NATIONAL COMMUNICATION

OF THE REPUBLIC OF LATVIA

UNDER UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

MINISTRY OF ENVIRONMENTAL PROTECTION AND REGIONAL DEVELOPMENT

RIGA

1995

CONTENTS

FOREWORD

Alongside with many other countries worldwide Latvia signed the Un ited Nations Framework Convention on Climate Change during the United Nations Conference on Environment and Development in Rio de Janeiro, 1992, thu s demonstrating its determination to play an active role in taking measure s ultimately aimed at countering irreversible climate changes due t o anthropogenic activities.

The Saeima of Latvia ratified the Convention on 23 February, 19 95, thus becoming a Member State to the Convention and undertaking to fulfi l obligations pursuant to the Convention; Government acknowledges tha t assessing the current situation and prognosticating developmental trends for a next decade peculiarities of a transition period in politics and economy are bound to give rise to various problems and difficulties.

However, Latvian Government believes that the difficulties of a transition period will be overcome by virtue of efforts of Latvian people and international assistance; science and modern technologies will develop, a national policy on climate will be devised and implemented, a period o f sustained growth will begin in economy.

The National Communication of Latvia demonstrates that th e Government has already commenced the process.

INDULIS EMSIS
Minister of State
Ministry of Environmental Protection
and Regional Development

SUMMARY
INTRODUCTION

Latvia participated at the United Nations Conference on Environment and Development at Rio de Janeiro in June, 1992 and signed the Framework Convention on Climate Change. The Convention is ratified by the Saeima on 23 February, 1995.

National Communication of the Republic of Latvia provides other countries members to the Convention with general information about Latvia; presents data on emissions of greenhouse gases (GHG); outlines policy and measures to be adopted gradually in order to stabilize GHG emissions by 2000 and to prevent these from increasing in future.

Ministry of Environment Protection and Regional Development of the Republic of Latvia:
- Department of Environment Protection,
- Environment Data Centre,
- State Environment Inspection.

Ministry of Transport of the Republic of Latvia:
- Ecology Department,
- Hydrometeorlogical Agency.

Ministry of Economy of the Republic of Latvia:
- Department of Promotion of Entrepreneurial Activities,
- Department of Energy Development and Balance of Resources.

Ministry of Agriculture of the Republic of Latvia:
- Department of Agriculture,
- State Forest Service.

Ministry of Finances of the Republic of Latvia:
- Department of Forecasting and Macro Fiscal Analysis.

State Committee of Statistics of the Republic of Latvia:
- Administration of Environment Protection Statistics,
- Division of Statistics of Material Resources.

Riga City Municipality
Advisor of Prime Minister on Environment Protection Affairs
Energy Agency of Latvia
State Institute of Forest Inventory

Foreign institutions:
Ministry of Housing, Physical Planning and Environment of the Netherlands,
Institute of Environmental Studies at Vrije University of the Netherlands,
Polish Foundation of Energy Efficiency

The principal difficulties in preparing the National Communication are linked with deep changes aimed at transition from centrally planned economy model to market relations, taking place in all sectors of economy, state administration and legislation in the aftermath of a collapse of the USSR and regaining of independence. Restructuring is still under way in many sectors of economy which have been principal sources of GHG emissions in the past. Since a full-value system for accumulation of statistical data is yet to be devised, it is not possible for the time being to produce reliable projections or recommendations concerning directions of economic development up to 2000 and 2010.

Apart from Latvia there is a number Eastern European countries - signatories to the Convention, which are undergoing a transition stage to market-based economy. The special circumstances taken into account, the Convention provides for some "flexibility" in preparing the

National Communication in countries with transition economies.

Within a context of the National Communication of the Republic of Latvia the term "flexibility" is interpreted in the following way:

1. 1990 is designated as **a base year** in accordance with the Convention, however, to facilitate better understanding of processes taking place in various sectors of national economy, additionally to the base year, information is presented related to some previous years.

2. **Inventory of emissions.** Since radical changes have been taking place in Latvian economy from 1990, it has been impossible to assess industrial activities in some of subsectors, except cement production, and to evaluate GHG emissions in accordance with the methodology recommended by IPCC\OECD, therefore NO_x, CO and NMVOC emissions pertinent to industries and sectors utilizing solvents are made available from statistical records of Latvian Environment Data Centre. CO_2 sink in forestry is assessed in compliance with the methodology of US Environmental Protection Agency using database of the Forest Department of the Ministry of Agriculture.

3. **Projection of emissions.** Despite all economic sectors are considered in the Chapter dealing with policies and measures aimed at reducing GHG emissions, reliable quantitative assessment of efficiency of measures is feasible solely in energy sector.

GENERAL INFORMATION ABOUT REPUBLIC OF LATVIA

Latvia is situated on the edge of the Eastern European plane on shores of the Baltic Sea. Location of Latvia and the proximity of the Atlantic Ocean determines climatic conditions, i.e., moderately warm summers, moderately cold winters, frequent cyclones. A total land area of Latvia is 64.600 km^2, including 39% of cultivated land, 44% of forests, shrubs and groves. Population of Latvia in 1990 is about 2.7 millions of inhabitants.

Latvian economy is undergoing a transition period from centralized planning to market relations, which has brought about crisis in all sectors of state activities, particularly in an energy sector and industries. Latvian energy sector has no considerable resources of its own - 50% of electricity and 90% of fuel is imported, thus a transition to market prices in case of energy resources hit Latvian economy exceptionally severely and served as one of the aspects causing its decline.

After regaining independence Latvian legislation is undergoing a transformation stage. For the time being legislative acts elaborated and approved after regaining independence are in force, as well as those used in Latvian SSR and the USSR.

INVENTORY OF EMISSIONS

The following gases are considered in GHG inventory in Latvia: CO_2, CH_4, N_2O, NO_x, CO, NMVOC (non-methane volatile organic compounds). Inventory data on 1990 emissions are presented in Table S.1. Employing coefficients of the global warming potential (GWP) it is assessed, that aggregated reduced GHG emissions in 1990 amounted to 27632 Gg of CO_2 equivalents, of which CO_2 constitute 83.1%, CH_4 - 14.1%, N_2O - 2.8%.

Combustion of fuel is the principal source of CO_2 emissions, whereas agriculture - the main source of CH_4 emissions. CO_2 sink in Latvia in 1990 covered about 50% of total CO_2 emissions.

Aggregated GHG emissions in Latvia over the period of 1990 -1994 have dropped markedly due to processes of restructuring and decline of production and fragmentation in many

sectors of industry and collective farming.

Aggregate Table S.1. Inventory of GHG emissions in Latvia in 1990 (Gg)

GHG source and sink categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC
Total emissions and sinks	22976.3	158.937	2.38	90.135	363.125	62.722
1.All energy	22605.6	4.167	1.03	90.135	363.125	55.324
1.A. Fuel combustion	22605.6	2.368	1.03	90.135	363.125	55.315
1.A.1. Energy & transformations activities	8274.4	0.509	0.07	15.223	22.727	0.648
1.A.a Losses - transport & distribution	34.5					
1.A.2. Industry	2680.4	0.059	0.014	3.362	0.939	0.099
1.A.3. Transport	5660.6	1.486	0.108	65.833	329.077	54.199
1.A.5. Residential	3140.3	0.184	0.029	2.711	4.414	0.179
1.A.6. Agriculture/forestry	1449.7	0.108	0.016	1.582	4.789	0.124
1.A.7. Other	1365.7	0.022	0.793	1.424	1.179	0.066
1.B. Fugitive fuel emission		1.799				0.009
2. Industrial processes	370.7					
2.E.1. Cement production	370.7					
3. Solvent and other product use						7.398
3.A. Degreasing and dry cleaning						1.119
3.B. Chemical products manufacture / processing						0.680
3.C. Other						5.599
4. Agriculture		111.27	1.351			
4.A. Enteric fermentation		97.96				
4.B. Animal waste		13.31				
4.C. Agricultural soils			1.351			
5. Land use change and forestry	(-14300)					
5.C. Managed forests	(-14300)					
6. Waste		43.5				
6.A. Landfills		43.5				

POLICIES AND MEASURES MITIGATING CLIMATE CHANGE

No particular national policy mitigating climate change has been elaborated in Latvia. To a large extent the climate policy is a combination of environmental protection policy and of development stratagies in various economic sectors.

Development concepts and plans for Latvian economic sectors:

- Environmental Protection Policy Plan (EPPP, elaborated and accepted in 1995),
- Projection of Latvian Economic Development (elaborated in 1994),
- Public Investment Programme (elaborated in 1994),
- Macroeconomic Stabilization Programme (elaborated in 1994),
- Energy Master Plan for Latvia (LEDP, elaborated in 1994),
- National Development Programme of Motor Transport (elaborated in 1994 in the frame of Transport Development National Programme),
- Forest Development Proramme (elaborated in 1992),
- Forestry Development Policy (elaborated in 1994),
- Concept of National Strategy in Rural Areas (elaborated in 1994),
- Concept of National Strategy in Industry (elaborated in 1995).

Objectives of national climate policy are formulated in EPPP, i.e., significant improvement of environment quality is sought in territories, where environment quality causes high risks, preventing in the same time deterioration of environment quality in the remaining territory; also EPPP is aimed at integration efforts with respect to environment protection in all sectors and sides of life. Pursuant to Article 4, Clause 2, Paragraph (a) of the Convention on Climate Change "....Parties shall adopt national policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of greenhouse gasses and protecting and enhancing its greenhouse gas sinks and reservoirs. These policies and measures will demonstrate that developed countris are taking the lead in modifying longer-term trends in anthropogenic emissions consistent with the objective of the Convention, recognizing that the return by the end of the present decade to earlier levels of anthropogenic emissions of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol would contribute to such modification, and taking into account the differences in these Partie's starting points and approaches, economic structures and resource bases, the need to maintain strong and sustainable economic growth, available technologies and other individual circumstances, as well as the need for equitable and appropriate contributions by each of these Parties to the global effort regarding that objective". **Pursuant to Paragraph (a), Clause 2, Article 4 of the Convention on Climate Change to which Latvia as a Signatory Party, the said objectives relevant to greenhouse gases is to stabilize emissions of these gases by 2000 not exceeding the levels of 1990 emissions.** Due to economic decline none of the sectors expects rapid growth in production and consumption activities before 2000, moreover, the activity levels will fall short of those of 1990, consequently, emissions of GHG in comparison with 1990 shall not increase. However, the levels may grow after 2000 or even earlier, provided unprognosticated changes take place and actual economic development markedly differs from forecasted scenarios. Thus, the measures characteristic of Latvia's circumstances, both the planned and implemented ones are considered.

Climate policy and measures in individual economic sectors can be expressed by combining principal requirements of sectorial development with basic principles of environment protection. Most significant measures pertinent to climate policy are connected with energy and transport sectors. Policy and measures aimed at reducing GHG emissions in all sectors of economy are summarized in Tables S.2.- S.4.

Aggregate Table S.2. Policy and measures for reduction of CO_2 emission levels

Economic sector	Economic measures	Laws	Education, information	Governmental measures	Voluntary actions	Scientific studies
1. Energy sector						
1.A. Combustion of fuel 1.A.1. Energy production and transformation	1. Natural resource tax (P) 2.Differentiated excise tax for different types of fuel in favour of gas; shall cut CO_2 emissions by 6% (P)	Natural resource tax (P)	Awareness building action "Last warning" (11.02.95) dedicated to GHG impact upon climate (I)	1. Free market price for fuel (I) 2.Organization of energy saving campaign (I) 3.Reconstruction of heating network shall cut losses and CO_2 emissions by 3% (UI) 4. Installation of heat meters shall cut heat consumption and CO_2 emissions by 10 % (UI) 5. Utilization of alternative energy - construction of hydroelectric plants on small rivers(UI) 6. Financial support to scientific research (P)	1. Indigenous biofuel (wood, peat), more extensive utilization of hydro resources shall cut CO_2 emissions by 2 - 4% (UI) 2. Reduction of heat losses by packing room during the cold season (I)	1. Development of novel technologies (UI) 2. Studies of alternative energy sources (solar, wind) (UI) 3. Studies on heat insulation of buildings (UI)
1.A.3. Transport	Differentiated excise tax on different types of petrol (P)	1. Rigorous regulations of annual vehicle check-up (I) 2. Speed limits (I)	Education of vehicle drivers (I)	1. Changes in transport infrastructure in favour of water transport and railway transport (P) 2. Restrictions for private transport within cities (UI) 3. Improvements in public transport system (P)	More extensive use of bicycle transport (UI)	Development of production of up-to-date and ecologically friendly transportation means and equipment (P)
1.A.5. Heating of residential buildings	Natural resource tax (P)	Natural resource tax (P)	Ads on heat saving in mass media (I)	Free market prices for all types of fuel (I)	Reduction of heat losses by packing room during the cold season (I)	Studies on heat insulation of buildings (UI)

5. Land use change and forestry 5.C. Managed forests	Fines for unauthorized felling (I)	Laws on land and forest management (I)	Building of public awareness of the forest as "lungs" of the planet, ads in mass media (UI)	1. Forest inspection services, financial support (I) 2. Preservation and renewal of forest resources (I) 3. Land use supervision system (UI)	Tidying-up of forests, planting campaign (UI)	

Note: I - implementation completed, UI - under implemenation, P - planned.

