”. A project for secondary school students “Reasonable Energy Use” in co-operation with the Children’s Environmental School was also carried out.

- Within the framework of the Danish–Latvian co-operation program, there was implemented an information campaign on labelling of household electrical appliances as well as prepared information material.
- Actions of compact fluorescent bulbs (CFB) in the residential sector within ELI program were implemented in different rural municipalities and towns of Latvia. This includes setting up of information stands, brochures, developing document packages and instructions to municipalities. *Days of Light* are organised during such actions when CFB were sold at a reduced price. CFB actions were implemented with the aim to reduce the amount of GHG emissions and impact on global climate.

8.4. Training programmes

Climate change problems are included in various training programs both as separate courses and as topics of study programs.

Three biggest universities of Latvia have included in their study program subjects that reveal and analyse impact on climate change:

- Directly – for example, RTU EEF has included a course on Climate Technologies in their bachelor and master degree programs;
- Indirectly – for example, in the study program of the LUA: in the Agricultural Energy Institute of the Technical Faculty there is a subject “Alternative energy and energy conservation ”, in RTU EEF there is “Alternative energy sources”. Students of different faculties of the LU and RTU can learn about environment management systems and quality standards both when studying individual study disciplines and as a separate course.

Within the development of international professional and business co-operation between enterprises and different associations, new modern technologies and experience come into Latvia and various environmental management schemes are applied more frequently. Quality, management, product performance and other certificates are obtained, such as environment quality standards ISO 14 000, environment administration and audit schemes, eco-certification, eco-labelling, etc. All this encourages cleaner production, resources and energy efficiency. LPPC in co-operation with foreign partners and the financial support of MEPRD and PHARE program has organised several training courses and workshops on environmentally friendly business activity, saving and efficient use of energy and other resources. The project of the Regional Environment Centre for CEE and LPPC on assessing several enterprises in Daugavpils was implemented in 2000 and recommendations on increasing efficiency of production process and rational use of resources were prepared.

Issues and problems of climate change are included also in several in-service retraining and post-graduate training programs. Thus, for instance, within the EC OPET program the Institute of Environment and Energy was established where on a regular basis processes linked with GHG emissions and their reduction on a global and national level are presented and analysed. Furthermore, RTU has established The Sustainable Development Centre where in co-operation with the Alborg University (Denmark) PROCEED (*Program of Co-operation on Energy Economy Development*) program first courses for municipal

specialists were organised (aspects of climate technologies equalled to one half of 120 lesson long training course).

Within the SCORE program a training program for Latgale municipalities was implemented, setting up the support centre for projects of increase of energy efficiency in Latgale. Co-operation between Latgale and Dutch municipalities was promoted and three manuals prepared – *Manual for Project Preparation on Raising Energy Efficiency in Local Governments, Manual for Policy Planning to Increase Energy Efficiency in Local Governments* and *Manual for Planning Public Relations to Increase Energy Efficiency in Local Governments.*

8.5. Sources of information

Access to environmental information including also on activities resulting in climate change is Latvia in provided by mass media, internet, NGOs as well as by activities of international organisations and implementation of individual programs focussed on environment – related matters and translation and distribution of IPCC information materials.

Information about the global climate change is found in the general mass media on a national and regional level, such as radio, television, press, information prepared by news agencies. Besides, there are also several specialised governmental and non-governmental environmental media – Environmental Film Studio and magazine Environmental News providing both explanatory and, frequently, also sensational information about global climate change. Basically these are repeated stories or references to scientific, informative or entertainment publications of foreign countries.

Lately, alongside with the rapid development of information technologies, homepages and databases are being improved containing information on factors causing global climate change. The most important homepages are the homepage of the Ministry of Environmental Protection and Regional Development (http://www.varam.gov.lv), Latvian Environment Agency (http://www.vdc.lv), State Hydro-meteorological Board (http://www.meteo.lv).

8.6. Involvement of non-governmental and public organisations

Lately NGO are playing an increasingly bigger role in stimulating people to be more active and participate in the decision-making as well as popularising environmentally friendly action and way of living. NGOs are the ones that regularly update environmental information and attract attention of wider public to this information by organising actions, rallied, campaigns and other attractive types of drawing attention. One of such actions was the training program organised by the NGO Centre – *Local Environment in a Global Context* – with a core activity of two-day seminars on environment and energy matters in five towns of Latvia where a particular section was devoted to climate change and policy. With the financial support from the Latvian Environment Protection Fund – the Environment Protection Club already several years prepares and publishes a special magazine – *Environmental News* (Vides zinas) highlighting both global environment topics and also explaining various problems of protection of local environment and encouraging environmentally friendly behaviour models.

At the beginning of 2001 NGO – Public Policy Institute (PPI) with the financial support of SOROS foundation started a survey on *Energy Efficiency of Housing in the Latvian Climate Policy*. Within the scope of the survey it is planned to summarise not only results of survey and recommendations but also to organise information campaign *Latvian Volunteers*

for Energy Efficiency. During the campaign the NGO will assist pensioners and low-income families in Rezekne, Smiltene and Madona to heat insulate windows and doors thus drawing attention of the whole community to these issues.

NGOs also carry out extensive co-operation within the scope of international programs (see Section 8.7).

8.7. Participation in international activities

Representative offices of many international non-governmental environment organisations actively work in Latvia. These organisations are, for example, World Wildlife Fund (WWF) and Coalition Clean Baltic (CCB) implementing projects of non-depleting rural development and forestry.

In 2000 an international NGO co-operation project was implemented between the Latvian Green Library, Polish Ecological Club and Hungarian National Environment Protection Union. Regional Environment Centre (CEE) and the additional subsidy program of the NGO Centre funded the project. The goal of the project was to independently analyse activities of the countries within the scope of the JI as well as to analyse the role and opportunities of CEE in international negotiations on climate policy in Hague in November 2000. Results and conclusions of the program were discussed in the climate policy forum in each country with participation of representatives of the state institutions, enterprises and non-governmental organisations thus promoting exchange of opinions and explanation of information.

SCORE co-operation program is implemented since 1996. The program covers various activities aimed at more efficient energy use and education of the community on these issues. Eight demonstration projects on raising energy efficiency were implemented in schools, living houses and production enterprises within SCORE program in 1997-1998. Furthermore, in 1998-2000 renovation program of housing was implemented through various demonstration projects and a manual on *Increase of Heat Efficiency of Buildings* was prepared. Information actions and training carried out within the SCORE program are described above (see section 8.3 and 8.4).

Since 1999 International ELI is represented in Latvia with the main target to reduce impact on global climate (see more detailed description in Section 4.3.1.3). ELI Program should be regarded as a public climate awareness formation program.

OPET Latvia office works within the OPET network (it covers 56 world organisations). The activities are directly or indirectly linked with promotion of climate technologies.

Latvian governmental and public organisations participate in international program Climate Technology Initiative (CTI) which organises training courses, information exchange and climate project competitions.

Several local governments of Latvia actively work on the development and implementation of the *Local Agenda 21*. Riga Environment Strategy has been developed for Riga city and Riga Environment Centre *Agenda 21* has been established. There are also several other local governments in Latvia working at environment protection action programs. They devise sustainable development action plans and work out indicators. Distance learning program of *Local Agenda 21 Co-ordinators* was implemented with the assistance of PHARE program in 2000.

List of references

1. 2nd Baltic State of the Environment Report. Baltic Environmental Forum. Riga, 2000.
2. Aistara G. Kopigi veicamie pasakumi Latvija: teorija, prakse, ieteikumi. Zala biblioteka, 2000. (*in Latvian*)
3. Analysis of Energy Efficiency Aspects in Latvia. Baltic Energy Efficiency Group. Riga, 1999.
4. ANO Ekonomiskas komisijas 1998. gada 25. junija Orhusas konvencija "Par pieeju informacijai, sabiedribas lidzdalibu lemumu pienemšana un pieeju tiesu varai vides jautajumos". Populara versija. (*in Latvian*)
5. United Nations Framework Convention on Climate Change. United Nations, 9 May 1992.
6. Atjaunojamo energoresursu programma. Nosleguma zinojums. PHARE, 2000. (*in Latvian*)
7. Biodegvielu ražošana un pielietošana Latvija. LR Nacionalas programmas projekts. LR Zemkopibas ministrija. Riga, 1996. (*in Latvian*)
8. Biodegvielas ražošanas un pielietošana Latvija. LR Nacionala programma. LR Zemkopibas ministrija. Riga, 2000. (*in Latvian*)
9. National Programme of Biological Diversity. Ministry of Environmental Protection and Regional Development. Riga, 2000.
10. Blumberga D., Blumberga A., Kass I. The experiences of AIJ Projects in Latvia /Book: "Reports on AIJ projects and contributions to the discussion of the Kyoto mechanisms" published by Federal Ministry of Environment, Nature Conservation and Nuclear Safety and Science Centre North Rhine-Westphalia, 1999, Page 47-52.
11. Buvniecibas nacionala programma (2000.-2010.). Projekts. LR VARAM. Riga, 1999. (*in Latvian*)
12. Celu satiksmes drošibas nacionala programma. CSDD. (*in Latvian*)
13. Climate Change 1995. The Science of Climate Change. IPCC, WMO, UNEP, 1996.
14. Climate Change 2001: The Scientific Basis. Cambridge, 2001.
15. Danish Assistance to Central and Eastern Europe. Programme 2001 for the Energy Sector. Danish Energy Agency, 2000.
16. Danilans I. Kvartara periods un ta nogulumi Latvija. Riga, 1961.108 lpp. (*in Latvian*)
17. Deklaracija par Ministru Kabineta iecereto darbibu, LR Ministru Kabinets, 2000, http://www.mk.gov.lv/lat/ministrukabinets/dokumenti/deksadal/ (*in Latvian*)
18. Efektiva energijas izmantošana iestades Latvija. Dansk Energi Management A/S, projekta nr.2136/054-970600 nosleguma atskaite. 2000. (*in Latvian*)
19. Eku siltumefektivitates paaugstinašana Ludza. Riga, 2001. (*in Latvian*)
20. Guidelines for the Preparation of National Communications by Parties included in Annex I to the Convention, Part II: UNFCCC Reporting Guidelines on National Communications. United Nations, 1999.
21. IFC/GEF Efficient Lighting Initiative (ELI)/ Latvia Appraisal Report. March. 2000.
22. IPCC 1996 Revised Guidelines for National Greenhouse Gas Inventories.
23. Izglitibas sistemas attistibas projekts. Projekta pieteikums valsts investiciju programmai. Izglitibas un zinatnes ministrija, 1999. (*in Latvian*)
24. How to mitigate climate change. II parts. Policies and measures for GHG emissions reduction in Latvia. Industry, agriculture and waste management. Summary. Ministry of Environmental Protection and Regional Development of the Republic of Latvia. Riga, 2000.

25. How to mitigate climate change. Study on the assessment of policy and technology option in Energy and Forestry sectors in Latvia. Summary. Ministry of Environmental Protection and Regional Development of the Republic of Latvia. Riga, 1998.
26. Klimata parmainu samazinašanas politikas plans Latvijai. VARAM. Riga, 1998. (*in Latvian*)
27. Latvia: Wood Harvesting, Distribution and Conversion Study. ERAB. 1995.
28. Kurinama un energijas strukturpolitika. Nosleguma atskaites projekts. PHARE. 1999. (*in Latvian*)
29. Code of good agricultural practice for Latvia. Jelgava, 1999.
30. Laivinš M., Environmental changes related dynamics of the number of sites of rare indigenous and exotic plant species in Latvia. Baltic Forestry 1997, vol.3, no.2.
31. Laivinš M. Latvijas borealo priežu mežu sinantropizacija un eitrofikacija. Latvijas Vegetacija 1. Riga, 1998. (*in Latvian*)
32. Latvia Energy Review. Energy Department of Ministry of Economics of the Republic of Latvia.1999.
33. Latvia Forestry Sector Master plan. Final Report. State Forest Service, Latvia; Swedforest International AB, Sweden, January 1995.
34. Latvia's Forest Sector. State Forest Service. Riga, 1999.
35. Latvian National Inventory report for 1998 and 1999 years. Latvian Environmental Agency, 2000.
36. Latvijas dabas enciklopedija. "Latvijas enciklopedija". Riga, 1995. (*in Latvian*)
37. Latvian National Energy programme. PHARE. Riga, 1997.
38. Latvijas integracija Eiropas Savieniba. Petijumu programmas "Ekonomiskie, kulturas un socialie aspekti Latvijas integracijai Eiropas Savieniba" rezultati". BO SIA "Zinatnu akademijas Ekonomikas instituts". Riga, 2000. (*in Latvian*)
39. Latvijas lauku attistibas plans Eiropas savienibas pirmsiestašanas pasakumiem lauksaimniecibas un lauku attistibai (SAPARD) 2000.-2006.g. Eiropas Komisijas Lauksaimniecibas Generaldirektorats. (*in Latvian*)
40. Latvijas meža politika. Valsts meža dienests, 1999. (*in Latvian*)
41. Action plan of the Government for intensifying Integration in EU in 2000, http://www.eib.lv/www/owa/frame_eng
42. National Communication of the Republic of Latvia under United Nations Framework Convention on Climate Change. Ministry of Environmental Protection and Regional Development. Riga, 1995.
43. Second National Communication of the Republic of Latvia under United Nations Framework Convention on Climate Change. Ministry of Environmental Protection and Regional Development. Riga, 1998.
44. LR Zemkopibas ministrijas rikojums Nr. 27 "Par valsts atbalstu Eiropas Savienibas kvalitates prasibam atbilstošas produkcijas ražošanai". 2001. gada 26. janvaris. (*in Latvian*)
45. Latvijas rupniecibas attistibas pamatnostadnes. LR Ekonomikas ministrija. Riga, 2000. (*in Latvian*)
46. Latvijas sadzives atkritumu apsaimniekošanas strategija (1998-2010). VARAM. Riga, 1997. (*in Latvian*)
47. Statistical yearbook of Latvia 2000. Central Statistical Bureau of Latvia. Riga, 2000.
48. Latvijas vegetacija 1. Riga, 1999. (*in Latvian*)
49. Latvian Environmental Agency homepage, http://www.vdc.lv/dati
50. Lauksaimniecibas subsidiju izmantošanas koncepcija un programmas pamatojums 1998. – 2002. gadam. LR Zemkopibas ministrija. 1997. (*in Latvian*)
51. Lauksaimniecibas subsidiju valsts programma 2001. gadam. LR MK. (*in Latvian*)

52. Lauksaimniecibas un tas nozaru attistibas programmas pamati. LR Zemkopibas ministrija, 1998. (*in Latvian*)
53. Likumprojekts “Iepakojuma likums”. VARAM, 2001. (*in Latvian*)
54. Nacionala inovaciju koncepcija (akcepteta MK 27.02.01.). (*in Latvian*)
55. Review of the implementation of Commitments and of other provisions of the Convention. FCCC/CP/1999/7.
56. Rigas attistibas plans 1995.-2005. (*in Latvian*)
57. Rigas satiksmes koncepcija 1999.-2003.gadam. Rigas Dome, 2000. (*in Latvian*)
58. Seglinš V. Latvijas piekrastes zonas jutiguma indikatori un iepriekšejos gados ievakto datu apkopojums. Riga, 2001. (*in Latvian*)
59. SIA BO “ZAAO” homepage, www.zaao.apollo.lv
60. The Economics of Greenhouse Gas Limitation. Technical Guidelines. Draft, UNEP Collaborating Centre on Energy and Environment, Riso National Laboratory, February 1998.
61. The technical project for the rehabilitation and continued operations of the Riga city solid waste disposal site "Getlini". Document of the World Bank, November 1997.
62. Transporta attistibas nacionala programma (1996.-2010.). LR Satiksmes ministrija. Riga, 1995. (*in Latvian*)
63. Transporta attistibas nacionala programma 2000-2006. LR Satiksmes ministrija, 2000. (*in Latvian*)
64. Transport and communications in 2000. Collection of statistical data. Central Statistical Bureau of Latvia. Riga, 2001.
65. UN-ECE/FAO Temperate and Boreal Forest Resources Assessment 2000 (for LATVIA).
66. Valsts energoefektivitates strategija. Koncepcijas projekts. LR Ekonomikas ministrija, 2000. (*in Latvian*)
67. Veikto energoekonomijas pasakumu novertejums. VARAM Buvniecibas departaments, VARAM BO VU “Vides Projekti” SCORE demonstracijas projekti. 2000. (*in Latvian*)
68. Velotransporta attistibas programma Rigas pilsetai. Rigas Dome, 2000. (*in Latvian*)
69. Vides aizsardzibas politika Latvija. VARAM, 1999. (*in Latvian*)
70. Vides aizsardzibas politikas plans Latvijai. Riga, 1995. (*in Latvian*)
71. Vides aizsardzibas ricibas programma. VARAM, 1996. (*in Latvian*)
72. Environmental management in Eastern Europe, http://www.vps.lv.
73. Vides parvaldibas sistemu ieviešanas praktiska pieredze un rezultati Latvijas farmaceitiskaja rupnieciba. Danish Technological Institute, Latvijas Piesarnojuma profilakses centrs, Latvijas Attistibas agentura. (*in Latvian*)
74. Environmental indicators in 1999. Statistical bulletin. Central Statistical Bureau of Latvia. Riga, 2000.
75. Vides sazinas un izglitibas strategija un ricibas programma, VARAM. (*in Latvian*)
76. Economic development of Latvia. Report. Ministry of Economy Republic of Latvia. Riga, June 2000.
77. Economic development of Latvia. Report. Ministry of Economy Republic of Latvia. Riga, December 2000.
78. Economic development of Latvia. Report. Ministry of Economy Republic of Latvia. Riga, June 2001.

ANNEXES

Annex 1

Key recently adopted laws, CM regulations, programs and projects linked with GHG emission mitigation

Name of the instrument	Brief description
General and multi-sectoral policies and measures	
Law "On Environment Protection" (06.08.1991)	Key objectives of the law are to ensure the following: • Qualitative environment for people; • Preservation of natural genotype, biotopes and landscape diversity; • Preservation and development of ecosystems; • Rational use of nature resources.
Amendments to the law "On Environment Protection" (20.06.2000)	To include environment protection requirements in regulatory documents, concepts, plans, programs pertaining to other sectors; to ensure wide participation of the community in observance of environment protection principles and implementation of environment policy, to provide the community free access to information.
Law "On Pollution" (15.03.2001)	The aim of the law is to eliminate or lessen damages for human health or life, property and environment caused by pollution and to eliminate consequences caused by such damage, and: • To eliminate generation of pollution and, if impossible, to reduce emissions into soil, water and air; • To eliminate or, if impossible, to reduce the use of non-renewable resources and energy; • To eliminate or, if impossible, to reduce waste generation; • To identify and register the polluted and potentially polluted sites on the territory of Latvia; • To identify measures for study and rehabilitation of the polluted and potentially polluted sites; • To identify persons who will cover costs of study and rehabilitation of polluted and potentially polluted sites.
Law "On Natural Resources Tax" (14.09.1995)	Law "On Natural Resources Tax" and Regulations of the CM "On the procedure of enforcement of the Law "On Natural Resources Tax"" are aimed to restrict wasteful use of natural resources, to reduce production and sales of environment polluting products, to encourage introduction of new and updated technologies and to financially support system environment protection measures.
Amendments to the law "On Natural Resources Tax" (06.04.2000)	The amendments stipulate higher tax rates for pollution. Tax rates are identified for each ton of emissions regardless of the type of fuel. • Non-hazardous emissions (hard particles) – 4.00 Ls/t; • Medium hazard emissions (CO) – 5.50 Ls/t; • Hazardous emissions (SO_2, NO_x) – 13.0 Ls/t; • High hazard emissions (V_2O_5) – 820.0 Ls/t. At the moment CO_2 emissions are not taxed, however this tax is projected for future.
Law "On Specially	Law "On Specially Protected Nature Territories" stipulates:

Protected Nature Territories" (02.03.1993)	• Fundamental principles of the system of specially protected territories; • On the procedure of establishment and support to the specially protected territories; • Administration principles of the specially protected territories, principles of control and records. The subjects of the law are specially protected nature territories – geographically identified areas that enjoy special protection of the state and are created to: • Protect and preserve natural diversity; • Carry out research and environmental supervision. Specially protected territories, for example, nature reserves, natural parks, and sanctuaries are wide territories with unrestricted development of natural processes and nature with little man-caused transformation and high diversity of habitats.
Law "On Environmental Impact Assessment" (14.10.1998)	The aim of the law is to eliminate or mitigate unfavourable impact on environment caused by projected activities of physical or legal persons. The low defines impact assessment principles and lists objects where impact assessment is required.
Law "On Protective Belts" (05.02.1997)	Law "On Protective Belts" prescribes: • Types of protective belts and their functions; • Basic principles of creation of protective belts; • Maintenance of control of protective belts; • Limitations for business activity in the areas of protective belts. The law, *inter alia*, also stipulates business activity limitation and prohibitions in protective belts and the dune zone of the Baltic Sea and Riga Bay. The main task of these regulations is to reduce or eliminate anthropogenic negative impacts on the mentioned sites.
CM Regulations No.356 "The Procedure of Enforcement some Provisions of the Law "On Natural Resources Tax" (10.10.2000)	Defines the limit of use of natural resources and polluting substances, procedure of tax calculation and payment as well as the procedure how a tax payer may benefit from tax discounts and partial repayment of taxes for consumption of environmentally harmful goods and products.
CM Regulations No.219 "On Air Quality" (15.06.1999)	The aim of regulations is to identify national environmental quality standards in regard to air quality as well as the procedure of evaluation of air pollution and air protection measures to prevent harmful impacts of air pollution on human health or environment, to eliminate or to mitigate such impacts. Air quality standards are set for sulphur dioxide, nitrogen oxide, nitrogen dioxide, dust (hard particles), lead and ozone.
Policy Plan for Environment Protection in Latvian. MEPRD, 1995.	The first national strategic document in the history of environment protection in Latvia containing formulation of objectives of environment protection policy for the nearest decades. The instrument sets principles to be respected in the development of the strategy and list the measures applied for implementation of the strategy.
Environment Protection	The program addresses specific environmental aspects: solution of

Action Program. MEPRD, 1996.	environmental problems, introduction of political measures for protection of the environment and creation of preconditions for environment protection (environmental monitoring, research, and formation of environmental public awareness).
Latvia–Netherlands project "How to Mitigate Climate Changes" (Part 1 and 2). MEPRD, 1998–2000	At the moment this is the newest study in Latvia linked with climate change mitigation analysing measures and policies for GHG emission reduction in Latvia. The work was done by a group of specialists under the guidance of MEPRD. The Construction, Spatial Planning and Environment Ministry of the Netherlands funded the project.
Climate change mitigation policy plan for Latvia. MEPRD, 1998.	Aims of the Plan: climate policy should ensure sustainable development; it should be integrated in strategic plans of all economic sectors, in legislation and public awareness; it should foster understanding of people about the necessity and possibilities to eliminate global warm-up as well as about eventual consequences if no measures are taken.
National Program on Biological Diversity. MEPRD, 2000.	The task of the program is to encourage sustainable use of nature resources, and, in parallel, to protect nature, to manage nature protection work from the governmental level till local governments and residents, to fulfil international commitments, to help foreign and local businessmen to find out priorities for investment.
Policies and measures in the energy sector	
Energy generation and transmission (1A1)	
"Law on Energy" (03.09.1998)	The law regulates energy sector as economic infrastructure covering generation of energy resources, use of energy and production of different types of energy, purchasing, transformation, distribution, supply to users and energy consumption. Energy law, *inter alia*, also includes provisions encouraging development of local and renewable energy resources: • Obligation to buy energy produced from renewable energy resources respecting the established capacity limits of the producer; • Higher electrical energy purchasing prices from different types of generation equipment of renewable energy resources; • Renewable energy resources do not benefit from any direct state subsidies. Minimal purchase price is financed by energy utilities by increasing average sales tariff of electricity. The law also regulates gas supply and heat supply systems.
Amendments to the law "On Energy" (10.05.2001)	Amendments prescribe protective impact on the environment and use of environmentally friendly technologies; provide rules for installation of generation equipment and purchase of electricity produced from renewable resources. The document also stipulates that owners of buildings and other facilities have the right to choose the most cost-efficient type of energy supply, yet refusal from centralised district heating or, on the contrary, connecting to the system should not cause disturbances of heat deliveries to other users of the system.
Structural policy on fuel	The program evaluates the software of the presently available