Aggregate Table S.3. Policy and measures for reduction of CH_4 emission levels

Economic sector	Economic measures	Laws	Education, information	Governmental measures	Voluntary actions	Scientific studies
1. Energy sector 1.A. Combustion of fuel	Natural resource tax (P)	Natural resource tax (P)	Awareness building action "Last warning" (11.02.95) dedicated to GHG impact upon climate (I)	1. Free market price for fuel (I) 2.Organization of energy saving campaign (I) 3. Installation of heat meters shall cut heat consumption and CH_4 emissions by 1.5 % (P) 4. Utilization of alternative energy - construction of hydroelectric plants on small rivers(UI) 5. Financial support to scientific research (P)		Development of technologies for improved combustion of fuel (UI)
1.B. Emission of fugitive fuel 1.B.1. Natural gas	1. Natural resource tax (P) 2. Fines on actions leading to gas leakage (I)	Natural resource tax, laws on protection of atmospheric air (P)		1. Free market price for fuel (I) 2. Technical inspection services for gas management, provision of financial support (I) 3. Installation of gas meters shall cut consumption and emissions of CH_4 by 1-2 % (UI) 4. Financial support to scientific research (P)		Providing state-of-the-art equipment for gas companies (UI)

4. Agriculture 4.A. Enteric fermentation 4.B. Animal waste			Training of farmers (I)	Free market prices of energy resources and fodder causes reduction of cattle (I)	More efficient management in private farms, if compared to large farms: adequate storage conditions for manure, its time-ly turn-in into soil (UI)	
6. Waste 6.A. Landfills	Fines for unauthorized dumping (I)	2. Drafting of new laws (UI)	Training courses in Latvian colleges and secondary schools (I)	1. Establishment of waste management administration (P) 2. Construction of waste reprocessing plant (P) 3. Financial support for scientific studies (P)	1. Actions of waste sorting (UI) 2. Reduction of waste amount (P)	1. Study of utilization of biogas (P) 2. Development of recycled waste utilization technologies (UI)

Note: I - implementation completed, UI - under implemenation, P - planned.

Aggregate Table S.4. Policy and measures for reduction of N_2O emission levels

Economic sector	Economic measures	Laws	Education, information	Governmental measures	Voluntary actions	Scientific studies
1. Energy 1.A. Combustion of fuel 1.A.1. Energy production and transformation	Natural resource tax (P)	Natural resource tax (P)	Awareness building action "Last warning" (11.02.95) dedicated to GHG impact upon climate (I)	1. Free market price for fuel (I) 2.Organization of energy saving campaign (I) 3. Installation of heat meters shall cut heat consumption and N_2O emissions by 1.5 % (P) 4. Utilization of alternative energy - construction of hydroelectric plants on small rivers(UI) 5. Financial support to scientific research (P)		

4. Agriculture 4.C. Agricultural soils		Laws on land management (Chapter 4, Appendix, Table 4.2) (I)	Providing consultations and assistance to farmers executed by companies (I)	1. Free market prices for organic fertilizers prevent its squandering (I) 2. Financial support of scientific studies (P)	1. Proper storing of organic fertilizers (UI) 2. Proper turn-in of fertilizers into soil (UI)	Elaboration of scientifically substantiated recommendations (UI)

Note: I - implementation completed, UI - under implemenation, P - planned.

PROJECTIONS

Macroeconomic projection for 2000, GHG emissions inventory for 1990 and assessment of efficiency of the policy countering climate change form basis for GHG projection.

Macroeconomic projection is elaborated basing on three scenarios of economic development. Eventual growth of investments is regarded as the main factor fostering further economic growth, which, in its turn to a large extent depends upon macroeconomic policy adopted by the government.

In compliance with the first scenario, to be regarded arbitrarily as a pesimistic one, it is assumed that the government fails to find suitable tools for a more efficient increment of investments. In this event growth of the gross domestic product (GDP) during 1994 and 1995 might be insignificant and only beginning with 1996, the growth might amount to 3-4% per annum.

The second scenario is based on the assumption that the growth rate of the gross domestic product reaches 6%. Data concerning this scenario are presented with most details, since it is regarded as the most realistic. Summary Tables for each scenario are presented in Appendix 5.

In accordance with the third scenario, it is assumed that the government shall succeed in accelerating the process of investment, resulting in the growth of gross domestic product already in 1995 by 4%, the most rapid growth (7 - 8 % per annum) is expected to take place in 1998 and 1999. Some basic assumptions used in working out macroeconomic projections are demonstrated in Table S.5.

Aggregate Table S.5. Basic assumptions for macroeconomic forecast

Indicators (million Ls in fixed prices of 1993)	Year 1990	Reduction % by the year 2000 compared to year 1990
Gross domestic product	2953	(-40%) - (-25%)
Energyproduction	365.8	(-22%) - (-15%)
Manufacturing	2053.5	(-54%) - (-37%)
Transport	1121.6	(-25%) - (-6%)

Projection of aggregate GHG emissions in 2000 (2nd scenario corresponding to medium economic growth rates and maximum growth in gross domestic product after 1996 by 6% per annum) is presented in Table S.6.

Aggregate Table S.6. Projection of GHG emissions in Latvia in 2000 (Gg)

SEG	1990	2000 (s.2)
CO_2	22976	16956
CO_2 sink	(-14300)	(-8940)
CH_4	159	114.15
N_2O	2.38	1.43
NO_x	90.13	52.48
CO	363.12	278.23
NMGOS	62.7	39.19

The considerable drop in GHG emissions is attributable to a decline of all economic sectors, however this process will be facilitated by policy and measures referred to in Tables S.2., S.3. and S.4. Assessment of the efficiency implemented measures is partly feasible solely in energy sector, because:

- Latvia has no experience in assessments of this type,
- there has been no practice of individual grouping of measures aimed at reduction of GHG emissions and other air pollution in Latvia previously.

The data depicted in Table S.6. reveal that CO_2 emissions in 2000 in comparison with 1990 will drop by 26%, CH_4 by 28%, N_2O by 40%. Aggregate GHG emissions expressed in Gg of CO_2 equivalents (global warming potential) in comparison with 1990 will decrease by 27%.

SYSTEMATIC OBSERVATIONS AND STUDIES

Institutions subordinated to MEPaRD and Hydrometeorlogical Agency under the Ministry of Transport perform observations and monitoring of climate changes. Climate observations and databases asssist scientists in understanding better the climate changes in Latvia and elsewhere in the world. Studies related to the aboce issues are undertaken with support of Latvian Science Council are carried out at Latvian Universities. The principal studies follow:

- spectroscopy and photochemistry of polluted atmosphere;
- bio-indicative systems and systems for qualitative environment assessment;
- use of novel bio-motoring techniques in fresh water basind;
- circulation of organic carbon and biogenic elements in an ecosystem of the Riga Gulf.

Applied investigations are connected with development of heat energy saving methods, as well as with research in the field of energy-intensive and ecologically-friendly techniques for energy production.

After reinstitution of national sovereignty Latvian scientists are gradually engaging in implementation of the Programme on Global Climate Change, however the collaboration is mere nominal and not attracting any financial support from united international sources or from national budget.

EDUCATION, TRAINING AND PUBLIC AWARENESS

During recent 1 to 3 years a wide network of studies related to environment protection has been created in Latvian schools and universities. As a result, efforts undertaken by school personnel and academic community yield valuable initial contribution to put general public and young generation in particular in know of environmental issues and eventual impact of these upon global climate change.

1. INTRODUCTION

The Framework Convention of United Nations on Climate Change has been elaborated in Rio de Janeiro in June, 1992 during the United Nations Conference on Environment and Development where among other countries the delegation of the Republic of Latvia participated. Alongside with other 165 countries worldwide Latvia signed the Convention, thus becoming a Party to the Convention.

The ultimate objective of this Convention is to achieve the stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Greenhouse gases mean those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and reemit infrared radiation. The following gases are included in the list of greenhouse gases: water vapour, carbon dioxide (CO_2), methane (CH_4), nitrous (I) oxide (N_2O), tropospheric ozone (O_3), as well as carbon oxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOCs) and freons, which yield atmospheric GHG as a result of chemical reactions.

Scientific research activities give evidence that the rise of an amount of GHG contributes substantially to increasing the natural greenhouse effect, which causes additional warming of a surface of the Earth and atmosphere and brings about an adverse effect upon the global climate. It manifests itself not only as an increase of the mean global temperature by 0.3 to 0.6 ^oC during the last 100 years, but also as a rise of the level of seas and oceans, occurrence of draughts and heat periods, as well as of storms and floods, increase of precipitation (depositions) levels, depletion of stratospheric ozone layer, formation of smog, weakening and destruction of natural ecosystems [1 - 3].

Pursuant to the Convention, documents have been drafted under the supervision of the Ministry of Environment Protection and Regional Development, required for ratification of the Convention by the Saeima. Convention has been ratified on 23 February 1995. In accordance with Article 4, paragraph 2 (b) of the Convention within a period of six months after ratification each Party shall ensure the availability of detailed information to other Parties, i.e., a national communication about GHG emissions, sources and sinks. A work group to prepare the National Communication of the Republic of Latvia has been formed pursuant to the resolution #63-r of 25 February, 1994 adopted by Prime Minister. The National Communication is aimed at informing other Parties about the situation in Latvia, as well as of measures and climate policy to be implemented gradually in order to stabilize emissions of GHG at the reference (base) year level and to prevent its increase in future. The ratification of the Convention is tantamount to a near-term commitment taken by Latvia that it shall return to the CO_2 level of 1990 by 2000, the same referring to other anthropogenic GHG emission levels not controlled by the Montreal Protocol.

The following institutions have made contribution to elaboration of the National Communication of the Republic of Latvia:

Ministry of Environment Protection and Regional Development of the Republic of Latvia:
- Department of Environment Protection,
- Environment Data Centre,
- State Environment Inspection.

Ministry of Transport of the Republic of Latvia:
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- Division of Statistics of Material Resources.

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Advisor of Prime Minister on Environment Protection Affairs
Energy Agency of Latvia
State Institute of Forest Inventory

Foreign institutions:
Ministry of Housing, Physical Planning and Environment of the Netherlands,
Institute of Environmental Studies at Vrije University of the Netherlands,
Polish Foundation of Energy Efficiency

Latvia participates in international negotiations and projects related to the Framework Convention on Climate Change.

Government of the Netherlands and experts from Poland render substantial assistance in preparation of the National Communication of the Republic of Latvia. A protocol of intentions was signed in October, 1993 by the Minister of Housing, Physical Planning and Environment of the Netherlands Mr. J.G.M. Alders and by the State Minister of Environment of the Republic of Latvia Mr. I. Emsis on co-operation within a framework of a common project. The common Latvian-Dutch project "Country Case Study of Greenhouse gases - Sources, Sinks and Potential Measures in the Republic of Latvia" was initiated on 1 January, 1994. The project is partially financed by the Dutch Government. Technical assistance was rendered in assessment of GHG emissions, as well as in printing of the National Communication from Dutch and Polish experts. The Government of Latvia financially supported the part of a project connected with inventory of GHG emissions, forecasting and preparation of the National Communication.

The principal difficulties in preparing the National Communication are linked with deep changes taking place in all sectors of economy, state administration and legislation in the aftermath of a regaining of independence. General concept of development in economy for the period of up to 2000 is still to be devised, the situation is further aggravated by the processes of denationalization and privatization under way.

Apart from Latvia there is a number Eastern European countries - signatories to the Convention, which are undergoing a transition stage to market-based economy. The special circumstances taken into account, the Convention provides for some flexibility in preparing the National Communication in the countries with transition economies.

Within a context of the National Communication of the Republic of Latvia the term

"flexibility" is interpreted in the following way:

1. 1990 is designated as **a base year** in accordance with the Convention, however, to facilitate better understanding of processes taking place in various sectors of national economy, additionally to the base year, information is presented related to some previous years.

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3. **Projection of emissions.** Despite all economic sectors are considered in the Chapter dealing with policies and measures aimed at reducing GHG emissions, reliable quantitative assessment of efficiency of measures is feasible solely in energy sector.

2. GENERAL INFORMATION ABOUT THE REPUBLIC OF LATVIA

Information necessary for preparing the National Communication is presented in this Chapter. Concise description of geography, climate, demography, economy, as well as of state policy and legislation since the foundation of an independent state till nowadays and also policy and legislation pertinent to environment protection before the reference year are discussed below.

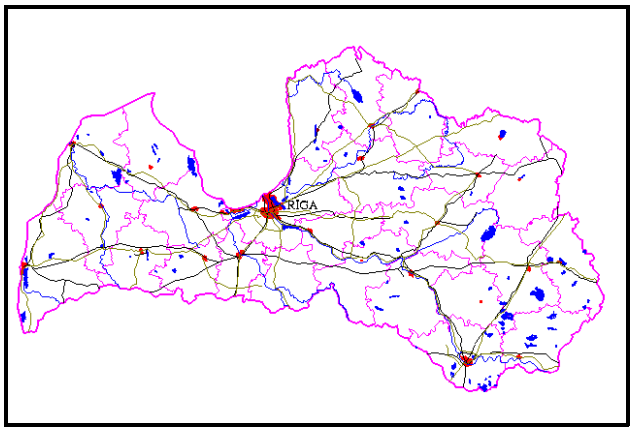

Fig.2.1 Territorial division of Latvia, major cities and rivers.

2.1. Geography

Latvia is located on the edge of the Eastern European plane in the proximity of the Atlantic Ocean on shores of the Baltic Sea. A total land area of Latvia is 64,400 square kilometres bordering with Estonia to the north, Russia to the east, Byelorussia to the southeast, Lithuania to the south. Its coastline is nearly 500 km long (Fig. 2.1. and 2.2.) [4, 5].

From geological point of view the earth crust of Latvia is young - it has been formed during break-away of glaciers by the end of the Ice Age. The mean height of the territory above sea level equals 87 m, the highest peak point being Gaizinkalns - 312 m above sea level. Of the total land area 39 % is cultivated, including 26 % for arable crops; about 44 % of the total territory of Latvia are forests, shrubs and groves.

Latvia is not rich in important mineral resources, among combustible resources solely peat is produced at industrial amounts. There are significant reserves of raw building materials - limestone, gypsum, dolomite, clay, gravel.