and energy. PHARE, 1999.	models in Latvia; analyses previously developed energy programs, legislative documents and technical data (energy balance, electricity and heat supply). It also provides description of modelling – reference scenario and scenarios based on different assumptions. In conclusion, the program offers recommendations for the structural policy of the state.
The program on renewable energy resources. PHARE, 2000.	The aim of the project is to prepare medium and long-term strategy and action plan for the development of the use of renewable resources in Latvia. The project contains the assessment of the potential of renewable energy resources in Latvia and the conditions of use; it describes international commitments affecting the use of renewable energy resources; summarises international financial programs that include funding of renewable energy resources projects; evaluates Latvian situation and legislation with regard to use of renewable resources comparing this with the EU objectives and legislation. The project also provides the development strategy and action plan for the use of renewable energy resources for the time period till 2010 and offers proposals for implementation of this strategy.
National Program on Energy. EU PHARE, Ministry of Economy, 1997.	The program was developed in 1996–1997 and was conceptually approved by the CM in September 1997. The program sets forth a set of measures for stable provision of Latvia with energy resources to match quality and quantity requirements of consumers and with maximally small impact on the environment. It is planned to update the program every 5 years.
State Energy Efficiency Strategy. Ministry of Economy. 2000.	The strategy was developed by the Ministry of Economy and has the objective to identify a set of measures for increase of energy efficiency to reach by 2010 the decrease of primary energy consumption per unit of GDP by 25%.
Production and Use of Biofuel in Latvia. National Program of Latvia. Ministry of Agriculture, 2000.	The program analyses the possibility to produce biofuel from rapeseed oil, latol as gasoline and ethanol mix, as well as generation of biogas from industrial and household waste. The program also highlights and analyses the impact of the above measures on social sphere, ecology and macroeconomic indicators.
Latvia: Wood Harvesting, Distribution and Conversion Study. EBRD, 1995.	Jaakko Pöyry working group developed the study funded by EBRD in 1994-1995. It analyses the use and prices of fuel wood and wood processing waste and conversion of district heating boilers to work with wood.
Manufacturing industry and construction (1A2)	
Latvia: construction standard LBN 003-01 "Construction climatology"	The project will identify the climatic parameters needed for design of houses in conditions of Latvia. The construction normative (standard) is developed in line with the multi-annual observation data processing methodologies adopted by the WMO.
Latvia: construction standard LBN 002-01 "Heat technique of limiting constructions"	Will define the design methods of heat technique in limiting constructions of buildings harmonised with CEN standards. Heat resistance requirements in limiting constructions will be increased by average 20% in comparison with the presently effective technical norms.
Latvia: construction	Will define the design principles of heating and ventilation

standard LBN 231-01 "Heating and ventilation of buildings"	systems in buildings harmonised with CEN standards.
Adaptation of harmonised EN 13160 standard series of the European standardisation organisation CEN	Will implement conformity assessment methods and conformity certification procedures of heat insulation materials pursuant to the European Construction Products' Directive 89/106.
LBN-421 "Energy audit in buildings"	It is planned to develop this standard to identify the procedure of energy audit in buildings.
Ordinance No.68 of the Ministry of Architecture and Construction of Latvia "On Increase of Heat Resistance of Limiting Constructions in Buildings" (12.09.1991)	Identifies minimal heat resistance values of limiting constructions in buildings to be observed when building new houses or reconstructing the old ones. Technical requirements for heat keeping in constructions and windows will be raised 3-5 times.
CM regulations No.142 on the construction standard of Latvia LBN 006-00 "Material Requirements in regard to Buildings" (27.03.2001)	Stipulate that buildings and ventilation equipment are constructed so that energy consumption to operate this equipment is minimal and dependent on the climatic conditions of location of the equipment and requirements of residents.
Educational system development project. Project application for the public investment program. Ministry of Education and Science, 1999.	The project is planned for implementation in 1999-2003. The World Bank and Japan financially support it. The objective of the project, *inter alia*, is to bring down maintenance costs of schools, to start school optimisation with parallel measures of increasing energy efficiency.
The National Program on Construction (2000-2010). Draft. VARAM, 1999.	The program focuses on the development of construction and housing, increase of heat keeping in houses and public buildings, testing and certification.
Transport (1A3)	
Law "On Excise Tax on Oil Products " (13.11.1997) with repeated amendments	The law spells out tax rates for different oil products (this mainly refers to heavy fuel oil as the use of diesel fuel is rather limited). The law has basic two aims – increase of state revenues and reduction of hazardous emissions into atmosphere. When taxing oil products used as fuel the aim is to restrict their use and replace by natural gas or local fuel. The law says that 0.02 LVL/litre will reduce the tax applied to fuel with alcohol addition. Pursuant to the law, excise tax for heavy fuel oil starting with January 1, 2003 will equal to 7 LVL/t. The following tax rates to heavy fuel oil will be applied in the transition period: • By December 31, 2000 – 4 LVL; • After January 1, 2001– 5 LVL; • After January 1, 2002 – 6 LVL.

Pursuant to the law "On Excise Tax on Oil Products" the following documents have been passed: - CM regulations No.399 "On the Procedure of Repayment of Excise Tax on Oil Products, if Fuel Oil, its Substitutes and Components are used as Fuel"(30.11.1999); - CM regulations No.140 "On the Procedure of Repayment Excise Tax on Diesel Fuel (gaseous fuel) to Agricultural Producers (20.03.2001)	Regulations include conditions and procedures how heat producers and manufacturers of agricultural products may receive compensation for the already paid excise tax. Part of this tax, according to plans, will be directed for support of the development of renewable energy resources.
CM regulations No.154 "On Assessment, Limitation and Control of Emissions of Air Polluting Substances Caused by Stationary Air Pollution Sources" (25.04.2000)	Establish the procedure of assessment, elimination, restriction and control of air pollutant emissions caused by stationary air pollution sources.
Law on the Framework Agreement on Establishment of Organisational Structure of Inter-country Oil and Gas Transport Systems (15.03.2001)	The agreement, inter alia, stipulates the procedure of rehabilitation and construction of inter-country oil and gas transport systems.
CM regulations No.74 "Requirements in regard to Technological Equipment of Fuel Filling Stations and the Procedure of Technical Maintenance of Equipment" (20.02.2001)	Regulations stipulate requirements in regard to technological equipment installed in fuel filling stations and the procedure of supervision of this equipment to avoid danger to human life and environment.
CM regulations No.241 "On Environmental Quality Standards of Fuel" (07.07.1998)	Define environmental quality requirements for fuel and requirements to improve institutions of conformity assessment of fuel to ensure protection of quality of environment and consumers.
CM regulations No.332 "On Conformity Assessment of Gasoline and Diesel Fuel" (26.09.2000)	Define quality requirements to gasoline and diesel fuel marketed in Latvia and used for operating internal combustion engines with compression ignition as well as identify market surveillance institutions, procedures of conformity assessment of fuels and marker surveillance.
Regulations No.2 of the Ministry of Transport "On	Regulate, among other things, also the content of exhaust gases of engines.

Technical Condition of Transport Vehicles and State Technical Inspection" (04.02.2000) and amended in Regulations No.4 (15.01.2001)	
National Program on Transport Development (1996-2010). Ministry of Transport, 1995.	The National Program on Transport Development is a complex long-term program. It identifies problems and objectives of the development of transport as well as strategic and tactical resources to reach the goal. Successful implementation of the transport program will result in creating conditions and prerequisites for transport to effectively promote economic growth in future and to increase of wellbeing and mobility of people.
Household sector (1A4)	
CM Regulations No. 29, 30, 31, 32, 33 establishing the labelling procedures of household refrigerators, ovens, washing machines, etc. (23.01.2001)	The regulations identify types of information to be provided on labels in regard to consumption of electrical energy, other types of energy and key resources and any other relevant information to estimate consumption of energy and other important resources by the equipment.
Policies and measures in industry	
Fundamental positions of the Latvian industry. Ministry of Economy, 2001.	The aim of Fundamental Positions is to define principles of the economic policy of the government to increase competitiveness and identify medium term priorities for implementation of this aim.
National innovation concept. Adopted by the CM on 27.02.2001.	The goal of the concept is to encourage open-to-innovations economy in Latvia.
Environmental management in Eastern Europe. DATI.	DATI finances the program "Environmental Management in Eastern Europe" aimed at improvement of EMS. "Environmental Management in Eastern Europe" is a wide program consisting of several individual environmental management system projects in different industrial sectors. Enterprises participating in the project have the opportunity to get the international ISO 14001 certificate.
Practical experience and outcomes of introduction environmental management systems in pharmaceutical industry of Latvia. LPPC, DTI, LDA, 2001.	The aim of the brochure is to inform about preconditions necessary for introduction of EMS in accordance with ISO 14001 requirements and to demonstrate cleaner production possibilities in pharmaceutical industry with real examples taken from enterprises involved in the project "EMS in Latvian Pharmaceutical Industry".
Policies and measures in agricultural sector	
"Law on Agriculture" (13.11.1996)	The law spells out state support to agriculture, which may not be less than 3% of total annual expenditure of the state basic budget. The law spells out subsidies to afforestation of agriculturally abandoned land and modernisation of forest tree farms.
Concept on the use of agricultural subsidies and program justification for	According to the program, the goal of the development of agriculture is creation of efficient agriculture able to integrate in the single European market, producing products with quality

1998–2002. Ministry of Agriculture, 1997.	parameters meeting the EU and world requirements. Support is defined for the following key areas: • Cultural and technical and agri-technological improvement of soils; • Development of agricultural production and processing as well as technical modernisation; • Support to non-traditional sectors and rural environment; • Development of pedigree cattle breeding and seed production; • Production of high quality plant products for processing.
Fundamentals of the development program of agriculture and agricultural sectors. Ministry of Agriculture, 1998.	The program is devised to further develop and foster political positions of agricultural development adopted in the state and to define the necessary policy implementation measures. The document covers sectors of agricultural production and processing of agricultural products.
Good agricultural practice conditions in Latvia. LUA, 1999.	Developed within the scope of Danish–Latvian joint project funded by the Danish Environment Protection Agency, Ministry of Agriculture of Latvia and Latvian Environment Protection Fund. The aim is to reduce negative impact arising from business activity on environment, to eliminate depletion of basic natural resources, irrational use of these resources. Agricultural production should respect the conditions accepted in the developed European and other countries to foster unobstructed entry of Latvian products into external markets and make environment of Latvia attractive for tourists.
Policies and measures in the sector of land use and forestry	
Law “On Real Estate Tax” (04.06.1997)	The Law spells out tax exemptions applied according to the procedure established by CM (CM regulations No. 135) for land under young stands or forests in the age of young stands.
Law “On Personal Income Tax” (11.05.1993)	The Law prescribes that before calculating the tax, expenditure of forest regeneration is deducted from payment amount when withholding tax on sale of growing forest.
“Forest Law” (24.02.2000)	The object of the law is forest and forestland. The aim is to regulate sustainable management of all forests in Latvia, to guarantee equal rights to all forest owners and lawful possessors, to guarantee immunity of property rights and independence of business activity and establish equal obligations. The law regulates the right to be in the forest, tree harvesting, use of non-wood values, issues of reproductive materials, forest regeneration and afforestation, forest protection, nature protection forests, development of forest management plan, issuance of felling confirmations, forestland transformation and public management of forests. The law also stipulates responsibility for violation of forest management and use legislation.
CM regulations No. 135 “On the Procedure of Exemption from Real Estate Tax Payment for Lands under Young Forest Stands and Afforestation in	These regulations prescribe that forest stands are young stands if approved as regenerated and afforestated and where age of dominant tree species does not exceed: 40 years for coniferous and hard deciduous trees, 20 years for soft deciduous trees (except grey alder) and 10 years for grey alder. Besides, the law stipulates real estate (property) tax exemption procedure for land under