There are 12,400 rivers in Latvia, but only 777 are more than 10 km long. Longest rivers are the Daugava, the Gauja, the Venta, the Ogre. Largest lakes are the Lubanas, the Raznas, the Engures and the Burtnieku.

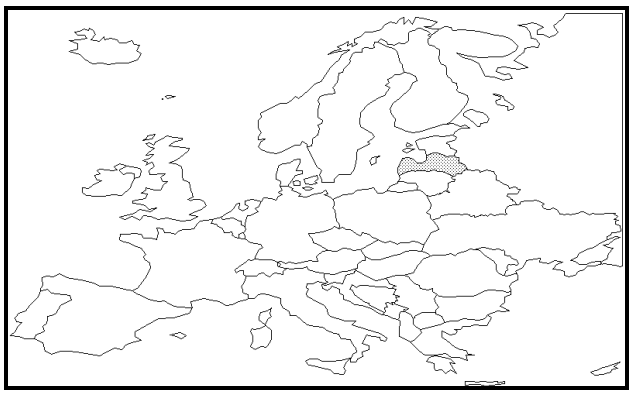

Fig.2.2 Location of Latvia in Europe.

Riga is the capital of the Republic of Latvia, other largest cities: Daugavpils, Liepaja, Jelgava, Jurmala, Ventspils. Liepaja and Ventspils being ice-free ports on the Baltic Sea have always played an important role in formation of policy and economy of Latvia [5-7].

2.2. Climatic conditions

Climate in Latvia is determined by its location in the northwest of Eurasia in the proximity of the Atlantic Ocean. To a large extent climate in Latvia is influenced by flows of marine air. Frequent cyclones bring about considerable changes in weather. This results in lower summer temperatures and higher winter temperatures when compared to the average temperature at medium degrees of latitude for inland areas. The average annual temperature in Riga is +6 ^{o}C; in January it is -4.9 ^{o}C, in July it is +16.9 ^{o}C [6, 7].

2.3. Population

Population of Latvia has increased from about 1.9 millions in 1935 to 2.7 millions in 1991 (Table 2.3.1.). The density of population is about 40 people per square km.

Table 2.3.1. Number of permanent residents

Year	Population '000	Including	
		urban	rural
1935	1905936	709321	1196615
1959	2079948	1076024	1003924
1970	2351903	1435207	916696
1979	2502816	1663975	838841
1981	2514640	1693252	821388
1986	2587716	1777830	809886
1990	2673470	1852857	820613
1991	2667870	1847373	820497
1992	2656958	1836344	820614
1993	2565854	1775894	789960

Reference: [8].

This increase relates to the period beginning after the 2nd World War up to 1989 and can be explained as immigration flow from Russia, Byelorussia, and the Ukraine. By virtue of the said immigration over this period Latvia exhibited the highest population growth in Europe, whereas the natural growth (birth rate) kept decreasing continuously. The trend is demonstrated explicitly by age distribution of population of Latvia by the end of 1993 (Tab.2.3.2).

Table 2.3.2. Age distribution of population (%)

Population age	1990	1991	1992	1993
0-14 yrs	21.5	21.4	21.3	21.0
At working age	57.5	57.3	56.9	56.8
Older than at working age	21.0	21.3	21.8	22.2

Reference: [9].

2.4. Economy

Latvia belongs to a group of countries the economy of which undergo a period of changes. Rapid transition from planned economy to market relations has caused a deep crisis in all sectors of Latvian economy [10]. Dinamics of the griss domestic product (GDP) in fixed prices is demonstrated in Fig. 2.3.

Year	Percentage
1985	79.1
1990	100
1991	91.7
1992	60.8
1993	48.7

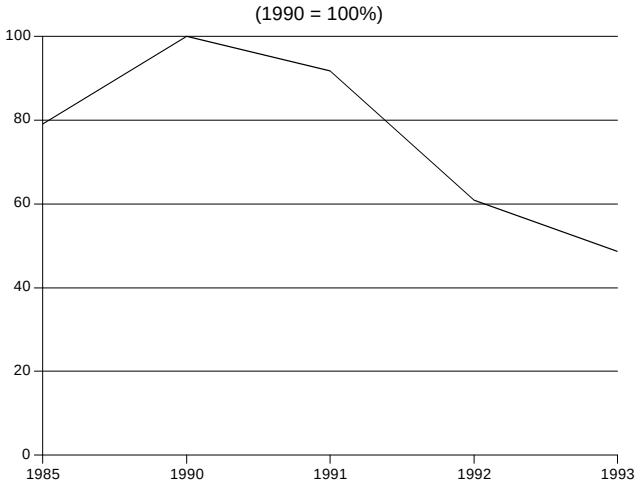

Fig.2.3. Dynamics of gross domestic product. Reference: [8].

There are signs of stabilization of GDP in 1994, moreover 3 - 5 % growth of GDP is prognosticated in 1995 - 1997 and beyond (see Chapter 5). Due to undergoing changes in economy (transition to market economy, privatization, restructuring of sectors etc.) it is difficult to elaborate a national programme on implementational policy in economy, although development programmes or strategic state concepts for the period up to 2000 or 2010 have been worked out or are under consideration in separate sectors:

- Environment Protection Policy Plan (EPPP, elaborated and accepted in 1995),
- Projection of Latvian Economic Development (elaborated in 1994),
- Public Investment Programme (elaborated in 1994),
- Macroeconomic Stabilization Programme (elaborated in 1994),
- Energy Master Plan for Latvia (LEDP, elaborated in 1994),
- National Development Programme of Motor Transport (elaborated in 1994 in the frame of Transport Development National Programme),
- Forest Development Proramme (elaborated in 1992),
- Forestry Development Policy (elaborated in 1994),
- Concept of National Strategy in Rural Areas (elaborated in 1994),
- Concept of National Strategy in Industry (elaborated in 1995).

Thus it is possible to form an insight into an overall state of Latvian economy at the present moment and development trends in future.

Energy sector determines development of all remaining sectors of state economy. Latvian energy sector has no considerable resources of its own - 90% of fuel and 50% of electricity are imported from Russia (75%) of all supplies, the Ukraine, Byelorussia, Estonia and Lithuania.

Transmission pipelines for natural gas, oil and oil products are located in Latvia [11].

Development Programme of Energy Sector proposes the following basic principles aimed at ensuring a higher level of independence for Latvian energy sector:

- a guaranteed operation of the energy sector,
- economical utilization of energy resources,
- increasing the role of indigenous energy resources (water, wood, peat); exploration of oil deposits,
- availability of energy supplies both from the East and the West,
- opportunity of producing at least 80-85 % of the necessary electric energy in electric power plants in Latvia (about 50 % at present).

The overall recession in economy after 1990 and slump in industrial sector in particular, has caused a considerable drop in energy consumption levels during recent years (Table 2.4.1.).

Table 2.4.1. Total energy consumption in Latvia (Mtoe)

1990	1991	1992	1993
819	6.6	5.42	4.74

Reference : [11]

Basing upon GDP development trends and taking into account fuel prices, as well as planned energy saving activities, experts infer that the level of energy consumption in Latvia during the period of next 10 - 15 years will not exceed the consumption level of 1990.

There is a comparatively well developed network of transport ways in Latvia: 2413 km long railroad network and a public road network of 50,000 km. The geopolitical location of Latvia requires to pay keen attention to development of a transport system. The changes taking place during recent years related to regaining of independence have altered all sides of life, including the transport sector. Domestic freight decreases, whereas international freight grows. Problems linked with public transport, ecology and traffic safety are brought into prominence. Table 2.4.2. demonstrates dynamics of transportation means in numbers.

Table 2.4.2. Dynamics of transport means (in numbers)

Number of transport means (by the end of year)	1990	1991	1992	1993
Transport vessels	111	111	107	129
Trucks,'000	67	71	75	85
Buses,'000	12	13	18	20
Cars, '000	283	328	350	391
Railway engines	484	471	431	411
Tram cars	402	421	406	403
Trolley buses	416	401	365	360

Reference: [9]

The table depicts the rise in a number of vehicles utilizing internal combustion (cars,

trucks, buses) during recent years, whereas a number of transportation means using electric energy (trolley buses, trams) has decreased. It is expected that the trend will persist in future. It is worth noting, that fuel consumption in the sector has not risen; this can be attributed to the increase in fuel prices and a more effective utilization.

Industrial sector played an important role in Latvian economy before 1990, though only 40 % of total industrial production was supplied with raw materials from local sources. The leading branches were engineering industry, light manufacturing, chemical industry, metal and timber processing works, production of building materials and food industry. 1990 in Latvia can be characterized as the year of significant recession in various sectors of industry, some branches disappearing entirely. The principal aspects causing slump in industrial sector are the following:

1 - change of the existing type of management, cumbersome transition to market economy,

2 - marked increase in prices of energy resources and crude materials incoherence in international market relations (the Eastern market is lost, the Western not developed yet),

3 - poor knowledge and understanding of administration officers in state, production and technical management sectors of market economy and of activities under free market conditions,

4 - low competitiveness of manufactured products.

Critical situation gives rise to an objective necessity to alter the structure of Latvian Industry, subject the restructuring process to control to avert spartancity, to lessen eventual negative social consequences, to implement production techologies which are friendly to environment.

The strategic state concept in industrial sector point out as eventual priorities the following directions of development: light manufacturing, engineering industry, pharmaceutical industry and biotechnology, timber processing industry and production of building materials from indigenous crude materials. Table 2.4.3. neveals industrial overall production indices in fixed prices.

Table 2.4.3. Industrial overall production indices (in relative prices; 1990 = 100)

Year	Entire industry	Including		
		extractive industries and quarry works	processing industries	electric and heat energy, water supply
1985	85.6	100	85.6	85.5
1990	100	100	100	100
1991	99.4	89	99.5	97
1992	65	57	64	74
1993	42	33	43	57

Reference [9].

Agriculture has traditionally been a developed sector in Latvian economy. Urbanization, decrease in soil fertility, low production efficiency are among the main reasons why the area of arable land during last 30 years has kept on decreasing and in 1990 constituted 26 % of the total area. The change of ownership i.e., transition from collective to private management, initiated after 1990, caused severe consequences in Latvian agriculture. From a 50 year long socialistic

hypertrophically developed agriculture Latvia inherited socio-economic problems related to reinstitution of land property rights of rural residents as well as to environmental pollution, caused by poorly balanced intensive agriculture (lumping of fields, continuous land reclamation and chemical treatment etc.). By virtue of agrarian reform and a process of reprivatization about 188,000 private farmsteads, 103 state farms and 814 enterprises of various sizes have been formed.

The overwhelming majority of these are small and very small farms raising crops and breeding cattle for their own subsistence. At present enterprises specializing in production of competitive goods are under formation. In many instances farmers turned out to be caught ill-prepared to meet the requirements of market economy. High prime cost of agriculture products due to use of obsolete equipment and out-dated technology, as well as lack of proper management skills, prohibits not only successful competition with cheap food products imported from European countries, but also renders any export activities impossible. Export opportunities to Russia and other former USSR countries are marred both by the unstable financial system and by national monetary policy. The aforementioned aspects have contributed to bringing down recent agriculture production levels in Latvia (Table 2.4.4.).

The concept of state strategy in agriculture provides for definite "transition period" aimed at ensuring sustainable growth in rural areas, facilitating formation of well-developed farms based upon private ownership, assisting employees currently busy in agricultural sector to take vocational training courses, so that in the long run rural Latvia is in a position to join the Common Market of European Union.

Table 2.4.4. Indices of agricultural production (in relative prices: 1990 = 100)

Year	Agricultural production	Cultivation of plants	Cattle-breeding
1985	105.3	107.7	102.6
1990	100	100	100
1991	96	105	92
1992	81	94	76
1993	63	93	50

Reference: [9].

Forests are largest resources of the Republic of Latvia. Forests cover almost half of the territory and its share is gradually expanding. Under Latvian circumstances forests are a dominating ecosystem, it would have occupied 90 % of the total area had there been no transforming presence of humans. Conceptually, the share of area occupied by forests shall be determined in connection with areas required for:

- agriculture,
- environment protection,
- timber production.

Crude or semi-processed timber has become one of the most important items of Latvian export recently.

2.5. Environment

Natural forests, meadows and marshes have remained in Latvia, exhibiting rich populations of animals and plants. In western and northwestern parts of Europe many of these species are on the verge of extinction. Environmental problems in Latvia are linked with the so-called "hot-beds" - large industrial and transport centres, Riga region in particular, areas abandoned by Russian troops. The following environmental problems are designated as priorities:

- trans-boundary transfer of pollution,
- eutrophication of water basins, degradation of water ecosystems,
- risks related to anthropogenic activities,
- problems connected with waste,
- decreasing of biological diversity,
- degradation of landscapes,
- irrational utilization of natural resources,
- poor quality of drinking water.

The plan of environment protection policy proposes underlying principles and means for solution of the above problems.

2.6. National policy and legislation

2.6.1. General policy of state and legislation

Latvia as an independent state was proclaimed on 18 November 1918. By adopting the Constitutional Law - Satversme on 15 February, 1922 the people of Latvia proclaimed Latvia as an independent democratic parliamentary republic, where sovereign power rests with people. In pursuance of Satversme the Parliament of the Republic of Latvia - the Saeima is entitled to elect the State President for a period of 3 years.On 1 April, 1925 the Saeima adopted and President announced the "Law on Structure of Cabinet of Ministers". Pursuant to this Law all State Administration Institutions are subordinated to the Cabinet of Ministers.

In 1940 Latvia was occupied and incorporated by the USSR and did not exist as an independent country but as LSSR. During this period the USSR legislative acts were partly duplicated or applied directly.

Declaration on regaining of independence of the Republic of Latvia is adopted by the Supreme Soviet on 4 May, 1990 determining a transition period for "de facto" restoration of the State power, as well as for regaining State sovereignty through negotiations. Since the coup d'etat of 19 August, 1991 in the USSR render continuation of negotiations impossible, the constitutional law on reestablishment of the state status - independent democratic republic is adopted on 21 August, 1991 determining that Latvia is an independent democratic republic and henceforth, solely laws and resolutions adopted by institutions of Supreme State Power and Administration are in force. After regaining of independence "de facto" gradual reforms of systems of Latvian economy and state administration, including judicial system take place:

- the Republic of Latvia becomes a full member of UN on 17 September, 1991;
- the Law "Human and civil rights and obligations" comes into force on 10 December, 1991;
- 5th Saeima of the Republic of Latvia is elected as a result of general democratic elections;
- 5th Saeima convened in July, 1993,effectively reenforcing the Satversme of the Republic of Latvia;

- the Law of 1 April, 1925 on "Structure of Cabinet of Ministers" is reenforced on 16 July, 1993.

The supreme legislation right rests with the Saeima (Parliament), however on exceptional occasions the Cabinet of Ministers, as well as Ministries enjoy rights to adopt legislative acts - regulations, provided these conform to the existing legislation.

After regaining of independence transformation of the entire legislation system is under way. It is a complicated and cumbersome process. Therefore, at the present moment both legislative acts are applied, the ones drafted and adopted during the independence years, as well as some of there devised and applied prior the independence. At the present moment Latvian legislation is being harmonized with European norms and international standards.

2.6.2. Policy and legislation in environment protection prior to the base year

Right up to 1988 all environmental problems are addressed separately in each economy sector, thus yielding solutions inevitably subjected to the interests of a sector. The only institution tackling environment protection issues outside sectorial approach at that time is an non-governmental organization - Latvian Nature and Monument Protection Association.

Legislation in environmental protection has been closely connected with regulation acts on utilization of natural resources. Thus, many of requirements related to environment protection are included in regulating acts on utilization of natural resources:

- Code of Water (1972);
- Code of Land resources (1976);
- law on "Atmospheric air protection" (1981.);
- law on "Protection on utilization of animals" (1981.);

A group of laws indirectly connected with environmental protection is of utmost significance:

- Criminal Code of Latvia (1961) with Amendments envisages criminal liability;
- Labour Code of Latvia (1972) envisages disciplinary liability;
- Administrative Code of Latvia (1984) with Amendments envisages administrative liability with respect to infringements in environmental protection.

It is worth noting, that some legislative acts approved before 1990 are still in force, for instance, the normative act on: "Permitted concentration levels of hazardous pollutants in the atmosphere above populated areas". Process of adopting amendments and elaborating new laws which is currently under way, is an arduous, expensive and time-consuming undertaking going on in the Ministry of Environmental Protection and Regional Development, as well as in other Ministries related to issues of environment protection (Ministries of Transport, Economy and Agriculture).

Approach to solution of environmental problems is subjected to a cardinal change in 1988, when a special State administration institution is established, i.e., Committee of Nature Protection with regional subsidiaries, subordinated to the Council of Ministers. In 1991 the Committee of Nature Protection is transformed into the Committee of Environment Protection, under direct subordination of the Parliament of that period, i.e. the Supreme Soviet till the 5th Saeima is elected in 1993. After reestablishment of the Cabinet of Ministers the Committee of Environment Protection is transformed into the Ministry of Environment Protection and Regional Development under its subordination.

Policy and legislation after the reference year are discussed in Chapter 4.

3. INVENTORY OF GREENHOUSE GAS EMISSIONS IN LATVIA

3.1. Introduction

This chapter presents a summarized national inventory of greenhouse gas emissions and removals by sinks in the Republic of Latvia. It considers anthropogenic emissions of six gases recommended by IPCC Draft Guidelines for National Greenhouse Gas Inventories [12]: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), nitrogen oxides (NO_x), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOCs). The national inventory of the anthropogenic emissions by sources and the removals by sinks is carried out beginning from 1 January ,1994 till 31 August, 1994, within a framework of Latvian - Dutch project "Country Case Study on Greenhouse Gases - Sources, Sinks and Potential Measures -in the Republic of Latvia" and with technical assistance from Polish Foundation for Energy Efficiency (FEWE).

Estimates of quantities of emissions are calculated employing data given in [13-15] and statistical information contributed by Latvian Environmental Centre; sinks in forestry are assessed in accordance with [16]. All estimates refer to 1990 emissions, quantities are reported in gigagrams (Gg). The Table 3.1.1. reviews sources and quantities of GHG emissions.

GHG emissions in Latvia are summarized over the following economic sectors (sources):
1. Energy (CO_2, CO, NO_x, N_2O, CH_4, NMVOC).
2. Industry (CO_2, CO, NO_x).
3. Solvent and other product use (NMVOC).
4. Agriculture (CH_4, N_2O).
5. Land use change and forestry (CO_2 sink).
6. Waste (CH_4).

Table 3.1.1. GHG emissions in Latvia in 1990 (Gg)

GHG sources	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
TOTAL	22976	158.94	2.380	90.14	363.13	62.722
1.Energy	22606	4.17	1.03	90.14	363.13	55.324
2.Industry	371					
3. Solvent and other product use						7.398
4. Agriculture		111.27	1.35			
5. Land use change & forestry	(-14300)					
6. Waste		43.50				

In accordance with IPCC\OECD requirements GHG emissions are summarized over economic sectors (industry and forestry sectors excluded, since these are presented in the text) and are given Tables A.3.1. - A.3.8 in Annex 3.

3.2. CO_2 emissions and removals

CO_2 emissions originate in sectors of energy and industry, whereas sinks are provided by land management and forestry. Table 3.2.1. provides the total of CO_2 emissions in each sector. The following Chapters give a more detail information about CO_2 emissions in each sector.

Table 3.2.1. Total CO_2 emissions in 1990 (Gg)

Sectors	Emission / removal
1. Energy	22606
2. Industry	371
TOTAL	22976
5. Land use change & forestry	(-14300)

3.2.1. CO_2 emissions in energy sector

CO_2 emissions from energy sector are connected with fuel combustion (Table 3.2.2.). Elaboration of energy balance is necessary to calculate the quantity of CO_2 emissions, which in its turn requires accurate statistical information. To calculate the energy balance the Soviet statistic system has been used in Latvia prior to 1991, which failed to reflect complete fuel consumption ,therefore the energy balance for 1990 has been devised Latvian experts technically assisted by FEWE, basing on recommendations provided by experts in statistics and energy sector.

Emission factors used for calculation of CO_2 emissions (represented in Annex 3 Table A.3.2) [14, p.1,9] relating to the lower heat capacity value of fuels.

Table 3.2.2. CO_2 emissions from fuel combustion activities in 1990 (Gg)

	PJ	CO2 Emissions (Gg)
1.All energy 1.A. Fuel combustion Total		22606
1.A.1. Energy & transformations activities	126.11	8274.4
1.1. Natural gas	68.75	3837.4
1.2. Oil	55.14	4223.3
1.3. Solid fuels	2.22	213.7
1.A.2. Industry	40.04	2680.4
2.1. Natural gas	20.77	1159.2
2.2. Oil	14.79	1100.2
2.3. Solid fuels	4.48	421.0
1.A.3. Transport	80.14	5660.6
3.1. Natural gas	1.38	77.1
3.2. Oil	78.55	5564.1
3.3. Solid fuels	0.21	19.4
1.A.5. Residential	43.43	3140.3
5.1. Natural gas	7.83	437.0
5.2. Oil	28.98	2077.4
5.3. Solid fuels	6.62	625.9
1.A.6. Agriculture / Forestry	18.94	1449.7
6.1. Natural gas	3.02	168.3
6.2. Oil	11.26	823.6
6.3. Solid fuels	4.66	457.8

1.A.7. Other	16.12	1400.2
7.1. Natural gas	1.13	63.1
7.2. Oil	2.56	183.8
7.3. Solid fuels	12.44	1153.3

References: [4, 15, 17 - 21].
Lasses of 1.A.a are added to 1.A.7 (Table S.1)

3.2.2. CO_2 emissions in industry

Cement production generates a major share of industrial CO_2 emissions (Table 3.2.3). CO_2 emissions are estimated on the basis of annual total production of cement and the emission factor [14], (page 2.6).

Table 3.2.3. CO_2 emissions from cement production in 1990 (Gg)

Emission sources	Amount of cement produceed, Gg	Emission factor t CO_2 / t cement	CO_2 emission Gg
2. Industry 2.E.1. Production of cement	744.3	0.498	370.661

Reference: [17]

3.2.3. CO_2 sinks in land use change and forestry

Forests and soils (meadows) absorb and accumulate CO_2 from the atmosphere. CO_2 is potentially emitted upon harvesting trees or converting grassland into cultivated land. Since available statistical data on grassland conversion to cultivated land for each year, beginning starting from 1965 up to 1990 are essentially incomplete, CO_2 emissions are not taken into consideration. Removals of CO_2 take place due to the reforestation. Atmospheric CO_2 is absorbed by the growing vegetation. The annual total CO_2 sequestration in forestry (forests, shrubs, groves) is calculated using US EPA (Environmental Protection Agency) methodology [16] and the State Forest Service Data Base of the Ministry of Agriculture of the Republic of Latvia, and equals 20600 Gg (Table 3.2.4 and Table A.3.7 from Annex 3). Due to the hemiboreal zone location the coefficients of boreal and temperate zones offered by IPCC/OECD methodology [8,9] are not applicable to calculations for Latvia. Moreover, the State Forest Service Data base accounting tree species without specifying primary and secondary forest areas, cannot be used for CO_2 sequestration assessment. Inconsistency arose when calculations of biomass increment were attempted, since IPCC/OECD methodology uses very rough figures for the type of calculations. Also it should be noted that this method fails to account for reduction in biomass increment due to feeling of trees. The methodology of US EPA [16] permits use of the whole national data base for different species of trees: the mean age of species, the area covered by species, the biomass increment of species. The biomass coefficient and the density of dry wood is chosen in accordance with [16].

Table 3.2.4. Calculated CO_2 sink in forestry in 1990 (Gg)

5. Land use change and forestry 5.C. Forestry	
CO_2 sequestration (Gg)	20600
Actual decrease in sequestration	(- 20)
Total CO_2 sequestration	20580
Calculated CO_2 emissions from cut	(- 6280)
- Fuelwood burned	1428
- Exported	628
- Other	4224
Calculated net removals (Gg)	14300

References: [16].

Of the said 20600 Gg forests various types of trees sequestrate about 20100 Gg CO_2 (Table A.3.7, # 1-7) whereas shrubs and groves, which in pursuance of Latvian Regulations on Land Management are not regarded as forests provided their area fails to exceed 0.5 ha, in compliance with a calculation performed by experts are in a position to sequestrate about 500 Gg of CO_2 (Table A.3.7, # 8-10). A total amount of felled trees in Latvia in 1990 equals 4.54 million m^3. As a result of felling CO_2 sequestration dropped by 20 Gg. In accordance with [14] potential CO_2 emissions from felled trees equals 6280 Gg, hence calculated sink of CO_2 emissions in 1990 equals 14300 Gg. Latvian experts have a separate opinion concerning the calculations of CO_2 sequestration differing from the IPCC technique: assumption that all felled trees decompose to form CO_2 does not hold. CO_2 emissions shall be calculated only for that part of felled wood which is not exported, thus no responsibility rests with Latvia concerning the exported share. The methodological approach in this event shall be consistent with approach adopted for countries producing and exporting fossil fuel.
However, in elaborating the present Communication IPCC\OECD requirements are observed.

3.3. CH_4 emissions

The main sources of CH_4 emissions in Latvia are energy sector, agriculture and waste management (the last two prevail). Table 3.3.1 provides total CH_4 emissions in each sector from each source. More detailed information will follow.

Table 3.3.1 Total CH_4 emissions in 1990 (Gg)

Sectors	CH_4 emissions (Gg)
1. Energy	4.167
1.A. Fuel combustion	2.368
1.A.1. Energy & transformation activities	0.509
1.A.2. Industry	0.059
1.A.3. Transport	1.486
1.A.5. Residential	0.184
1.A.6. Agriculture	0.108
1.A.7. Other	0.022
1.B. Fugitive fuel emissions	1.80
4. Agriculture	111.27
4.A. Enteric fermentation	97.96
4.B. Animal waste	13.31
6. Waste	43.50
TOTAL	158.94

References: [4, 14, 15, 17-20, 22]

3.3.1. CH_4 emissions in energy sector

CH_4 emissions in energy sector originate from incomplete combustion of fuel, as well as emissions from gas pipelines. The amount of CH_4 emissions is assessed using energy balance, necessary emission factors are chosen from [22] and data of Polish FEWE (Annex 3, Table A.3.3).

3.3.2. CH_4 emissions in agriculture

The most part of CH_4 emissions comes from agriculture sector. Agriculture activities give emissions of GHG through different processes:

a) CH_4 emissions from enteric fermentation in domestic animals

The production of CH_4 is a part of normal digestive process of the ruminant animals. Rumen methanogenic bacteria, or methanogens, is the source of CH_4 produced in ruminant animals. Methane is produced as part of the digestive processes of non-ruminant herbivores.

b) CH_4 emissions from animal waste

CH_4 is produced during decomposition of manure under anaerobic conditions. The emission factors (Annex 3. Table A.3.4.) which have been used for calculation of the emissions from enteric fermentation and animal waste were adjusted to local conditions. The emission factors are chosen from [14].

3.3.3.CH_4 emissions from municipal waste

Methane is produced during anaerobic decomposition of organic matter in landfills in the presence of methanogenic bacteria. The emission factor is chosen from [14]. Amount of municipal waste in landfills and CH_4 emissions are given in Annex 3. Table A.3.8.