the Age of Young Stands" (20.03.2001)	young stands or forests in the age of young stands.
CM Regulations No.94 "On the Procedure of Forestland Transformation" (27.02.2001)	The document establishes conditions of forestland transformation and the procedure of getting forestland transformation permits. It also spells out the procedure of reimbursement (and estimation of the reimbursement) to the state for losses caused by transformation of natural forest environment.
CM Regulations No.110 "On the Procedure of Management of Research Forests" (06.03.2001)	The document defines the research forests are forest territories where long-term scientific research objects have been singled out in various periods of time, such as forest farms, sample fields of forest selection and genetics, integral forest monitoring and other objects. Such forests are managed according to the research-based forest management program developed by the SFS Forest Research Station.
CM Regulations No.108 "On Afforestation and Plantation Forests" (06.03.2001)	Regulations, *inter alia*, define the order of afforestation of lands, which, according to legislation, may be transformed into forestland.
CM Regulations No.212 "On the Procedure of Forest Monitoring" (22.05.2001)	The document describes the order of assessing changes in health of trees growing in the forest caused by the impact of different factors, evaluation of forest ecosystems and changes of ecosystems due to the impact of air pollution and other factors influencing the condition of a forest.
CM Regulations No.372 "On Felling of Trees in Forest Lands" (24.10.2000)	Regulations stipulate: • Criteria for final and sanitary fellings • Maximum width and area of clear cutting; • Procedure of recognition forest stands unproductive; • Procedure of harvesting disease infected or pest invaded trees; • Procedure of formation of felling areas (forest stands or their parts where forest felling is carried out or planned); • Procedure of tree felling in extraordinary situations. The regulations, among other things, also establish that by June 30, 2001 it is prohibited to do: • Final felling in forest habitats of protected plants, mushrooms, lichen and animals (natural forest territories where endangered, extinct or rare species of plants and animals are found); • Clear cutting in genetic reserves (high value natural origin forest stands for preservation of genetic diversity and genofund); • Clear cutting in objects of scientific research if the research program does not say otherwise (in forests with objects of long-term scientific research located outside the designated research forests); • Clear cutting in stands with outstanding quality trees (stands where outstanding quality trees have been selected for the purposes of vegetative reproduction to arrange seed plantation).
CM instructions No.117 "On Maximal Volumes of	Determines maximal volume of wood harvesting for 2001-2005 in state forests in accordance with Article 45 of the Forest Law.

Wood Harvesting in 2001-2005" (28.02.2001)	
Latvian forest policy. State Forest Service, 1999.	The new forest policy provides the definition of sustainable forest management. Forests, according to this definition, should fulfil ecological, economic and social functions. Forest policy defines tasks to be fulfilled in all the mentioned areas in the context of climate change.
Latvia Forestry Sector Masterplan. State Forest Service, Latvia; Swedforest International AB, Sweden, 1995.	Specialists of SFS together with Swedish experts from Swedforest International AB developed the plan in 1995. The Swedish government funded project. Masterplan includes series of recommendations for further development of forest sector in the areas of forest management, environment protection, for the development of forest related industrial sectors and external and internal market.
International projects, PHARE funded projects "Institutional support to private forestry in Latvia". (12.1998-07.2000)	Development of demonstration projects, equipping of the seed inspection laboratory, training of seed control laboratory specialists, certification of seed material in line with the EU requirements, training on rural landscape planning.
Policies and measures in the sector of waste management	
"Law on Waste Management" (14.12.2000)	The aim of the law is to define the order of waste management to protect human life and health, environment and personal property.
CM Regulations No.56 "On Building, Management and Closure of Household Waste Disposal Sites" (08.02.2000)	Establish the procedure of arranging a waste disposal site. Technical and economic justification should be carried out before building of the disposal site. This technical and economic study should, among other things, also include information on the amount and content of waste accepted for storing in the landfill, protective engineering structures to be built on the site and to identify rules of arrangement of waste acceptance, treatment and disposal zones. Regulations say that the time of operation of the landfill is at least 20 years; the document spells out the procedure of closure of the site and post-closure environmental monitoring.
State Strategy for Household Waste Management in Latvia (1997-2010). MEPRD, 1997.	Objectives of sectors related to waste management are ranged in the Strategy and Program in the following priority sequence: • Reduction of waste generation; • Reduction of the produced waste volumes and their dangerousness; • Maximally possible secondary utilisation (recycling) of the generated waste; • To use waste that cannot be used for recycling as a source of energy generation; • Safe disposal of waste not suitable for either recycling or energy generation and also waste that has remained after energy generation. Program "500-" contains the concept that regional waste management system should be created in the result of household waste management reforms. The system would consist of approximately 10-12 household waste landfills. This would create conditions for efficient use of waste in the energy sector.

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B)

Latvia

(Sheet 1 of 1)

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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	**23,527.20**	**-10,825.58**	**195.96**	**11.01**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**102.41**	**512.50**	**178.77**	**119.33**
1. Energy	**22,964.29**		**63.69**	**1.05**							**102.02**	**498.50**	**87.32**	**118.01**
A. Fuel Combustion — Reference Approach[2]														
A. Fuel Combustion — Sectoral Approach[2]	22,964.29		10.45	1.05							102.02	498.50	82.70	118.01
B. Fugitive Emissions from Fuels	NE		53.24	ND							NE	NE	4.62	NE
2. Industrial Processes	**562.91**		**NO**	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NO/NE**	**NO/NE**	**60.56**	**1.32**
3. Use of Solvent and Other Product	**NO**			**NE**									**30.90**	
4. Agriculture [3]	**NO**	**NO**	**111.27**	**9.67**							**NO/NE**	**NO/NE**	**NO/NE**	**NO**
5. Land Use Change and Forestry	[3] **NO/NE**	[3] **-10,825.58**	**1.60**	**0.01**							**0.39**	**14.00**	**NO**	**NO**
6. Waste	**NO/NE**		**19.39**	**0.27**							**NO/NE**	**NO/NE**	**NO/NE**	**NO/NE**
7. Other	**NO**	**NO**	**NA**	**NA**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NO**	**NO**	**NO**	**NO**
Memo Items:														
International Bunkers	**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation	NE		NE	NE							NE	NE	NE	NE
Marine	NE		NE	NE							NE	NE	NE	NE
Multilateral Operations	**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**1,302.00**													

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.

(1) The emissions of HFCs and PFCs are expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are provided in Table 2(II) of this common reporting format.

(2) For verification purposes, countries report the results of their calculations using the Reference approach and explain any differences with the Sectoral approach in document box of Table1.A(c). Where possible, the calculations using the Sectoral approach are used for estimating national totals. In the table are included only the results of calculations from one approach.

(4) An estimate of CO_2 emissions and CO_2 removals are not provided in one column. "Net" emissions (emissions - removals) of CO_2 are estimated and a single number placed in either the CO_2 emissions or CO_2 removals column, as appropriate. For the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

Indicators:

NE - not estimated
NO - not occuring
0,00 - less than zero

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Latvia
1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**12,701.62**	**4,115.14**	**3,411.86**	**NE**	**NE**	**NE**	**20,228.62**
1. Energy	**22,964.29**	**1,337.51**	**326.74**				**24,628.54**
A. Fuel Combustion (Sectoral Approach)	22,964.29	219.47	326.74				23,510.50
1. Energy Industries	8,288.17	13.86	30.69				8,332.72
2. Manufacturing Industries and Construction	2,682.76	4.54	5.58				2,692.88
3. Transport	6,011.22	29.93	266.60				6,307.75
4. Other Sectors	5,956.92	171.15	23.87				6,151.94
5. Other	25.22	NO	NO				25.22
B. Fugitive Emissions from Fuels	NE	1,118.04	NE				1,118.04
1. Solid Fuels	NE	NE	NE				NE
2. Oil and Natural Gas	NE	1,118.04	NE				1,118.04
2. Industrial Processes	**562.91**	**NO**	**NO**	**NE**	**NE**	**NE**	**562.91**
A. Mineral Products	562.91	NO	NO				562.91
B. Chemical Industry	NO	NO	NO	NE	NE	NE	NO/NE
C. Metal Production	NO/IE	NO	NO		NE	NE	NO/IE/NE
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NE	NE	NE	NE
F. Consumption of Halocarbons and SF_6				NE	NE	NE	NE
G. Other	NO	NO	NO	NE	NE	NE	NO/NE
3. Use of Solvent and Other Product	**NO**		**NE**				**NO/NE**
4. Agriculture	**NO**	**2,336.75**	**2,998.01**				**5,334.76**
A. Enteric Fermentation		2,057.24					2,057.24
B. Manure Management		279.51	NE				279.51
C. Rice Cultivation		NO					NO
D. Agricultural Soils		NO	2,998.01				2,998.01
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NE	NE				NE
G. Other		NO	NO				NO
5. Land Use Change and Forestry [(1)]	**-10,825.58**	**33.60**	**3.41**				**-10,788.57**
6. Waste	**NO/NE**	**407.27**	**83.70**				490.97
A. Solid Waste Disposal on Land	NO	407.27					407.27
B. Wastewater Handling		NE	83.70				83.70
C. Waste Incineration	NE	NE	NE				NE
D. Other	NO	NO	NO				NO
7. Other *(please specify)* [redacted]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items:							
International Bunkers	**NE**	**NE**	**NE**				**NE**
Aviation	NE	NE	NE				NE
Marine	NE	NE	NE				NE
Multilateral Operations	**NE**	**NE**	**NE**				**NE**
CO_2 Emissions from Biomass	**1,302.00**						**1,302.00**

[(1)] For CO_2 emissions from Land-Use Change and Forestry the net emissions are reported. For the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	Neto CO_2 emissions / removals	CH_4	N_2O	Total emissions
Land Use Change and Forestry	CO_2 equivalent (Gg)					
A. Changes in Forest and Other Woody Biomass Stocks	NO	-10,960.00	-10,960.00			-10,960.00
B. Forest and Grassland Conversion	NE		NE	33.60	3.41	37.01
C. Abandonment of Managed Lands	NE	NE	NE			NE
D. CO_2 Emissions and Removals from Soil	134.00	NO	134.42			134.42
E. Other	NO	NO	NO	NO	NO	NO
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	134.00	-10,960.00	-10,825.58	33.60	3.41	-10,788.57

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [(a)]	31,017.19
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [(a)]	20,228.62

[(a)] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land Use Change and Forestry.

Indicators:
NE - not estimated
IE - included in another sector
NA - not occuring
0,00 - less than zero

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B)
(Sheet 1 of 1)

Latvia
1995

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2 emissions	CO_2 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		**10,145.30**	**-10,483.55**	**101.34**	**3.75**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**42.30**	**453.67**	**64.02**	**59.18**
1. Energy		**10,017.90**		**29.10**	**0.26**							**41.80**	**436.17**	**48.71**	**59.07**
A. Fuel Combustion	Reference Approach[2]														
	Sectoral Approach[2]	10,017.90		7.50	0.26							41.80	436.17	46.56	59.07
B. Fugitive Emissions from Fuels		NE		21.60	NE							NE	NE	2.14	NE
2. Industrial Processes		**127.40**		**NO**	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NO/NE**	**0.00**	**9.22**	**0.11**
3. Use of Solvent and Other Product		**NO**			**NE**									**6.09**	
4. Agriculture [3]		**NO**	**NO**	**44.64**	**3.22**							**NO/NE**	**NO/NE**	**NO/NE**	**NO**
5. Land Use Change and Forestry		[4] **NO/NE**	[4] **-10,483.55**	**2.00**	**0.01**							**0.50**	**17.50**	**NO**	**NO**
6. Waste		**NO/NE**		**25.60**	**0.25**							**NO/NE**	**NO/NE**	**NO/NE**	**NO/NE**
7. Other		**NO**	**NO**	**NO**	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NO**	**NO**	**NO**	**NO**
Memo Items:															
International Bunkers		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation		NE		NE	NE							NE	NE	NE	NE
Marine		NE		NE	NE							NE	NE	NE	NE
Multilateral Operations		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass		**1,882.00**													

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.

[1] The emissions of HFCs and PFCs are expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are provided in Table 2(II) of this common reporting format.

[2] For verification purposes, countries report the results of their calculations using the Reference approach and explain any differences with the Sectoral approach in document box of Table1.A(c). Where possible, the calculations using the Sectoral approach are used for estimating national totals. In the table are included only the results of calculations from one approach.