Both domestic and commercial and industrial wastewater in Latvia are subjected to aerobic treatment. There is only one anaerobical treatment pilot plant in Latvia. CH_4 emissions from wastewater treated there are not taken into account.

3.4. N_2O emissions

N_2O emission sources in Latvia are energy sector and agriculture, the last being of greater importance. Table 3.4.1 provides total N_2O emissions in each sector from each source. More detail information of N_2O emissions presented below.

Table 3.4.1. Total N_2O emissions in 1990 (Gg)

Sectors	Emissions (Gg)
1. Energy	1.03
1.A. Fuel combustion	1.03
1.A.1. Energy & transformation activities	0.07
1.A.2. Industry	0.014
1.A.3. Transport	0.108
1.A.5. Residential	0.029
1.A.6. Agriculture	0.016
1.A.7. Other	0.793
4. Agriculture	1.351
4.C. Agricultural soils	1.351
4.C.1. Mineral fertilizers	0.446
4.C.2. Organic fertilizers	0.905
TOTAL	2.38

References: [4, 14, 15, 17 - 20, 22, 23]

3.4.1. N_2O emissions in energy sector

N_2O emissions in energy sector originate from fuel combustion. The amount of N_2O emissions is assessed using energy balance, the necessary emission factors are presented in [22] and using Polish FEWE data as well (Annex 3, Table A.3.3).

3.4.2. N_2O emissions in agricultural sector

N_2O emissions originate in soils during denitrification and nitrification. Commercial nitrogen (N) fertilizers and organic fertilizers provide an additional nitrogen source and increase N_2O emissions from the soil. Mean emission factors for nitrogen are choosen from [14,22]. Since emission factors depend upon the type of a fertilizer, the structure of a soil, temperature, cultivated crops etc., there is extensive uncertainty in emission factors, these might differ by one order of magnitude in either direction from the ones reported in [14, 22].

The data on turn-in of commercial nitrogen fertilizers in Latvia are obtained from the

State Scientific Enterprise "Raziba".

N_2O emissions from all nitrogen containig fertilizer types are summarized in Annex 3, Tables A.3.5 and A.3.6.

3.5. Other GHG emissions

Total emissions of other GHG including NO_X, CO and NMVOCs in energy sector, utilization of solvents are presented in Table 3.5.1. Principal source of these emissions is transport (Fig.3.1).

Table 3.5.1. Total NO_X, CO and NMVOC emissions in 1990 (Gg)

Sectors	NO_X	CO	NMVOC
1. Energy	90.135	363.125	55.324
1.A. Fuel combustion	90.135	363.125	55.315
1.A.1. Energy & transformation activities	15.223	22.727	0.648
1.A.2. Industry	3.362	0.939	0.099
1.A.3. Transport	65.833	329.077	54.199
1.A.5. Residential	2.711	4.414	0.179
1.A.6. Agriculture	1.582	4.789	0.124
1.A.7. Other	1.424	1.179	0.066
1.B. Fugitive fuel emissions			0.009
3. Solvent use			7.398
3.A. Degreasing and dry cleaning 3.B. Chemical products manufacture / processing 3.C. Other			1.119 0.680 5.599
TOTAL	90.135	363.125	62.722

References: [4, 17 - 20]

Note: Emissions from 1.A.a Looses are not included.

The main sources of NO_x, CO and NMVOC emissions in energy sector is incomplete combustion, emission of fugitive fuel from gas pipelines and transport. Calculations are based upon energy balance. Emission factors chosen from [14] and Polish FEWE (Annex 3, Table A.3.3). Assessment of NO_x and CO emissions using the same factors (NO_x in transport, in particular) yield emissions differing from information at the disposal of MEPaRD, since the former are calculated in accordance with alternative technique.

The only GHG emissions originating in utilization of solvents and related products are NMVOCs. The following activities are attributed to this class: degreasing of metallic surfaces, chemical (dry) cleaning, production of chemicals, painting, varnishing etc. Emission amounts are calculated on the basis of the Statistical Report of Latvian Environment Data Centre.

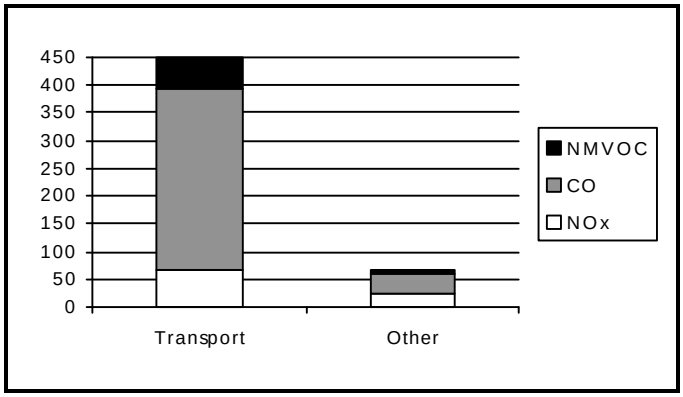

Fig.3.1 NO_x, CO and NMVOC emissions in 1990 (Gg). (Transport\Others).

3.6. Converted GHG emissions (Global Warming Potential)

In order to juxtapose contribution of various GHG in aggregate emissions a notion of converted emissions is devised - the global warming potential (GWP). GHG emissions are expressed in CO_2 equivalents in Gg by using factors of the global warming potential. Converted CO_2, CH_4, N_2O emissions are presented in Table 3.6.1. GWP factors are taken from [1].

Table 3.6.1. Total Global Warming Potential, 1990

	CO_2	CH_4	N_2O	Total
Emissions (Gg)	22976.3	158.937	2.38	
GWP factors	1	24.5	320	
Effect	22976.3	3894	762	27632
Percentage	83.1	14.1	2.8	

4. POLICIES AND MEASURES MITIGATING CLIMATE CHANGES

4.1. Introduction

Information concerning the implemented or planned state policies and measures aimed at protection of a climate system in Latvia during the period from 1990 - 2000. Data are summarized by type of economy sector and individual GHG emissions. Due to lack of financial support during economic recession only few of the planned measures have been implemented.

4.2. International activities

Since climate changes are of a global nature, the National Climate Policy shall conform to Global Strategies. During last decades a number of international regulating documents have been adopted, setting out rights and obligations of Member Countries. Latvia has acceded to some of these (Table A.4.1 and Chapter 6.3.) and is undergoing a process of gradually bringing national laws to compliance with international requirements.

4.3. National targets, policy and measures after base year

Policies and measures implemented or planned during the period of time from 1990 till 2000, which are aimed at preventing climate change are summarized in the Chapter 4.3.1. General climate policy and legislation in Latvia in reference to pollution by GHG or by other types of pollutants, since these emission groups have not been discerned by legislation, are presented in 4.3.1. Chapters 4.3.2 to 4.3.4 address tools employed in environment protection policy, i.e., economic sanctions or incentives, technological solutions, governmental measures aimed at reduction of CO_2, CH_4, N_2O and other GHG anthropogenic emissions in various economy sectors - energy, agriculture, forestry, waste management, in accordance with perspective development plans of respective sectors. Systematic monitoring activities, scientific research (both, national and international), education and public awareness building measures are addressed separately (see Chapters 6 and 7).

4.3.1. General climate policy and legislation in environment protection

The highest institution dealing with environment protection in Latvia is the Ministry of Environment Protection and Regional Development (MEPaRD) founded in 1993 by restructuring the Committee of Environment Protection founded in 1991 and by extending the scope of its functions. Regional Environment Protection Committees, Latvian Environment Data Centre, State Environment Inspection, State Environment Expertise Administration, as well as other institutions have been established, thus laying the basis for development of environment protection policies and their integration in all sectors of economy.

No special national policy countering climate changes have been adopted in Latvia, "climate change" here means depletion of ozone layer and a greenhouse effect. Since the problem of ozone layer depletion is included in the Montreal Protocol, the Framework Convention on climate change addresses solely changes caused by GHG. Climate change, alongside with other priorities (eutrophication, waste, transport, quality of drinking water) are an integral part of general environment protection policy. Objectives and underlying principles of the state environment protection policy are set out in the Environment Protection Policy Plan, where solutions to priority environment problems as well as appropriate political tools are considered. During elaboration stage of the EPPP, MEPaRD collaborated with other ministries, Riga City Municipality, Latvian Environment Data Centre and scientific research institutions. EPPP is approved by Cabinet of Ministers on 25 April 1995. To a large extent the climate policy is an

amalgamation of environment protection policy and of strategic development plans for various economy sectors, i.e., energy, industry etc. One may say, that the national climate policy is at its developmental stage, because the said plans for various economy sectors have neither been finalized yet nor approved by the Cabinet of Ministers.

Objectives of national climate policy are formulated in EPPP, i.e., significant improvement of environment quality is sought in territories, where environment quality causes high risks, preventing in the same time deterioration of environment quality in the remaining territory; also EPPP is aimed at integration efforts with respect to environment protection in all sectors and sides of life. Pursuant to Article 4, Clause 2, Paragraph (a) of the Convention on Climate Change "....Parties shall adopt national policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of greenhouse gases and protecting and enhancing its greenhouse gas sinks and reservoirs. These policies and measures will demonstrate that developed countries are taking the lead in modifying longer-term trends in anthropogenic emissions consistent with the objective of the Convention, recognizing that return by the end of the present decade to earlier levels of anthropogenic emissions of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol would contribute to such modification, and taking into account the differences in these Parties's starting points and approaches, economic structures and resource bases, the need to maintain strong and sustainable economic growth, available technologies and other individual circumstances, as well as the need for equitable and appropriate contributions by each of these Parties to the global effort regarding that objective". **Pursuant to requirements of the Convention on Climate Change, Latvia as a Signatory Party has taken commitment to stabilize emissions of GHG - CO_2, CH_4, NO_2, NO_x, CO and NMVOC by 2000 at level not exceeding the emission level in 1990.** One of the most powerful tools for implementation of a climate policy is legislation. Principal laws, regulations or other regulating documents adopted or drafted after the base year, which are in a position to have significant influence upon GHG emission, are enlisted in Appendix of Chapter 4, Table 4.2. The law "On Natural Resource Tax" (NRT) has a special role to play: it is conceived for the first time in 1990 and aims at limiting irrational utilization of natural resources, as well as at accumulating funds for financial support of environmental protection activities. The Tax comprises two components: 1 - fees for utilization of natural resources and pollution of environment in accordance with permitted standards and 2 - punitive sanctions for excessive pollution and unauthorized use of natural resources. However, by virtue of rapid changes in economy the tax fails to fulfil its fiscal and regulatory function because rates have devaluated due to inflation and other causes. A new draft NRT has been elaborated which is expected to enter into force in 1995. The tax shall be levied on recovery and utilization of natural resources, introduction of pollutants into environment, degradation of environment or resources, as well as import or sale of goods or products noxious to environment. The tax introduces some novel economic tools, not envisaged in the previous Law on NRT:

- a scope of usage of the term "natural resource" is extended by introducing the following amendment "goods or products noxious to environment", including all types of fuel, batteries, accumulators, packaging materials etc., use of these shall be subjected to imposition of an natural resource tax to be payable as an excise tax and partly reimbursable in the case the said goods or products are subjected to utilization;
- natural resource tax rates levied on use of natural resources and pollution of environment have been raised;
- emission licences are released for sale, credits are available for tax payments, CO_2 tax is introduced, payable through excise tax imposed on fuel.

As it follows from Table A.4.2 a system of acts regulating environment protection issues have been already partly formed in Latvia, however, at the present moment it is not possible to meet all requirements or to observe regulating acts included in it. The system of regulating acts shall conform to a number of other tools aimed at implementing policies of environment protection.

4.3.2. Measures for reducing CO_2 emissions

Rearrangements taking place in Latvian economy directed at a transition from economy of centralized plans to market economy have caused a deep recession in all sectors of economy in Latvia. Statistics and calculations attest (see Chapter 5) that in none of the sectors, including energy sector, which is the main source of CO_2 emissions, a rapid growth of production and consumption is anticipated before 2000; moreover these shall fall short of the 1990 level, thus CO_2 emissions if compared to the 1990 level might fail to increase. However, the rise may occur right after 2000 or even earlier, provided unexpected changes take place and actual development of economy fails to follow scenarios expounded here. It is worth noting, that the first signs of economic recovery have already emerged. This is a reason why the implemented or planned measures adjusted for local circumstances and aimed at reducing CO_2 emissions are being addressed. (**Note:** similar considerations refer also to measures for reduction of other types of GHG). GHG emission levels in Latvia for the period 1990 to 2000 and expected reductions are depicted in Table 5.5.1.

4.3.2.1. Energy sector

The sector comprises combustion of fuel for production of electrical and heat energy, for transformation, as well as utilization in transport, industrial sector, heating etc.

General objectives of Latvian energy sector are to ensure long-term availability of energy to consumers at lowest possible costs, addressing environmental issues on the way and finding an optimum balance between costs and safety of supplies.

The three programmes devised by LATVENERGO, LATVIJAS GAZE and LATVIJAS NAFTA with participation of Swedish company VATTENFALL and Finnish company IMATRAN VOIMA OY are of utmost significance for further development of energy sector in Latvia:

- programme for Energy Development in Latvia (PEDL) offers a comprehensive review of energy sector, as well as strategy of energy supplies, thus setting out recommendations for investment in energy sectors;
- restructuring programme for energy sector (elaborated within a framework of PHARE 2) defines legislative and regulative scope in energy sector, as well as the procedure to be used in restructuring electrical energy, oil and natural gas subsectors;
- energy saving strategies in Latvia (within a framework of the project PHARE 3) setting forth measures aimed at energy saving in all economic sectors.