[4] An estimate of CO_2 emissions and CO_2 removals are not provided in one column. "Net" emissions (emissions - removals) of CO_2 are estimated and a single number placed in either the CO_2 emissions or CO_2 removals column, as appropriate. For the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

Indicators:
NE - not estimated
NO - not occuring
0,00 - less than zero

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS

Latvia

(Sheet 1 of 1)

1995

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**-338.25**	**2,128.12**	**1,161.26**	**NE**	**NE**	**NE**	**2,951.13**
1. Energy	**10,017.90**	**611.08**	**81.53**				**10,710.51**
A. Fuel Combustion (Sectoral Approach)	10,017.90	157.48	81.53				10,256.91
1. Energy Industries	4,542.83	7.46	17.98				4,568.27
2. Manufacturing Industries and Construction	1,038.33	3.49	4.34				1,046.16
3. Transport	1,748.79	7.88	33.17				1,789.84
4. Other Sectors	2,558.42	138.66	26.04				2,723.12
5. Other	129.52	NO	NO				129.52
B. Fugitive Emissions from Fuels	NE	453.60	NE				453.60
1. Solid Fuels	NE	NE	NE				NE
2. Oil and Natural Gas	NE	453.60	NE				453.60
2. Industrial Processes	**127.40**	**NO**	**NO**	**NE**	**NE**	**NE**	**127.40**
A. Mineral Products	127.40	NO	NO				127.40
B. Chemical Industry	NO	NO	NO	NE	NE	NE	NO/NE
C. Metal Production	NO/IE	NO	NO		NE	NE	NO/IE/NE
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NE	NE	NE	NE
F. Consumption of Halocarbons and SF_6				NE	NE	NE	NE
G. Other	NO	NO	NO	NE	NE	NE	NO/NE
3. Use of Solvent and Other Product	**NO**		**NE**				**NA/ND**
4. Agriculture	**NO**	**937.42**	**996.65**				**1,934.07**
A. Enteric Fermentation		825.62					825.62
B. Manure Management		111.80	NE				111.80
C. Rice Cultivation		NO					NO
D. Agricultural Soils		NO	996.65				996.65
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NE	NE				NE
G. Other		NO	NO				NO
5. Land Use Change and Forestry[1]	**-10,483.55**	**42.00**	**4.34**				**-10,437.21**
6. Waste	**0.00**	**537.62**	**78.74**				616.36
A. Solid Waste Disposal on Land	NO	537.62					537.62
B. Wastewater Handling		NO	78.74				78.74
C. Waste Incineration	NE	NE	NE				NE
D. Other	NO	NO	NO				NO
7. Other *(please specify)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items:							
International Bunkers	**NE**	**NE**	**NE**				**NE**
Aviation	NE	NE	NE				NE
Marine	NE	NE	NE				NE
Multilateral Operations	**NE**	**NE**	**NE**				**NE**
CO_2 Emissions from Biomass	**1,882.00**						**1,882.00**

[1] For CO_2 emissions from Land-Use Change and Forestry the net emissions are reported. For the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	Net CO_2 emissions / removals	CH_4	N_2O	Total emissions
Land Use Change and Forestry	CO_2 equivalent (Gg)					
A. Changes in Forest and Other Woody Biomass Stocks	NO	-10,600.00	-10,600.00			-10,600.00
B. Forest and Grassland Conversion	NE		NE	42.00	4.34	46.34
C. Abandonment of Managed Lands	NE	NE	NE			NE
D. CO_2 Emissions and Removals from Soil	116.45	NO	116.45			116.45
E. Other	NO	NO	NO	NO	NO	NO
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	116.45	-10,600.00	-10,483.55	42.00	4.34	-10,437.21

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [a]	13,388.34
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [a]	2,951.13

[a] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land Use Change and Forestry.

Indicators:
NE - not estimated
IE - included in another sector
NO - not occuring
0,00 - less than zero

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B)

Latvia

(Sheet 1 of 1)

1996

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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	**9,549.50**	**-10,496.38**	**95.08**	**3.77**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**35.32**	**193.08**	**48.28**	**58.89**
1. Energy	**9,364.12**		**25.04**	**0.38**							**34.82**	**175.58**	**26.72**	**58.75**
A. Fuel Combustion — Reference Approach[2]														
A. Fuel Combustion — Sectoral Approach[2]	9,364.12		6.26	0.38							34.82	175.58	25.48	58.75
B. Fugitive Emissions from Fuels	NE		18.78	ND							NE	NE	1.23	NE
2. Industrial Processes	**185.38**		**NO**	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NO/NE**	**0.00**	**14.76**	**0.14**
3. Use of Solvent and Other Product	**NO**			**NE**									**6.80**	
4. Agriculture [3]	**NO**	**NO**	**41.86**	**3.13**							**NO/NE**	**NO/NE**	**NO/NE**	**NO**
5. Land Use Change and Forestry	[3] **NO/NE**	[3] **-10,496.38**	**2.00**	**0.01**							**0.50**	**17.50**	**NA**	**NO**
6. Waste	**NO/NE**		**26.18**	**0.25**							**NO/NE**	**NO/NE**	**NO/NE**	**NO/NE**
7. Other	**NO**	**NO**	**NO**	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NO**	**NO**	**NO**	**NO**
Memo Items:														
International Bunkers	**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation	NE		NE	NE							NE	NE	NE	NE
Marine	NE		NE	NE							NE	NE	NE	NE
Multilateral Operations	**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**1,511.00**													

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.

[1] The emissions of HFCs and PFCs are expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are provided in Table 2(II) of this common reporting format.

[2] For verification purposes, countries report the results of their calculations using the Reference approach and explain any differences with the Sectoral approach in document box of Table1.A(c). Where possible, the calculations using the Sectoral approach are used for estimating national totals. In the table are included only the results of calculations from one approach.

[4] An estimate of CO_2 emissions and CO_2 removals are not provided in one column. "Net" emissions (emissions - removals) of CO_2 are estimated and a single number placed in either the CO_2 emissions or CO_2 removals column, as appropriate. For the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

Indicators:

NE - not estimated

NO - not occuring

0,00 - less than zero

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS

Latvia

(Sheet 1 of 1)

1996

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**-946.88**	**1,996.58**	**1,169.01**	**ND**	**ND**	**ND**	**2,218.71**
1. Energy	**9,364.12**	**525.76**	**117.49**				**10,007.37**
A. Fuel Combustion (Sectoral Approach)	9,364.12	131.48	117.49				9,613.09
1. Energy Industries	3,901.56	7.83	17.98				3,927.37
2. Manufacturing Industries and Construction	741.27	1.13	0.93				743.33
3. Transport	1,611.92	6.80	76.88				1,695.60
4. Other Sectors	3,053.56	115.71	21.70				3,190.97
5. Other	55.82	0.00	0.00				55.82
B. Fugitive Emissions from Fuels	0.00	394.28	0.00				394.28
1. Solid Fuels	ND	0.00	0.00				0.00
2. Oil and Natural Gas	ND	394.28	0.00				394.28
2. Industrial Processes	**185.38**	**NO**	**NO**	**NE**	**NE**	**NE**	**185.38**
A. Mineral Products	185.38	NO	NO				185.38
B. Chemical Industry	NO	NO	NO	NE	NE	NE	NO/NE
C. Metal Production	NO/IE	NO	NO		NE	NE	NO/IE/NE
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NE	NE	NE	NE
F. Consumption of Halocarbons and SF_6				NE	NE	NE	NE
G. Other	NO	NO	NO	NE	NE	NE	NE/NO
3. Use of Solvent and Other Product	**NA**		**ND**				**NE/NO**
4. Agriculture	**NA**	**879.04**	**969.06**				**1,848.10**
A. Enteric Fermentation		778.81					778.81
B. Manure Management		100.23	NE				100.23
C. Rice Cultivation		NO					NO
D. Agricultural Soils		NO	969.06				969.06
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NE	NE				NE
G. Other		NO	NO				NO
5. Land Use Change and Forestry[1]	**-10,496.38**	**42.00**	**4.34**				**-10,450.04**
6. Waste	**NE/NO**	**549.78**	**78.12**				627.90
A. Solid Waste Disposal on Land	NO	549.78					549.78
B. Wastewater Handling		NE	78.12				78.12
C. Waste Incineration	NE	NE	NE				NE
D. Other	NO	NO	NO				NO
7. Other *(please specify)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items:							
International Bunkers	**NE**	**NE**	**NE**				**NE**
Aviation	NE	NE	NE				NE
Marine	NE	NE	NE				NE
Multilateral Operations	**NE**	**NE**	**NE**				**NE**
CO_2 Emissions from Biomass	**1,511.00**						**1,511.00**

[1] For CO_2 emissions from Land-Use Change and Forestry the net emissions are reported. For the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	Net CO_2 emissions / removals	CH_4	N_2O	Total emissions
Land Use Change and Forestry	CO_2 equivalent (Gg)					
A. Changes in Forest and Other Woody Biomass Stocks	NO	-10,600.00	-10,600.00			-10,600.00
B. Forest and Grassland Conversion	NE		NE	42.00	4.34	46.34
C. Abandonment of Managed Lands	NE	NE	NE			NE
D. CO_2 Emissions and Removals from Soil	103.62	NO	103.62			103.62
E. Other	NO	NO	NO	NO	NO	NO
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	103.62	-10,600.00	-10,496.38	42.00	4.34	-10,450.04

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [a]	12,668.75
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [a]	2,218.71

[a] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land Use Change and Forestry.

Indicators:
NE - not estimated
IE - included in another sector
NO - not occuring
0,00 - less than zero

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B)

Latvia

(Sheet 1 of 1)

1997

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2 emissions	CO_2 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		**8,618.71**	**-10,508.48**	**103.80**	**3.83**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**44.85**	**371.95**	**73.99**	**44.14**
1. Energy		**8,465.21**		**35.10**	**0.41**							**44.35**	**354.45**	**50.22**	**44.07**
A. Fuel Combustion	Reference Approach[2]														
	Sectoral Approach[2]	8,465.21		12.06	0.41							44.35	354.45	48.39	44.07
B. Fugitive Emissions from Fuels		NE		23.04	NE							NE	NE	1.83	NE
2. Industrial Processes		**153.50**		**NO**	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NO/NE**	**0.00**	**15.73**	**0.07**
3. Use of Solvent and Other Product		**NO**			**NE**									**8.05**	
4. Agriculture [3]		**NO**	**NO**	**39.19**	**3.16**							**NO/NE**	**NO/NE**	**NO/NE**	**NO**
5. Land Use Change and Forestry		[3] **NO/NE**	[4] **-10,508.48**	**2.00**	**0.01**							**0.50**	**17.50**	**NO**	**NO**
6. Waste		**NO/NE**		**27.51**	**0.25**							**NO/NE**	**NO/NE**	**NO/NE**	**NO/NE**
7. Other		**NO**	**NO**	**NO**	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NO**	**NO**	**NO**	**NO**
Memo Items:															
International Bunkers		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation		NE		NE	NE							NE	NE	NE	NE
Marine		NE		NE	NE							NE	NE	NE	NE
Multilateral Operations		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass		**4,197.00**													

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.

[1] The emissions of HFCs and PFCs are expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are provided in Table 2(II) of this common reporting format.

[2] For verification purposes, countries report the results of their calculations using the Reference approach and explain any differences with the Sectoral approach in document box of Table1.A(c). Where possible, the calculations using the Sectoral approach are used for estimating national totals. In the table are included only the results of calculations from one approach.

[4] An estimate of CO_2 emissions and CO_2 removals are not provided in one column. "Net" emissions (emissions - removals) of CO_2 are estimated and a single number placed in either the CO_2 emissions or CO_2 removals column, as appropriate. For the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

Indicators:

NE - due to the lack of data, the calculations have not been done

NO - not occuring

0,00 - less than zero

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS (Sheet 1 of 1)

Latvia

1997

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**-1,889.77**	**2,179.74**	**1,187.92**	**NE**	**NE**	**NE**	**1,477.89**
1. Energy	**8,465.21**	**737.06**	**125.55**				**9,327.81**
A. Fuel Combustion (Sectoral Approach)	8,465.21	253.16	125.55				8,843.91
1. Energy Industries	3,819.17	10.54	22.32				3,852.03
2. Manufacturing Industries and Construction	1,242.94	3.93	6.82				1,253.68
3. Transport	2,178.37	10.33	53.94				2,242.64
4. Other Sectors	1,163.73	228.35	42.47				1,434.56
5. Other	61.00	NO	NO				61.00
B. Fugitive Emissions from Fuels	NE	483.90	NE				483.90
1. Solid Fuels	NE	NE	NE				NE
2. Oil and Natural Gas	NE	483.90	NE				483.90
2. Industrial Processes	**153.50**	**NO**	**NO**	**NE**	**NE**	**NE**	**153.50**
A. Mineral Products	153.50	NO	NO				153.50
B. Chemical Industry	NO	NO	NO	NE	NE	NE	NO/NE
C. Metal Production	NO/IE	NO	NO		NE	NE	NO/IE/NE
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NE	NE	NE	NE
F. Consumption of Halocarbons and SF_6				NE	NE	NE	NE
G. Other	NO	NO	NO	NE	NE	NE	NE
3. Use of Solvent and Other Product	**NO**		**NE**				**NO/NE**
4. Agriculture	**NO**	**823.01**	**980.53**				**1,803.54**
A. Enteric Fermentation		729.10					729.10
B. Manure Management		93.91	NE				93.91
C. Rice Cultivation		NO					NO
D. Agricultural Soils		NO	980.53				980.53
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NE	NE				NE
G. Other		NO	NO				NO
5. Land Use Change and Forestry[1]	**-10,508.48**	**42.00**	**4.34**				**-10,462.14**
6. Waste	**NO/NE**	**577.67**	**77.50**				655.17
A. Solid Waste Disposal on Land	NO	577.67					577.67
B. Wastewater Handling		NE	77.50				77.50
C. Waste Incineration	NE	NE	NE				NE
D. Other	NO	NO	NO				NO
7. Other *(please specify)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items:							
International Bunkers	**NE**	**NE**	**NE**				**NE**
Aviation	NE	NE	NE				NE
Marine	NE	NE	NE				NE
Multilateral Operations	**NE**	**NE**	**NE**				**NE**
CO_2 Emissions from Biomass	**4,197.00**						**4,197.00**

[1] For CO_2 emissions from Land-Use Change and Forestry the net emissions are reported. For the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	Net CO_2 emissions / removals	CH_4	N_2O	Total emissions
Land Use Change and Forestry	CO_2 equivalent (Gg)					
A. Changes in Forest and Other Woody Biomass Stocks	NO	-10,600.00	-10,600.00			-10,600.00
B. Forest and Grassland Conversion	NE		NE	42.00	4.34	46.34
C. Abandonment of Managed Lands	NE	NE	NE			NE
D. CO_2 Emissions and Removals from Soil	91.52	NO	91.52			91.52
E. Other	NO	NO	NO	NO	NO	NO
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	91.52	-10,600.00	-10,508.48	42.00	4.34	-10,462.14

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [a]	11,940.03
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [a]	1,477.89

[a] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land Use Change and Forestry.

Indicators:
NE - not estimated
IE - included in another sector
NO - not occuring
0,00 - less than zero

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B)
(Sheet 1 of 1)

Latvia
1998

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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	**8,287.11**	**-10,508.48**	**124.87**	**4.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**42.87**	**343.51**	**67.16**	**40.12**
1. Energy	**8,050.97**		**33.81**	**0.38**							**42.35**	**326.01**	**46.05**	**39.99**
A. Fuel Combustion — Reference Approach[2]														
A. Fuel Combustion — Sectoral Approach[2]	8,050.97		11.22	0.38							42.35	326.01	44.36	39.99
B. Fugitive Emissions from Fuels	NE		22.59	NE							NE	NE	1.69	NE
2. Industrial Processes	**236.14**		**NO**	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.02**	**0.00**	**15.81**	**0.13**
3. Use of Solvent and Other Product	**NO**			**NE**									**5.30**	
4. Agriculture [3]	**NO**	**NO**	**35.86**	**3.36**							**NO/NE**	**NO/NE**	**NO/NE**	**NO**
5. Land Use Change and Forestry	[3] **NO/NE**	[4] **-10,508.48**	**2.00**	**0.01**							**0.50**	**17.50**	**NO**	**NO**
6. Waste	**NO/NE**		**53.19**	**0.25**							**NO/NE**	**NO/NE**	**NO/NE**	**NO/NE**
7. Other	**NO**	**NO**	**NO**	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NO**	**NO**	**NO**	**NO**
Memo Items:														
International Bunkers	**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation	NE		NE	NE							NE	NE	NE	NE
Marine	NE		NE	NE							NE	NE	NE	NE
Multilateral Operations	**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**4,061.00**													

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.

[1] The emissions of HFCs and PFCs are expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are provided in Table 2(II) of this common reporting format.

[2] For verification purposes, countries report the results of their calculations using the Reference approach and explain any differences with the Sectoral approach in document box of Table1.A(c). Where possible, the calculations using the Sectoral approach are used for estimating national totals. In the table are included only the results of calculations from one approach.

[4] An estimate of CO_2 emissions and CO_2 removals are not provided in one column. "Net" emissions (emissions - removals) of CO_2 are estimated and a single number placed in either the CO_2 emissions or CO_2 removals column, as appropriate. For the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

Indicators:
NE - not estimated
NO - not occuring
0,00 - less than zero

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Latvia
1998

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**-2,221.37**	**2,622.24**	**1,239.28**	**NE**	**NE**	**NE**	**1,640.14**
1. Energy	**8,050.97**	**710.09**	**117.63**				**8,878.69**
A. Fuel Combustion (Sectoral Approach)	8,050.97	235.70	117.63				8,404.30
1. Energy Industries	3,543.18	9.41	19.84				3,572.43
2. Manufacturing Industries and Construction	1,275.28	4.43	8.06				1,287.77
3. Transport	2,126.22	9.98	48.05				2,184.25
4. Other Sectors	1,047.79	211.89	41.68				1,301.36
5. Other	58.50	NO	NO				58.50
B. Fugitive Emissions from Fuels	NE	474.39	NE				474.39
1. Solid Fuels	NE	NE	NE				NE
2. Oil and Natural Gas	NE	474.39	NE				474.39
2. Industrial Processes	**236.14**	**NO**	**NO**	**NE**	**NE**	**NE**	**236.14**
A. Mineral Products	236.14	NO	NO				236.14
B. Chemical Industry	NO	NO	NO	NE	NE	NE	NO/NE
C. Metal Production	NO/IE	NO	NO		NE	NE	NO/IE/NE
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NE	NE	NE	NE
F. Consumption of Halocarbons and SF_6				NE	NE	NE	NE
G. Other	NO	0.00	NO	NE	NE	NE	NO/NE
3. Use of Solvent and Other Product	**NO**		**NE**				**NO/NE**
4. Agriculture	**NO**	**753.10**	**1,040.98**				**1,794.08**
A. Enteric Fermentation		664.99					664.99
B. Manure Management		88.12	177.94				266.06
C. Rice Cultivation		NO					NO
D. Agricultural Soils		NO	863.04				863.04
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NE	NE				NE
G. Other		NO	NO				NO
5. Land Use Change and Forestry [1]	**-10,508.48**	**42.00**	**4.34**				**-10,462.14**
6. Waste	**NO/NE**	**1,117.04**	**76.33**				1,193.36
A. Solid Waste Disposal on Land	NO	1,117.04					1,117.04
B. Wastewater Handling		NE	76.33				76.33
C. Waste Incineration	NE	NE	NE				NE
D. Other	NO	NO	NO				NO
7. Other *(please specify)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items:							
International Bunkers	**NE**	**NE**	**NE**				**NE**
Aviation	NE	0.00	NE				NE
Marine	NE	0.00	NE				NE
Multilateral Operations	**NE**	**0.00**	**NE**				**NE**
CO_2 Emissions from Biomass	**4,061.00**						**4,061.00**

[1] For CO_2 emissions from Land-Use Change and Forestry the net emissions are reported. For the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	Net CO_2 emissions / removals	CH_4	N_2O	Total emissions
Land Use Change and Forestry	**CO_2 equivalent (Gg)**					
A. Changes in Forest and Other Woody Biomass Stocks	NO	-10,600.00	-10,600.00			-10,600.00
B. Forest and Grassland Conversion	NE		NE	42.00	4.34	46.34
C. Abandonment of Managed Lands	NE	NE	NE			NE
D. CO_2 Emissions and Removals from Soil	91.52	NO	91.52			91.52
E. Other	NO	NO	NO	0.00	0.00	0.00
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	91.52	-10,600.00	-10,508.48	42.00	4.34	-10,462.14

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [a]	12,102.28
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [a]	1,640.14

[a] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land Use Change and Forestry.

Indicators:
NE - not estimated
IE - included in another sector
NO - not occuring
0,00 - less than zero

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B)
(Sheet 1 of 1)

Latvia
1999

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2 emissions	CO_2 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		**7,545.44**	**-5,228.55**	**123.62**	**4.01**	**NE**	**NE**	**NE**	**NE**	**0.09**	**NE**	**40.74**	**327.66**	**113.82**	**33.38**
1. Energy		**7,384.78**		**24.50**	**0.34**							**39.86**	**295.84**	**42.09**	**33.27**
A. Fuel Combustion	Reference Approach[2]	7,379.11													
	Sectoral Approach[2]	7,384.78		9.57	0.34							39.86	295.84	40.45	33.27
B. Fugitive Emissions from Fuels		NE		14.93	NE							NE	NE	1.64	NE
2. Industrial Processes		**160.66**		**NO**	**NO**	**NE**	**NE**	**NE**	**NE**	**0.09**	**NE**	**0.02**	**0.00**	**65.13**	**0.11**
3. Use of Solvent and Other Product		**NO**			**0.01**									**6.60**	
4. Agriculture [3]		**NO**	**NO**	**31.35**	**3.39**							**NO/NE**	**NO/NE**	**NO/NE**	**NO**
5. Land Use Change and Forestry		[3] **NO/NE**	[4] **-5,228.55**	**3.64**	**0.03**							**0.86**	**31.82**	**NO**	**NO**
6. Waste		**NO/NE**		**64.14**	**0.25**							**NO/NE**	**NO/NE**	**NO/NE**	**NO/NE**
7. Other		**NO**	**NO**	**NO**	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NO**	**NO**	**NO**	**NO**
Memo Items:															
International Bunkers		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation		NE		NE	NE							NE	NE	NE	NE
Marine		NE		NE	NE							NE	NE	NE	NE
Multilateral Operations		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass		**3,547.00**													

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.

[1] The emissions of HFCs and PFCs are expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are provided in Table 2(II) of this common reporting format.

[2] For verification purposes, countries report the results of their calculations using the Reference approach and explain any differences with the Sectoral approach in document box of Table1.A(c). Where possible, the calculations using the Sectoral approach are used for estimating national totals. In the table are included only the results of calculations from one approach.