General state policy in energy sector is closely linked with environmental and climate policies. Therefore, experts from Latvian Energy Agency, Ministry of Economy, Ministry of Transport and Ministry of Agriculture have taken active part in elaborating the National Communication and EPPP, as well as have sought to the extent their capacities permit to coordinate the basic principles of the plan with plans and programmes of development of respective economy sectors. EPPP requirements accounted for the fundamental postulates for development of Latvian energy sector are the following:

- state independence with respect to energy, guaranteed operation of an energy sector;

- devising legislation in the energy sector;
- rational and economical utilization of energy resources;
- balanced energy resource structures are required, ensuring availability of supplies from alternative sources;
- utilization of indigenous fuel and resources;
- formation of prices and tariffs in accordance with free market principles.

PEDL and EPPP determines that the most important aspect in the subsector of **energy production and transformation** within a context of climate policy is an efficient utilization of energy resources and energy saving. In order to implement the said principles it is necessary :

- in electrical energy sector to:
    - perform optimization of flows of electrical energy and reduce losses within production cycles,
    - use up-to-date and energy-saving technologies, equipment and materials,
    - wherever it is technically feasible and economically justifiable, the existing boiler houses shall be reconstructed and their heat energy potential utilized in production of electrical energy;
- in heat engineering:
    - to improve technical conditions of the existing heating network; to reduce heat and water losses,
    - to enhance a transportation system through pipelines,
    - to supply network systems and individual consumers with heat meters and regulating equipment,
    - to develop production of heat insulating materials in Latvia;

The data of Latvian Energy Agency demonstrate that, provided all heating network are reconstructed by 2000, losses might be cut by 20 %. Since this undertaking requires massive investments, a partial 10-15% implementation might be considered, yielding about 3 % economy in fuel consumption and respectively cutting the level of CO_2 emissions. In Latvian cities with comparatively well developed district heating systems, it would be reasonable to introduce co-generation of heat and electrical energy, thus permitting to save fuel, as well as to mitigate environmental pollution by eliminating old boiler-houses and to produce heat and electrical energy during the same generation cycle. In saving programme it is reasonable to implement the following principle: a part of costs is covered either directly or through tax rebate.

Another approach to reducing CO_2 emission levels is extensive utilization of local resources of hydro-power, indigenous fuels (wood, peat) and transition to using alternative energy generation sources. There is a possibility of obtaining a loan from the World Bank to implement the following principal projects:

- renovation of hydroelectric power plants of the Daugava cascade;
- reconstruction of small boiler-houses and conversion to indigenous fuel;
- reconstruction of district heating systems in Riga and Jelgava.

Legislation in energy sector is not a too powerful tool yet to cut CO_2 emissions, however the new NRT draft offers some solutions of an economic nature - sales of emission licences, excise tax on fuel, through which CO_2 tax can be levied, integral fuel tax facilitating preferable utilization of natural gas in the capacity of a fuel (per heat energy unit gas generates the amount of CO_2, which is smaller by a factor of 2.5 than respective amount in the case liquid fuel).

Transport shall have a decisive role in promotion of economic development. Only transport infrastructure of definite quality is in a position to serve as the basis for further economic development. The existing transport infrastructure in Latvia, transport means and transportation

process fails to meet the standards adopted in countries worldwide. A drop in air quality in areas surrounding cities, highways and railroads testifies to this. The Ministry of Transport currently is working out the "National Programme of Transport Development (1995 - 2000). The draft "State Programme for Development of Road Transport" has been elaborated in 1994. The Programmes determine that the principal objective of a transport subsector is to ensure a planned development of efficient transport system, aimed at full satisfaction of ever growing demand in individuals and economic structures in availability of safe transportation with corresponding guarantees and at acceptable costs. Programmes point out the necessity to devise a package of measures "Development of ecologically friendly system of transportation. Ensuring ecologically safe means of transport". A target within the context of EPPP and climate change would be to reduce pollution caused by transport. The following practical measures are considered:

- development and of up-to-date and ecologically clean means of transportation, as well as production of equipment,
- popularization of environment-friendly means of transportation (electric transport, bicycles etc.);
- limiting use of individual transportation means in cities;
- development of public transportation sector;
- education of drivers;
- development of national legislation by bringing it as close to requirement of environment legislation of European Community as possible;
- improvement of a system of taxation and punitive measures.

Implementation of the said measures shall ensure reduction of CO_2 emission levels generated from vehicles by 2000 if compared with those of 1990 despite the number of vehicles is expected to increase considerably (Table 5.2.2. in Chapter 5).

Consumption levels of energy resources in **industrial sector, heating of buildings etc.**, on 2000 shall be lower than respective figures for 1990. Measures for reduction of CO_2 emissions is not different from those proposed in the subsector of energy production and transformation, i.e., economical utilization of fossil fuel, substitution of fossil fuel by indigenous fuel (biofuel), up-dating of existing technological communications, installation of heat meters and regulating equipment.

Total CO_2 emissions in energy subsectors during the period of 1990 - 2000, provided for reduction measures are depicted in Table 5.2.1 (see Chapter 5).

4.3.2.2 Industrial sector

Production of cement is the main source of CO_2 in industrial sector. Since construction volumes are dropping considerably in recent years, production of cement has decreased correspondingly, consequently, the CO_2 emissions are also down (see Table 5.2.1.). Modified technologies are considered for implementation in future, however at the present moment the anticipated changes have not yet been exactly formulated. There are no plans conceived on measures aimed at reducing CO_2 emission levels, neither based upon utilization of CO_2, nor related to amended taxation policy.

4.3.2.3. Land use change and forestry (CO_2 sink)

Forests are the main factor of circulation of carbon (C) in nature. One cubic meter of natural wood contains about 0.25 tons of C, generated in plants during the growth process by binding CO_2 from the air. When natural decomposition of wooden biomass takes place owing to microorganisms or by combustion, C is liberated and returns into atmosphere as CO_2. Thus,

absorbed and desorbed amount of C is at a balance, provided the afforestated area remains unchanged. As a result of planting of forests and their natural growth additional CO_2 sequestration takes place at a level quantitative indicators of which are difficult to assess accurately.

The forestry development policy in Latvia is outlined in the "Forestry Development Programme" and further elaborated in a document "Forestry development policy" . Latvian circumstances taken into account, where forests occupy above 40 % of the total area and forest areas during the period 1990 - 1994 in accordance with statistics have been increasing by 0.5 -1 % every year, the following forestry development principles are formulated:

- non-exhausting forest management;
- rational utilization of forest resources;
- development of cellulose production;
- utilization of forest resource residuals in state energy sector.

Environment protection, agricultural and wood production requirement taken into consideration the following forest conservancy measures shall be implemented:

- in the vicinity of residential areas existing forests shall be preserved and nurseries planted;
- the existing forests along rivers, lakes and other reservoirs shall be preserved;
- continuous area of ploughed-up fields shall not exceed 50 ha;
- every farmstead shall retain or reforest areas, which occupy at least 10 % of the total farm territory;
- private forests shall be kept in accordance with relevant laws;
- previously adopted laws shall be observed and new drafted;

However, it should be pointed out that the aforementioned measures in part because of limited financial means and also due to other reasons, shall be implemented only to an extent, sufficient to renew felled areas, therefore the CO_2 sink, estimated for the base year at 14300 Gg is not expected to expand before 2000.

CO_2 emissions and sink in various economy sectors for the base year and 2000, with measures for reducing CO_2 emissions accounted for, are revealed in Table 5.2.1 (see Chapter 5).

Measures aimed at reduction of CO_2 are summarized in Table S.2.

4.3.3. Measures for reduction of CH_4 emission

4.3.3.1. Energy sector

CH_4 emissions are generated mainly during incomplete combustion processes of biofuel, as well as at gas storage and transportation.

After the drop of 1990 - 1991, attributed to economic crisis and considerable decrease in consumption of various types of energy resources, the emission of CH_4 is raising again and is expected to reach the level of 1990 by 2000 unless measures are taken aimed at reducing emissions, which have been already discussed together with respective measures for reducing CO_2 emissions, moreover, isolation of heating network will decrease CH_4 by reducing fuel consumption by 0.5 %, installation of heat meters in energy production and transformation sectors will reduce CH_4 emissions by 1.5%, similarly, installation of gas meters will reduce CH_4 emissions of fugitive fuel by 1-2%.

The rising trend of CH_4 emissions can be explained by means of some of the underlying principles of policies in Latvian energy sector, i.e., wider use of indigenous fuel (wood, peat) as well as finding a lasting role for natural gas in a balance of energy resources.

To Latvia natural gas is supplied through Isborsk - Riga transmission pipeline, it is stored at Incukalns gas storage facility, the capacity of which is 2.1 milliard of m^3. Liquified gas is supplied from Russia by railroad, total volume of storage containers equals 7.500 tons, liquified gas exporting facilities are available in the Riga port. Besides, Latvia takes part in implementation of an international project on constructing a gas pipeline around the Baltic sea employing unique geologic features of creating new underground gas storage facilities in Latvia, which will increase safety of gas supplies for all countries involved in the project.

To reduce CH_4 emissions during storage and transportation a number of technical measures shall be undertaken - Incukalns gas storage facility shall be put in order (pumps, compressors etc.) and gas transmission pipeline and liquified gas storage containers controlled on regular basis (replacement of worn tubing, checking of pressure in a system etc.).

4.3.3.2. Agriculture

Cattle breeding is the sole source of CH_4 emissions in agriculture. CH_4 is generated in intestines during digestion process in ruminants (the amount depends upon a structure of fodder), as well as from animal manure during anaerobic decomposition. The overall slump in economy is reflected also in the sector of cattle breeding, i.e. during the period of time from 1990 to 1994 a considerable drop in a number of all types of cattle has taken place in Latvia (and consequently the amount of eliminated manure also). At the end of 1994 the downward trend has stopped, however only half of the 1990 level might be reached by 2000. Therefore, CH_4 emissions will fail to reach the level of 1990. Pursuant to EPPP it is recommended to optimize a number of cattle in accordance with available areas of pasture. It is expected that the change of ownership forms will contribute to reduction of CH_4 emission levels, since private farmsteads are capable of timely turning in manure or of storing it under safe conditions.

4.3.3.3. Waste management

CH_4 is forming in landfills due to anaerobic decomposition of organic substances and in small quantities is also educed from sewage water.

Up to 1990 the official attitude in Latvia, as well as in the entire USSR with respect to environment and environment protection has been the following: resources are unrestrictedly owned by the state or an institution under the rights of a user and are deemed integral part of the technological, management or other cycle. This approach failed to envisage any compensation for damages done to environment. Moral and legislative heritage of this type might cast some light upon mismanagement of waste in Latvia.

There is no framework law regulating organizational aspects of waste management in Latvia. The Law "On hazardous waste" is adopted, pursuant to which a definite part of waste is separated and all further handling activities are regulated; the Law also prohibits any import of hazardous waste. Besides, Latvia has acceded to Basel Convention of 1989 on "the Control over theTransboundary Movements and of Hazardous waste and their Disposal", which regulates trans-boundary movements and prohibits import of hazardous waste from developed countries to countries with economies in a transitional stage, e.g. Latvia.

However, waste is not sorted, consequently waste of all types: municipal, industrial, water treatment silt, production and hospital - are deposited in landfills ignoring requirements of environment protection. In pursuance with the existing legislation the hazardous waste originating during industrial processes shall be managed by enterprises themselves. It is not permitted to dispose of this waste in landfills for municipal solid waste. The amount of toxic waste is assessed, however a database is not created yet. Rough registration of municipal waste is under way; a

database will be created in near future. No environment monitoring takes place in areas of landfills, educed CH_4 is not utilized. There are about 500 landfills of this type in Latvia. Despite the financial difficulties the government and municipalities are facing under constricted conditions of transitional period, the lack of means failed to prevent the elaboration of waste management policies. In accordance with EPPP the following basic solutions are to be considered:

- reduction of the amount of waste;
- sorting of waste;
- reprocessing of waste (recycling, creation of environmentally safe grounds, biological reprocessing, incineration);
- setting in order sites previously used as waste deposits.

Most significant levers to tackle the said problems is strict observance of existing laws ("On natural resource tax", "On hazardous waste" etc.) as well as drafting of new laws, scientific research, employment of safer and more reliable technologies in industries, use of less obnoxious crude materials, economic incentives and sanctions, building of public awareness. Eduction of CH_4 from waste is expected to rise during the period of 1994 - 2000, however falling short of the 1990 level. CH_4 emissions in various sectors of economy, with emission reduction measures taken into account for the base year and for 2000, are shown in Table 5.3.1 (see Chapter 5). Measures aimed at reducing CH_4 emission levels are summarized in Table S.3.

4.3.4. Measures for reduction of N_2O emissions

4.3.4.1. Energy sector

N_2O emissions originate from combustion of wood and other types of fuel used in agriculture. Consumption of biofuels rises in Latvia and it is likely, that the trend will hold up to 2000, however, N_2O emissions by 2000 shall not exceed the base year level.

The amount of N_2O educed during combustion will decrease alongside with reductions in CO_2 and CH_4 emissions, when heating network is isolated and heat meters are installed at consumer end (reduction by 1.5 % is expected).

A marked rise in a number of vehicles in Latvia during the last decade taken into consideration, as well as the fact, that the specific number of vehicles equipped with convertors for catalytic transformation of CO_2, NO_x and NMVOCs, the N_2O emission levels from automobile transport is likely to exhibit rapid increase in future.

4.3.4.2. Agriculture

If soils are overfertilized with organic or mineral fertilizers to an extent plants are not in a position to utilize, excess nitrogen (N) under the influence of microorganisms and other natural factors, transforms into N_2O. Quantitative assessment of the process is very cumbersome, since the educed amount of N_2O depends upon a sum of various factors (meteorological conditions, type of soil, amount of N metabolized by plants, type of utilized fertilizer etc.). There have never been practice in Latvian agriculture of using fertilizers, pesticides and other means of plant protection at the large quantities these have been used in West European countries. This issue is regulated in legislation. Upon commencement of agrarian reform after 1990 even these meagre quantities have dropped considerably since large farms have been liquidated and there is little likelihood that amounts will reach the base year level by 2000. However, beyond 2000 development of agricultural production employing intensive production technologies to achieve high yields, pollution due to agricultural activities might cause problems, provided no precautions

are taken.

The most effective of these measures - to prevent overfertilization of soils with N-containing types of fertilizers by elaborating scientifically substantiated recommendations. Problems of this type in Latvia are addressed by State Scientific Production Company "Raziba". Since 1964 up to now there is an expert in every region of Latvia, i.e., agrochemist, whose objective is to study soils, to advise on rational liming and use of appropriate fertilizers, to provide consultations and practical assistance to farmers. It should be noted, that balance calculations of nutritional substances performed by company "Raziba" demonstrate that the amount of N turned in by fertilizer fails to cover the amount turned out by crops.

Among other measures the following shall be pointed out:

- changes brought about by onset of market economy (prices of mineral fertilizers will go up),
- technological arrangements (adequate storage of organic fertilizers, fertilizers turned directly into soil to facilitate assimilation and metabolism by plants);
- legislation (see Chapter 4.3.1).

N_2O emissions in various economic sectors for the base year and for 2000 with measures for reduction of emissions taken into account are revealed in Table 5.4.1 (see Chapter 5). Measures aimed at reducing N_2O are summarized and presented in Table S.4.

4.3.5. Measures for reduction of NO_x, CO and NMVOC emissions

The main sources of NO_x, CO and NMVOC emissions are:

- **energy sector** (combustion of fuel and emission of fugitive fuel) - eduction of NO_x, CO and NMVOCs;
- **solvent and other product use** (mechanical engineering, chemical engineering, household chemistry, timber processing, vehicle maintenance companies) eduction of NMVOCs.

In virtue of economic decline the levels of emission have dropped considerably, therefore, no measures are being planned. By implementing arrangements aimed at reducing emissions CO_2 and other GHG, at the same time reduction of NO_x, CO and NMVOCs will take place: installation of gas and heat meters at consumer end will decrease NOx, CO and NMVOC emissions by 3%, whereas emission of fugitive fuel from gas pipelines will drop by 7%. However, vehicle maintenance companies might cause problems in relation to NMVOCs, private companies in particular, the number of which at present is growing fast. As for now, there are no practical means capable of reducing the said emission levels, save the new NRT, after adoption of which, it is likely, that prices of hazardous good or products i.e., solvents, paints and varnishes will rise. However, this step will have little influence upon proprietors of vehicle maintenance companies.

Emissions of NO_x, CO and NMVOCs in various sectors of economy in the base year and 2000, with emission reducing measures accounted for, are shown in Table 5.5.1 (see Chapter 5).

4.3.6. Monitoring of GHG emission reducing measures

To assess the efficiency of measures related to the policies of mitigating climate change it is necessary to perform monitoring, i.e., systematic collection and summary of data on all types of measures taken in various sectors of economy aimed at reducing GHG emission levels, indicating the extent to which the said measures have contributed to achieve the goal and how efficient particular measures have been in achieving it. No monitoring of measures taken within a framework of policy of climate change are attempted in Latvia previously, since no finalized climate policies have ever been elaborated. In development plans of various economic sectors

(energy, industry, agriculture etc.) which are discussed in greater details in Chapter 4.3.2, actual environment and climate protecting measures are proposed, however, data related to efficiency of the said measures are presented mainly as projections. Upon devising national development programmes (economic development, environment protection) apart from mandatory environment protection arrangements, these shall comprise also monitoring of the aforementioned measures and implementation methods.

The National Communication of the Republic of Latvia under the Framework Convention on Climate Change basically can be considered as our first serious attempt to summarize and to the extent our possibilities permit to assess or prognosticate the efficiency of planned and implemented measures during the period 1990 - 2000, aimed at reducing emission levels of GHG.

5. PROJECTIONS OF GREENHOUSE GAS EMISSIONS

5.1. Introduction

Macroeconomic projection for 2000, GHG emissions inventory for 1990 and assessment of efficiency of the policy countering climate change form basis for GHG projection.

Macroeconomic projection is elaborated basing on three scenarios of economic development. Eventual growth of investments is regarded as the main factor fostering further economic growth, which, in its turn to a large extent depends upon macroeconomic policy adopted by the government.

In compliance with the first scenario, to be regarded arbitrarily as a pessimistic one, it is assumed that the government fails to find suitable tools for a more efficient increment of investments. In this event growth of the gross domestic product (GDP) during 1994 and 1995 might be insignificant and only beginning with 1996, the growth might amount to 3-4% per annum.

The second scenario is based on the assumption that the growth rate of the gross domestic product reaches 6%. Data concerning this scenario are presented with most details, since it is regarded as the most realistic. Summary Tables for each scenario are presented in Appendix 5.

In accordance with the third scenario, it is assumed that the government shall succeed in accelerating the process of investment, resulting in the growth of gross domestic product already in 1995 by 4%, the most rapid growth (7 - 8 % per annum) is expected to take place in 1998 and 1999.

Sectorial development versions have been devised for each scenario. GDP growth curves for various scenarios of economic development are depicted in Fig.5.1.

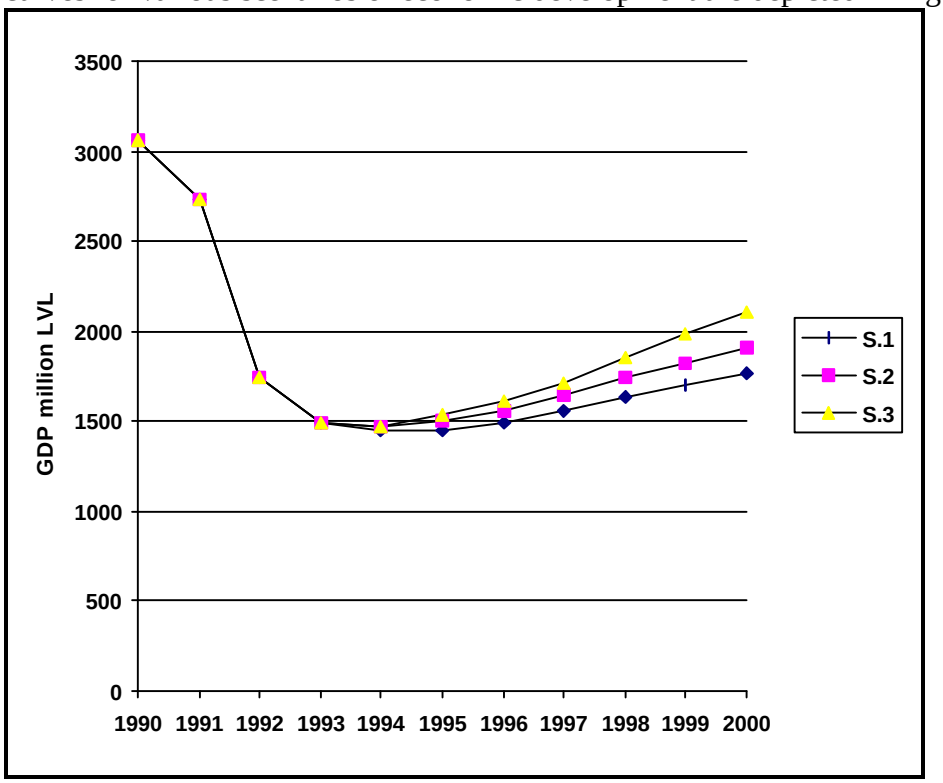

Fig.5.1. GDP curves for different economic development scenarios. GDP in 1993 prices (millions of Ls).

The key assumptions used in elaborating macroeconomic projections are presented in Table 5.1.1.

Table 5.1.1 Key assumptions in devising macroeconomic projections

Indicator (000'000 Ls in fixed 1993 prices)	1990	Reduction in 2000 against 1990
Gross Domestic Product	2 953	(-40%) - (-25%)
Energy production	365.8	(-22%) - (-15%)
Processing industries	2053.5	(-54%) - (-37%)
Transport services	1121.6	(-25%) - (-6%)

Reference: [17]

Forecasting can be divided into 3 stages.The first stage involves analysis of mutual relations between data on GHG emissions corresponding economic indicators. During the second stage macro economic forecast for 2000 is elaborated. At the third working stage projections for CO_2, CH_4, N_2O, CO, NO_x and NMVOC emissions are worked out for 2000 in accordance with macroeconomic forecast. In devising reduction in GHG emissions, recommendation of experts from various economic sectors are taken into consideration, as well as sectorial developmental programmes, policies and measures, which are presented in details in 4.3. It is assumed that due to financial restrictions some of measures will not be implemented completely. Unfortunately, because of scarce statistical data and lack of experience it is possible to calculate the efficiency of measures in compliance with IPCC\OECD requirements only for separate cases. Projected GHG emissions in 2000 pursuant to three scenarios are shown in Table 5.1.2.

Table 5.1.2. Projections of GHG emissions in 2000 (Gg)

GHG	1990	2000 (s.1)	2000 (s.2)	2000 (s.3)
CO_2	22976	16179	16956	18021
CO_2 removal	(-14300)	(-8940)	(-8940)	(-8940)
CH_4	158.9	110.75	114.15	114.37
N_2O	2.38	1.35	1.43	1.62
NO_x	90.13	48.83	52.48	56.55
CO	363.1	264.37	278.23	293.69
NMVOC	62.7	36.62	39.19	42

5.2. CO_2 Emissions and Sink

The main **source of CO_2 emissions** in Latvia is located in energy sector (fuel combustion). Total CO_2 emissions in 1990 and 2000 are revealed in Table 5.2.1. in year 2000 compared with year 1990. It is explained by the reason that the amount of production will not reach the amount of production in year 1990.

Table 5.2.1. Projections of CO_2 emissions in 2000 (Gg)

Sources of emissions	1990	2000 (s.1)	2000 (s.2)	2000 (s.3)
Total	22976.3	16179	16956	18021
1.Energy	22605.6	16115	16885	17935
1.A. Fuel combustion	22605.6	16115	16885	17935
1.A.1. Energy & transformation activities	8274.4	7510	7775	8040
1.A.a Losses	34.5	17	17	19
1.A.2. Industry	2680.4	1254	1395	1696
1.A.3. Transport	5660.6	3962	4274	4588
1.A.5. Residential	3140.3	1741	1757	1757
1.A.6. Agriculture/forestry	1449.7	557	588	696
1.A.7. Other	1365.7	1074	1079	1139
2. Industrial processes	370.7	64	71	86
2.E.1. Cement production	370.7	64	71	86
5. Land use change and forestry	(- 14300)	(- 8940)	(- 8940)	(- 8940)
5. C. Managed forests	(- 14300)	(- 8940)	(- 8940)	(- 8940)

Since none of economic sectors by 2000 will exceed production and consumption indicators of 1990 (Table 5.1.1), CO_2 emission levels in accordance with all development scenarios will fall short of the level of 1990. Consumption levels of primary energy resources in production of thermal and electrical energy are projected at consultations with experts of Latvian Energy Agency. On average the levels might constitute about 70-80% of 1990 level, residential demand in thermal energy is expected to reach the level of 1994. Increase in transport services and in number of vehicles is anticipated (Table 5.2.2), however CO_2 emissions from vehicles are not going to increase (Chapter 4.3.2).

Table 5.2.2. Dynamics of transport means (number of units)

Type of vehicle	1990	1991	1992	1993	1995	2000	2010
Cars, '000	283	328	350	391	420	550-600	700-800
Buses,'000	12	13	18	20	15	20	30
Trucks,'000	67	71	75	85	*)	*)	*)

Reference: [9]. Note: * Due to privatization and restructuring under way it not possible to prognosticate these figures in trucking sector yet.

The main measures in reducing CO_2 emissions is regarded to be an energy saving project (Chapter 4.3.2, EPPP, LEDP). It is calculated that rehabilitation of heating systems will allow to decrease the level of energy production by 20%. Since due to lack of financial means the said activities will not be implemented to full extent, thus aggregate efficiency, as well as reduction in

CO_2 emission levels will not exceed 3%. Installation of heat meters in 50% of households, will decrease demand in production of thermal energy by 10%, the same reduction is expected in CO_2 emissions. Differential fuel tax, which is included in drafted Natural resource tax will influence the structure of consumption of energy resources in favour of natural gas. Upon combustion gas educes 2.5 times smaller amount of CO_2 per thermal energy unit than liquid fuels, therefore, CO_2 emissions may drop by 6%. It is not possible to assess the efficiency of other measures (free market prices, public awareness building activities, the entirety of measures related to vehicles etc.) in quantitative terms. Dynamics of projected CO_2 emissions for the period of 1990-2000 is revealed in Fig.5.2.