[4] An estimate of CO_2 emissions and CO_2 removals are not provided in one column. "Net" emissions (emissions - removals) of CO_2 are estimated and a single number placed in either the CO_2 emissions or CO_2 removals column, as appropriate. For the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

Indicators:
NE - not estimated
NO - not occuring
0,00 - less than zero

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Latvia
1999

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**2,316.89**	**2,595.92**	**1,242.30**	**NE**	**NE**	**NE**	**6,155.11**
1. Energy	**7,384.78**	**514.46**	**104.29**				**8,003.52**
A. Fuel Combustion (Sectoral Approach)	7,384.78	200.96	104.29				7,690.02
1. Energy Industries	3,116.00	6.41	13.77				3,136.17
2. Manufacturing Industries and Construction	1,146.21	5.64	10.49				1,162.33
3. Transport	2,087.00	9.79	47.74				2,144.53
4. Other Sectors	978.37	179.13	32.29				1,189.79
5. Other	57.20	NO	NO				57.20
B. Fugitive Emissions from Fuels	NE	313.50	NE				313.50
1. Solid Fuels	NE	NE	NE				NE
2. Oil and Natural Gas	NE	313.50	NE				313.50
2. Industrial Processes	**160.66**	**NO**	**NO**	**NE**	**NE**	**NE**	**160.66**
A. Mineral Products	160.66	NO	NO				160.66
B. Chemical Industry	NO	NO	NO	NE	NE	NE	NO/NE
C. Metal Production	NO/IE	NO	NO		NE	NE	NO/IE/NE
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NE	NE	NE	NE
F. Consumption of Halocarbons and SF_6				NE	NE	NE	NE
G. Other	NO	NO	NO	NE	NE	NE	NO/NE
3. Use of Solvent and Other Product	**NO**		**4.28**				**4.28**
4. Agriculture	**NO**	**658.27**	**1,049.66**				**1,707.93**
A. Enteric Fermentation		577.91					577.91
B. Manure Management		80.36	151.90				232.26
C. Rice Cultivation		NO					NO
D. Agricultural Soils		NO	897.76				897.76
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NE	NE				NE
G. Other		NO	NO				NO
5. Land Use Change and Forestry[(1)]	**-5,228.55**	**76.36**	**7.75**				**-5,144.44**
6. Waste	**NO/NE**	**1,346.85**	**76.33**				1,423.17
A. Solid Waste Disposal on Land	NO	1,220.32					1,220.32
B. Wastewater Handling		126.53	76.33				202.85
C. Waste Incineration	NE	NE	NE				NE
D. Other	NO	NO	NO				NO
7. Other *(please specify)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items:							
International Bunkers	**NE**	**NE**	**NE**				**NE**
Aviation	NE	NE	NE				NE
Marine	NE	NE	NE				NE
Multilateral Operations	**NE**	**NE**	**NE**				**NE**
CO_2 Emissions from Biomass	**3,547.00**						**3,547.00**

[(1)] For CO_2 emissions from Land-Use Change and Forestry the net emissions are reported. For the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	Net CO_2 emissions / removals	CH_4	N_2O	Total emissions
Land Use Change and Forestry	CO_2 equivalent (Gg)					
A. Changes in Forest and Other Woody Biomass Stocks	NO	-5,321.71	-5,321.71			-5,321.71
B. Forest and Grassland Conversion	NE		NE	76.36	7.75	84.11
C. Abandonment of Managed Lands	NE	NE	NE			NE
D. CO_2 Emissions and Removals from Soil	93.16	NO	93.16			93.16
E. Other	NO	NO	NO	NO	NO	NO
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	93.16	-5,321.71	-5,228.55	76.36	7.75	-5,144.44

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [(a)]	11,299.56
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [(a)]	6,155.11

[(a)] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land Use Change and Forestry.

Indicators:
NE - not estimated
IE - included in another sector
NO - not occuring
0,00 - less than zero

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B)
(Sheet 1 of 1)

Latvia
2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2 emissions	CO_2 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		**7,100.06**	**-4,290.19**	**123.77**	**4.12**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**37.88**	**283.18**	**95.97**	**18.49**
1. Energy		**6,999.20**		**25.20**	**0.32**							**36.98**	**250.73**	**35.77**	**18.41**
A. Fuel Combustion	Reference Approach[2]	7,182.73													
	Sectoral Approach[2]	6,999.20		7.52	0.32							36.98	250.73	34.35	18.41
B. Fugitive Emissions from Fuels		NE		17.68	NE							NE	NE	1.42	NE
2. Industrial Processes		**100.86**		**NO**	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.02**	**0.00**	**54.40**	**0.08**
3. Use of Solvent and Other Product		**NO**			**0.01**									**5.80**	
4. Agriculture [3]		**NO**	**NO**	**30.64**	**3.53**							**NO/NE**	**NO/NE**	**NO/NE**	**NO**
5. Land Use Change and Forestry		[3] **NO/NE**	[4] **-4,290.19**	**3.71**	**0.03**							**0.88**	**32.45**	**NO**	**NO**
6. Waste		**NO/NE**		**64.23**	**0.24**							**NO/NE**	**NO/NE**	**NO/NE**	**NO/NE**
7. Other		**NO**	**NO**	**NO**	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NO**	**NO**	**NO**	**NO**
Memo Items:															
International Bunkers		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation		NE		NE	NE							NE	NE	NE	NE
Marine		NE		NE	NE							NE	NE	NE	NE
Multilateral Operations		**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass		**2,543.00**													

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.

[1] The emissions of HFCs and PFCs are expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are provided in Table 2(II) of this common reporting format.

[2] For verification purposes, countries report the results of their calculations using the Reference approach and explain any differences with the Sectoral approach in document box of Table1.A(c). Where possible, the calculations using the Sectoral approach are used for estimating national totals. In the table are included only the results of calculations from one approach.

[4] An estimate of CO_2 emissions and CO_2 removals are not provided in one column. "Net" emissions (emissions - removals) of CO_2 are estimated and a single number placed in either the CO_2 emissions or CO_2 removals column, as appropriate. For the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

Indicators:
NE - not estimated
NO - not occuring
0,00 - less than zero

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Latvia
2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**2,809.87**	**2,599.25**	**1,278.56**	**NE**	**NE**	**NE**	**6,687.69**
1. Energy	**6,999.20**	**529.10**	**99.61**				**7,627.90**
A. Fuel Combustion (Sectoral Approach)	6,999.20	157.82	99.61				7,256.62
1. Energy Industries	2,895.00	8.13	16.66				2,919.79
2. Manufacturing Industries and Construction	1,055.00	5.63	9.92				1,070.55
3. Transport	2,088.00	8.86	46.42				2,143.28
4. Other Sectors	901.00	135.21	26.60				1,062.81
5. Other	60.20	NO	NO				60.20
B. Fugitive Emissions from Fuels	NE	371.28	NE				371.28
1. Solid Fuels	NE	NE	NE				NE
2. Oil and Natural Gas	NE	371.28	NE				371.28
2. Industrial Processes	**100.86**	**NO**	**NO**	**NE**	**NE**	**NE**	**100.86**
A. Mineral Products	100.86	NO	NO				100.86
B. Chemical Industry	NO	NO	NO	NE	NE	NE	NO/NE
C. Metal Production	NO/IE	NO	NO		NE	NE	NO/IE/NE
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NE	NE	NE	NE
F. Consumption of Halocarbons and SF_6				NE	NE	NE	NE
G. Other	NO	NO	NO	NE	NE	NE	NO/NE
3. Use of Solvent and Other Product	**NO**		**3.21**				**3.21**
4. Agriculture	**NO**	**643.45**	**1,093.72**				**1,737.17**
A. Enteric Fermentation		565.11					565.11
B. Manure Management		78.34	151.50				229.85
C. Rice Cultivation		NO					NO
D. Agricultural Soils		NO	942.22				942.22
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NE	NE				NE
G. Other		NO	NO				NO
5. Land Use Change and Forestry[1]	**-4,290.19**	**77.87**	**7.75**				**-4,204.57**
6. Waste	**NO/NE**	**1,348.83**	**74.28**				**1,423.11**
A. Solid Waste Disposal on Land	NO	1,257.27					1,257.27
B. Wastewater Handling		91.56	74.28				165.84
C. Waste Incineration	NE	NE	NE				NE
D. Other	NO	NO	NO				NO
7. Other *(please specify)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items:							
International Bunkers	**NE**	**NE**	**NE**				**NE**
Aviation	NE	NE	NE				NE
Marine	NE	NE	NE				NE
Multilateral Operations	**NE**	**NE**	**NE**				**NE**
CO_2 Emissions from Biomass	**2,543.00**						**2,543.00**

[1] For CO_2 emissions from Land-Use Change and Forestry the net emissions are reported. For the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	Net CO_2 emissions / removals	CH_4	N_2O	Total emissions
Land Use Change and Forestry	CO_2 equivalent (Gg)					
A. Changes in Forest and Other Woody Biomass Stocks	NO	-4,384.88	-4,384.88			-4,384.88
B. Forest and Grassland Conversion	NE		NE	77.87	7.75	85.62
C. Abandonment of Managed Lands	NE	NE	NE			NE
D. CO_2 Emissions and Removals from Soil	94.69	NO	94.69			94.69
E. Other	NO	NO	NO	NO	NO	NO
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	94.69	-4,384.88	-4,290.19	77.87	7.75	-4,204.57

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [a]	10,892.26
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [a]	6,687.69

[a] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land Use Change and Forestry.

Indicators:
NE - not estimated
IE - included in another sector
NO - not occuring
0,00 - less than zero

EMISSION TRENDS (SUMMARY)

Latvia

GREENHOUSE GAS EMISSIONS	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	CO_2 equivalent (Gg)											
Net CO_2 emissions/removals	12,701.62	12,701.62	7,665.35	4,048.81	1,993.06	1,064.94	-338.25	-946.88	-1,889.77	-2,221.37	2,316.89	2,809.87
CO_2 emissions (without LUCF) [2]	23,527.20	23,527.20	18,491.30	14,924.26	12,860.80	11,911.42	10,145.30	9,549.50	8,618.71	8,287.11	7,545.44	7,100.06
CH_4	4,115.14	4,115.14	4,016.96	3,333.23	2,386.57	2,086.22	2,128.12	1,996.58	2,179.74	2,622.24	2,595.92	2,599.25
N_2O	3,411.86	3,411.86	2,399.33	2,220.53	1,583.79	1,352.84	1,161.26	1,169.01	1,187.92	1,239.28	1,242.30	1,278.56
HFCs	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
PFCs	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
SF_6	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total (with net CO_2 emissions/removals)	**20,228.62**	**20,228.62**	**14,081.65**	**9,602.57**	**5,963.41**	**4,504.00**	**2,951.13**	**2,218.71**	**1,477.89**	**1,640.15**	**6,155.11**	**6,687.71**
Total (without CO_2 from LUCF) [2]	**31,054.20**	**31,054.20**	**24,907.60**	**20,478.01**	**16,831.16**	**15,350.48**	**13,434.68**	**12,715.09**	**11,986.37**	**12,148.63**	**11,383.66**	**10,977.90**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	CO_2 equivalent (Gg)											
1. Energy	24,628.54	24,628.54	19,310.49	15,712.73	13,585.75	12,416.88	10,710.51	10,007.37	9,327.81	8,878.70	8,003.52	7,627.90
2. Industrial Processes	562.91	562.91	584.01	286.34	89.30	154.23	127.40	185.38	153.50	236.14	160.66	100.88
3. Use of Solvent and Other Product	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	4.28	3.21
4. Agriculture	5,334.76	5,334.76	4,418.17	3,870.53	2,533.50	2,139.23	1,934.07	1,848.10	1,803.54	1,794.08	1,707.93	1,737.17
5. Land Use Change and Forestry	-10,788.57	-10,788.57	-10,788.94	-10,838.44	-10,830.74	-10,809.47	-10,437.21	-10,450.04	-10,462.14	-10,462.14	-5,144.44	-4,204.57
6. Waste	490.97	490.97	557.92	571.40	585.60	603.14	616.36	627.90	655.17	1,193.36	1,423.17	1,423.11
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

[1] Base year is 1990.

[2] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report CO_2 emissions and removals from Land Use Change and Forestry.

Indicators:
NE - not estimated
NO - not occuring

Annex 3

VALUES USED IN DIRECT GHG EMISSION PROJECTION ESTIMATIONS

Table 1

Energy balance, PJ, 1994-2020

	1994	1999	2005	2010	2015	2020
Primary energy consumption	**204.17**	**163.30**	**168.51**	**177.55**	**191.11**	**208.36**
Import	***192.55***	***154.29***	***142.83***	***152.83***	***168.80***	***185.19***
Coal	12.61	3.58	6.67	10.01	14.39	21.63
Coke	0.23	0.32	0.35	0.39	0.43	0.47
Oil shale	-	0.49	5.85	3.16	2.11	0.12
Heavy fuel oil	62.47	25.52	8.58	7.97	8.03	8.07
Diesel fuel	26.67	18.40	21.13	23.17	25.68	28.52
Gasoline	19.83	14.74	13.72	15.51	17.54	19.91
Liquefied gas	2.28	1.78	2.25	2.35	2.58	2.94
Natural gas	34.71	41.86	50.11	52.32	57.60	64.42
Wood	24.22	38.25	34.11	35.94	38.26	37.01
Electricity	9.53	9.35	0.06	2.01	2.18	2.10
Generation of primary energy resources	***14.61***	***11.37***	***25.74***	***26.72***	***24.49***	***25.27***
Peat	2.71	1.43	14.79	14.70	10.75	11.27
Bio ethanol	-	-	0.47	0.53	0.60	0.62
Biogas	-	-	0.57	0.57	0.57	0.57
Regenerative resources	11.90	9.94	9.91	10.92	12.57	12.81
Export	***2.99***	***2.36***	***0.06***	***2.00***	***2.18***	***2.10***
Peat	-	0.05	-	-	-	-
Electricity	2.99	2.31	0.06	2.00	2.18	2.10
Transformation sector	**12.37**	**10.74**	**10.78**	**10.02**	**10.62**	**12.56**
Power stations	***-***	***0.01***	***0.38***	***0.38***	***0.38***	***0.38***
Biogas	-	-	0.57	0.57	0.57	0.57
HPP	11.90	9.93	9.90	9.90	11.32	11.42
Wind farms	-	0.01	0.01	1.02	1.25	1.39
Generated electricity	-11.90	-9.93	-10.10	-11.11	-12.76	-13.00
Co-generation stations	***5.22***	***5.41***	***8.40***	***7.80***	***8.58***	***10.70***
Coal	-	-	3.77	2.77	3.74	6.17
Peat	1.96	1.00	12.50	11.23	10.65	11.17
Oil shale	-	0.06	5.71	3.04	1.99	-
Heavy fuel oil	14.29	7.58	-	-	-	-
Diesel fuel	-	0.01	-	-	-	-
Natural gas	7.69	15.40	22.44	16.00	16.74	17.64
Wood	-	-	3.47	6.50	6.60	9.30
Generated electricity	-4.09	-4.86	-12.65	-13.31	-14.02	-16.16
Produced heat	-14.63	-13.78	-26.84	-18.43	-17.12	-17.42
Boiler houses	***7.15***	***5.32***	***2.00***	***1.84***	***1.66***	***1.59***
Coal	3.37	0.51	-	-	-	-
Peat	0.41	0.11	-	-	-	-
Oil shale	-	0.31	0.02	0.01	0.01	0.01
Heavy fuel oil	26.37	9.34	0.59	0.59	0.58	0.57
Diesel fuel	0.36	0.09	-	-	-	-
Liquefied gas	0.01	-	-	-	-	-
Natural gas	10.65	11.33	10.90	11.08	11.24	11.41

	1994	1999	2005	2010	2015	2020
Coke	6.27	6.02	5.41	5.34	5.27	5.20
Electricity	0.04	0.02	-	-	-	-
Produced heat	-40.33	-22.41	-14.92	-15.18	-15.44	-15.60
Energy sector*	**0.21**	**3.09**	**3.39**	**3.70**	**4.11**	**4.48**
Peat	0.03	0.12	0.09	0.09	0.10	0.10
Heavy fuel oil	-	0.73	0.82	0.89	0.99	1.08
Diesel fuel	0.12	0.21	0.24	0.26	0.29	0.31
Natural gas	-	0.64	0.71	0.78	0.86	0.94
Wood	-	0.05	0.05	0.06	0.07	0.08
Heat	-	0.34	0.38	0.41	0.46	0.50
Electricity	0.06	1.00	1.10	1.21	1.34	1.47
Losses**	**11.75**	**13.53**	**13.66**	**10.78**	**9.57**	**10.00**
Electricity	5.47	4.75	4.30	4.43	4.80	5.12
District heating	6.18	7.77	8.14	4.92	3.18	3.05
Natural gas	0.10	1.01	1.22	1.43	1.59	1.83
Final energy consumption***	**179.83**	**135.94**	**140.67**	**153.05**	**166.81**	**181.20**
Coal	9.24	3.07	2.90	7.24	10.65	15.46
Coke	0.23	0.32	0.35	0.39	0.43	0.47
Peat	0.31	0.15	2.20	3.38	-	-
Oil shale	-	0.12	0.12	0.11	0.11	0.11
Heavy fuel oil	21.81	7.87	7.17	6.49	6.46	6.42
Diesel fuel	26.19	18.09	20.89	22.91	25.39	28.21
Gasoline	19.83	14.74	13.72	15.51	17.54	19.91
Liquefied gas	2.27	1.78	2.25	2.35	2.58	2.94
Natural gas	16.27	13.48	14.84	23.03	27.17	32.60
Wood	17.95	32.18	25.18	24.04	26.32	22.43
District heating	48.77	28.08	33.23	28.28	28.92	29.46
Electricity	16.96	16.06	17.35	18.79	20.64	22.57
Bio ethanol	-	-	0.47	0.53	0.60	0.62
Energy efficiency	-	-	1.68	2.64	2.63	2.62
Agriculture	*10.81*	*4.16*	*4.36*	*4.63*	*5.05*	*5.48*
Coal	0.56	0.09	0.09	0.09	0.10	0.11
Peat	0.05	-	-	-	-	-
Heavy fuel oil	1.33	0.24	0.25	0.27	0.30	0.32
Diesel fuel	5.33	1.74	1.82	1.93	2.11	2.29
Gasoline	0.30	0.04	0.05	0.05	0.05	0.06
Liquefied gas	0.01	-	-	-	-	-
Natural gas	0.73	0.50	0.53	0.56	0.61	0.66
Coke	1.23	0.83	0.87	0.92	1.01	1.09
District heating	0.13	0.07	0.07	0.08	0.08	0.09
Electricity	1.14	0.65	0.68	0.73	0.79	0.86
Services	*44.59*	*27.30*	*28.45*	*32.81*	*36.65*	*39.95*
Coal	2.77	1.96	1.03	2.84	3.26	3.66
Peat	0.11	0.03	-	3.38	-	-
Heavy fuel oil	5.94	0.81	0.75	0.69	0.63	0.57
Diesel fuel	8.67	1.62	1.50	1.38	1.26	1.15
Liquefied gas	-	0.10	0.10	0.17	0.28	0.54
Natural gas	1.37	1.85	1.75	2.99	5.06	10.02
Wood	3.79	9.06	8.09	7.42	10.59	6.77
District heating	16.35	6.02	7.67	5.76	6.58	7.42
Electricity	5.59	5.85	6.32	6.94	7.76	8.60

	1994	1999	2005	2010	2015	2020
Energy efficiency	-	-	1.24	1.24	1.23	1.22
Industry	*39.06*	*29.97*	*32.81*	*35.73*	*39.54*	*43.52*
Coal	1.09	0.34	0.24	1.56	3.33	6.01
Coke	0.23	0.32	0.35	0.39	0.43	0.47
Peat	0.05	0.01	-	-	-	-
Oil shale	-	0.12	0.12	0.11	0.11	0.11
Heavy fuel oil	12.70	6.81	6.17	5.53	5.53	5.53
Diesel fuel	1.58	1.28	1.23	1.18	1.18	1.18
Liquefied gas	0.06	0.09	0.09	0.09	0.17	0.21
Natural gas	9.76	8.14	7.88	7.38	9.39	10.04
Wood	1.93	6.88	6.42	6.08	5.27	5.28
Heat	5.51	1.11	4.86	7.45	7.54	7.49
Electricity	6.15	4.87	5.45	5.96	6.59	7.20
Households	*54.63*	*45.39*	*44.62*	*46.29*	*47.23*	*48.53*
Coal	4.82	0.68	1.54	2.75	3.96	5.68
Peat	0.10	0.11	2.20	-	-	-
Heavy fuel oil	0.20	-	-	-	-	-
Diesel fuel	1.81	-	-	-	-	-
Liquefied gas	2.14	1.32	1.10	1.01	0.91	0.81
Natural gas	4.36	2.86	4.61	12.02	12.01	11.77
Wood	11.00	15.41	9.80	9.62	9.45	9.29
District heating	26.78	20.88	20.63	14.99	14.72	14.46
Electricity	3.42	4.13	4.30	4.50	4.78	5.12
Regenerative resources	-	-	-	-	-	-
Energy efficiency	-	-	0.44	1.40	1.40	1.40
Transport	*30.74*	*29.12*	*32.11*	*36.23*	*40.97*	*46.34*
Air transport	0.67	1.26	1.22	1.34	1.48	1.64
Aviation fuel	0.67	1.26	1.22	1.34	1.48	1.64
Road transport	25.66	24.09	26.90	30.42	34.42	38.94
Gasoline	19.53	14.70	13.67	15.46	17.49	19.85
Diesel fuel	6.02	9.09	11.73	13.27	15.01	16.98
Liquefied gas	0.06	0.27	0.96	1.08	1.22	1.38
Liquefied natural gas	0.05	0.03	0.07	0.08	0.10	0.11
Bio ethanol	-	-	0.47	0.53	0.60	0.62
Railway and city public transport	2.12	3.12	3.56	4.10	4.73	5.45
Diesel fuel	1.46	2.69	3.11	3.60	4.18	4.84
Electricity	0.66	0.43	0.45	0.50	0.55	0.61
Sea transport	***2.29***	***0.42***	***0.28***	***0.21***	***0.17***	***0.13***
Heavy fuel oil	1.64	0.01	-	-	-	-
Diesel fuel	0.65	0.41	0.28	0.21	0.17	0.13
Pipeline transport	-	0.23	0.15	0.16	0.17	0.18
Natural gas	-	0.10	-	-	-	-
Electricity	-	0.13	0.15	0.16	0.17	0.18

* Including quantities consumed in the energy sector (NACE 10, 23, 40).

** Losses include also consumption of electrical energy in power stations, technological consumption in transmission networks.

*** Energy efficiency is not included.

Table 2

Production of some agricultural products, 2000-2020

Indicator	2000	2005	2010	2015	2020
Land used in agriculture, thous.ha	2484.9	2484.8	2484.6	2484.5	2484.3
Plant production					
Limed area (ha)	3090.9	3160	3190.3	3230	3340.3
Total yield of some cereal crops (barn weight), thous.t	923.6	1125	1350	1740	2004
Cereals	918.98	1119.38	1343.25	1731.30	1993.98
Legumes	4.62	5.63	6.75	8.70	10.02
Cattle breeding					
Cattle, thous.	366.7	340	370	410	450
Swine, thous.	393.5	380	395	410	420
Sheep, thous.	28.6	35	40	45	50
Goats, thous.	10.4	15	20	22	25
Horses, thous.	15.7	20	21	22	23
Poultry, thous.	3104.6	3200	3300	3350	3400

Table 3

Some indicators of the forestry sector, 1995-2020

Indicator	1995	2000	2005	2010	2015	2020
Managed forests, thous.ha	2882	2888	3010	3140	3270	3400
Newly afforestated land thous.ha	125	4	122	130	130	130
Especially protected forests, thous.ha	52	13.6	15	20	21	23
Area under shrubs, thous.ha	NE	120	120	120	120	120
Cuttings and unfinished afforestation, thous.ha	NE	79	90	90	100	100
Annual increment of growing stock, m^3/ha	NE	6.2	6.2	6.2	6.2	6.2
Annual increment of growing stock, mill.m^3	NE	16.53	17.23	17.99	18.75	19.51
Total forest stock, mill.m^3	NE	545*	524	547	569	592
Annual harvesting (liquid amount)	6.89	11	8.8	9.6	10.6	11
Annual natural forest die-off (stem wood volume)	2.8	3.0	3.0	3.0	2.6	1.8

* Total forest stock used in calculation of CO_2 sequestration is 503 mill.m^3.

Annex 4

Table 1

Data used for CO_2 removal estimation in the forestry sector

Indicator	1990[1]	1995[1]	1999	2000
Annual forest harvesting (liquid amount), mill.m^3	5,76	6,89	10,7	11
Annual natural forest die-off (stem wood volume), mill.m^3	3,0	2,8	3,0	3,0
Forest lands, including	2751	2830	2676	2888
Foliage trees, thous. /ha	NE	NE	1123,7	1155
Coniferous trees, thous. /ha	NE	NE	1552,35	1733
Newly afforestated areas, thous.ha	143	112	NE	4
Specially protected forests, thous.ha	52	52	52	52
Non-wood lands, including				
Shrub area, thous.ha	NE	NE	118	120
Clearings and unfinished afforestation (in forest lands), thous.ha	NE	NE	149	79
Annual C sequestration growth, Gg	6540	6810	8078,28	8011,18
Annual C sequestration loss, Gg	3550	3920	6626,9	6815,3
Annual C removals, Gg	2990	2890	1451,37	1195,88
Annual CO_2 removals, Gg	10960	10600	5321,71	4384,88

Table 2

Data used for CH_4, N_2O and indirect GHG emission estimation in the forestry sector

Indicator	1990[1]	1995[1]	1999	2000
Annual biomass burnt on site, mill.m^3	0,47	0,56	1,01	1,03
Oxidised fraction[2]	0,9	0,9	0,9	0,9
Annual on–site oxidised biomass, mill.m^3	0,42	0,50	0,91	0,93
Annual C losses, mill. t	0,10	0,125	0,23	0,23

[1]Source: [42]
[2]Source: [22]