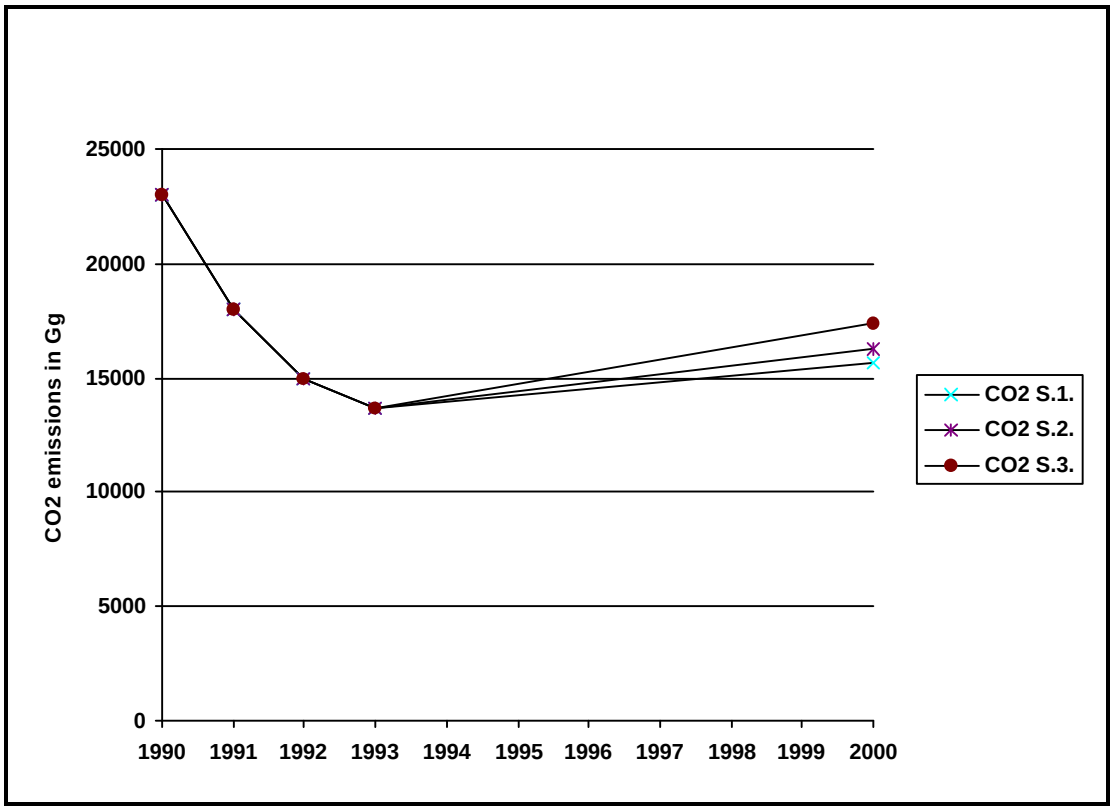

Fig.5.2. Projected dynamics of CO_2 emissions.

Calculation of CO_2 sink in land use change and forestry in 2000 yields 8940 Gg of CO_2 (14300 Gg for 1990). Projections are based upon an opinion of experts from the State Forest Service under the Ministry of Agriculture in pursuance of which a total forest area remains the same in 2000, as well as upon a view, that felling of trees in likely to increase. Thus, CO_2 sink in 2000 will equal 20600 Gg. It is expected that 8.4 millions of m^3 of trees are felled in 2000. Cleared areas will decrease sequestration by 40 Gg. As a result, total sequestration in 2000 will equal 20560 Gg of CO_2. Potential CO_2 emissions from felled trees will constitute 11620 Gg, thus rendering the calculated CO_2 sink to 8940 Gg. It is forecasted that 40% of felled trees are going to be exported in 2000 (see Annex 5, Table 5.5).

5.3. CH_4 emissions

CH_4 emissions originate from energy sector (combustion of fuel), emission from gas transmission pipelines and gas storage facilities, agriculture and waste management. Total CH_4 in 1990 and 2000 are presented in Table 5.3.1.

Table 5.3.1. Projection of CH_4 emissions in 2000 (Gg)

Source of emissions	1990	2000 (s.2)
Total	158.937	114.15
1. Energy	4.167	3.44
1.A. Fuel combustion	2.368	2.21
1.A.1. Energy & transformation activities	0.509	0.63
1.A.2. Industry	0.059	0.02
1.A.3.Transport	1.486	1.23
1.A.5. Residential	0.184	0,21
1.A.6. Agriculture/Forestry	0.108	0.1
1.A.7. Other	0.022	0.02
1.B. Fugitive fuel emission	1.799	1.23
4. Agriculture	111.27	58.65
4.A. Enteric fermentation	97.96	52.23
4.B. Animal waste	13.31	6.42
6. Waste 6.A. Landfills	43.5 43.5	52.06 52.06

Total CH_4 emissions in energy sector in 2000 will be subjected by identical measures considered in relation with CO_2 emissions (Chapter 5.2). Installation of heat meters will reduce CH_4 emissions originating from fuel combustion by 1.5%, rehabilitation of district heating networks and respective reduction in gas consumption is expected to decrease CH_4 emissions by 0.5%; however implementation of new natural resource tax draft will enhance gas consumption and emission from gas pipelines will grow by 1.5%.

A slowdown is forecasted in agricultural sector. Number of cattle will not increase, consequently the same trend will hold in CH_4 emissions.

It is projected that population in Latvia will be 2500 000 in 2000. Amount of communal waste might reach 700 Gg against 585 Gg in 1990. CH_4 emissions from communal waste is bound to grow, because the hardships of transition stage in economy will not permit to implement waste reducing measures or waste recycling activities before 2000.

Measures aimed at reduction of CH_4 emissions in agriculture and waste management are at a project stage and are considered in long-term perspective, therefore it is not possible to assess their efficiency.

5.4. N_2O emissions

N_2O emissions originate from fuel combustion and agricultural soils. Total N_2O emissions in 1990 and 2000 are depicted in Table 5.4.1.

Table 5.4.1. N_2O emissions in 2000 (Gg)

Sources of emission	1990	2000 (s.2)
Total	2.38	1.43
1.Energy	1.03	0.76
1.A. Fuel combustion	1.03	0.76
1.A.1. Energy & transformation activities	0,07	0.09
1.A.2. Industry	0.014	0.01
1.A.3.Transport	0.108	0.06
1.A.5. Residential	0.029	0.03
1.A.6. Agriculture/Forestry	0.016	0.02
1.A.7. Other	0.793	0.55
4. Agriculture	1.351	0.67
4.C. Agricultural soils	1.351	0.67

N_2O emissions from fuel combustion in Latvia are not large: no significant change is expected to take place by 2000. Rehabilitation of district heating network might reduce consumption of fuel, thus bringing about drop in N_2O, as well as other GHG emissions by 1.5%.

Utilization of mineral and organic fertilizers will be low since farmers are short of financial means. It is not possible to make quantitative assessment of impact of various measures (free market prices, education of farmers, legislation etc.) upon reduction in N_2O emissions.

5.5. Other GHG emissions

NO_X , CO and NMVOC emissions originate in energy sector (combustion of fuel, incl.transport), as well as from use of solvents. Total NO_x, CO and NMVOC emissions in 1990 and 2000 are revealed in Table 5.5.1.

Table 5.5.1. Projection of NOx, CO and NMVOC emissions in 2000 (s.2) (Gg)

Sources of emission	NO_x		CO		NMVOC	
	1990	2000	1990	2000	1990	2000
Total	90.135	52.48	363.125	278.23	62.722	39.19
1. Energy	90.135	52.48	363.125	278.23	55.324	35.69
1.A. Fuel combustion	90.135	52.48	363.125	278.23	55.315	35.69
1.A.1. Energy & transformation activities	15.223	14.43	22.727	36.65	0.648	0.87
1.A.2. Industry	3.362	1.57	0.939	0.36	0.099	0.05
1.A.3.Transport	65.833	30.58	329.077	219.3	54.199	34.3
1.A.5. Residential	2.711	3.18	4.414	14.69	0.179	0.3
1.A.6. Agriculture/forestry	1.582	1.21	4.789	6.68	0.124	0.13
1.A.7. Other	1.424	1.51	1.179	0.55	0.066	0.04
1.B. Fugitive fuel emission					0.009	
3. Solvent and other product use					7.398	3.5
3.A. Degreasing and dry cleaning					1.119	0.08
3.B. Chemical products manufacture / processing					0.680	0.22
3.C. Other					5.599	3.2

No particular measures for reducing NO_x, CO and NMVOC emissions are considered, since these emissions are influenced by measures aimed at reduction of other GHG levels. It is projected that installation of gas and heat meters will save fuel resulting in decrease of NO_x, CO and NMVOC emissions from fuel combustion by 3%, whereas emission of fugitive fuel from gas pipelines will drop by 7%.

Vehicle emission levels will alter. Total amount of emissions from mobile sources consists of the following key components:

- increase in a number of vehicles;
- reduction in fuel consumption in more advanced vehicles;
- growth of specific number of vehicles equipped with catalysts;
- more severe annual vehicle checks; speed limitations;
- restrictions to use of individual transport means in urban areas.

Total impact of the aforementioned measures upon NO_x, CO, NMVOC emission levels is not assessed, because implementation of these depend upon factors, which can not be prognosticated in Latvia at present (world fuel prices, development of science, development of public transport etc.).

Use of solvents and related products takes place in the following subsectors:

- mechanical engineering (degreasing, painting);
- chemical engineering;
- timber procession (varnishing, puttying);
- vehicle repair works;
- communal services (dry cleaning etc.).

If GHG emissions in industrial sectors are under strict control, the same can not be said about motor repair works. More attention shall be paid to this factor in future, since marked increase in a number of vehicles in Latvia bring about equally rapid rise in a number of motor repair works. Application of more severe standards to these enterprises can result in additional reduction of NMVOC emissions.

5.6. Converted GHG emissions (Global Warming Potential)

Using factors of the global warming potential (GWP), emissions of CO_2, CH_4 and N_2O are calculated for 2000 (Table 5.6.1).

Table 5.6.1. Projection of converted GHG emissions in 2000 (in Gg of CO_2 equivalents)

GHG	GWP factors	Emissions ,1990, Gg	Effect, 1990	Emissions, 2000 (s.2), Gg	Effect 2000 (s.2), Gg
CO_2	1	22976	22976	16956	16956
CH_4	24.5	159	3894	114.15	2797
N_2O	320	2.38	762	1.43	457
Total			27632		20210

Converted GHG emissions in 2000 (s.2) will amount to 20210 Gg CO_2 equivalents. Comparing with 1990 (27632 Gg CO_2 equivalents) calculated emissions in 2000 will drop by 27%.

5.7. Uncertainty

Uncertainty in emission forecast originates in macroeconomic projections (Table 5.7.1). Uncertainties in relation to other factors are not assessed.

Table 5.7. 1. Uncertainty of projected emissions in 2000 (%)

GHG Emissions, Gg	Uncertainty, %
CO_2+	5.4
CH_4	1.6
N_2O	9.4
NO_x	7.4
CO	5.3
NMVOC	6.8

6. SYSTEMATIC OBSERVATIONS AND STUDIES

National Climate Programme of the Republic of Latvia has not been devised yet, however systematic observations of environmental pollution are carried out by institutions ancillary to MEPaRD, climate monitoring is undertaken by Hydrometeorlogical Agency of the Ministry of Transport (HMA), scientific research is basically centred at Latvian University (LU), Riga Technical University (RTU), as well as at Institutes of Biology and Physico-Energy of Latvian Academy of Sciences.

6.1. Observations of environmental pollution and databases

At Environment Data Centre databases on pollution of air and water are created. Statistical reports are submitted by all regions of Latvia on annular basis to up-date databases. Each region reports on types and amounts of emissions from their enterprises (including boiler houses). Reports indicate the amount of pollutants emitted into air, how much of it is being treated or utilized. Also, information is presented about consumption of fuel and distribution by type. From 1995 on reports will require enterprises to implement measures aimed at reduction of pollutant emissions into atmosphere.

There is an extensive network of long-term services for observation of environmental pollution in Latvia. Regional networks characterize respective regions and participate into international monitoring programmes, including EMEP (Convention on Long-range Transboundary Air Pollution) and IM (Integral Monitoring). Local networks are created at national level and deal with local monitoring issues.

The existing number of services is sufficient to carry out observations within requirements of GAW (Global Atmospheric Watch) in reference to ozone, background pollution of atmosphere, transfer of chemical substances, stratification of atmospheric pollutants, chemical composition of water in soil and plants. The above might serve as a Latvian contribution to a system of global climate monitoring.

It is suggested to include two stations within the territory of Latvia into GAW register, i.e. in Rucava and Zoseni. Both of them will be in a position to offer objective data on coastal regions, as well as on inland territories of the Republic. Involvement of the two Latvian systems into the GAW system can not be underestimated, since it is of utmost importance to detect changes in relatively virgin nature of Latvia as soon as it is possible, to assess reaction of biological systems to different pollution levels, as well as to prognosticate further evolution of these systems.

6.2. Monitoring of climate

Monitoring of climate in the context of Climate Convention is defined as an execution of systematic observation in various natural environments, aimed at detection and observation of changes caused by influence of anthropogenic factors.

On the ground of the database of Latvian Hydrometeorlogical Agency the results of observation of air temperature and atmospheric precipitation are summarized for 24 hydrometeorlogical stations situated at various locations all over Latvia.

Analysis of air temperature demonstrates the fact, that in Latvia it is gradually growing warmer, moreover, if comparison is made between the first and the second half of the last 100 years, temperature has been rising faster during the second half. The mean annual temperature during the first 50 years has increased by 0.2^{o}C, moreover, this temperature is not influenced by growing urbanized areas and development of various local economy sectors yet. In return, by the

second half of the century the phenomenon of Riga as a major city and as an industrial centre begins to manifest itself, i.e., if other cities experience a growth of the mean annual temperature by about 0.5 degrees, Riga exhibits a growth by almost 1 degree.

The range of annual temperature has decreased. Major positive changes have occurred during winter months, moreover, it has happened mainly at the expense of increase in night temperature. The mean annual temperature extremes are brought closer together - the mean minimum has increased at a more rapid rate than the mean maximum.

Annual precipitation amount on the average has risen during the last 50 years. The process is more conspicuous in the areas where prevailing winds and topography promote upward movement of air masses. This increase is more pronounced during the beginning stage of a cold period.

The total amount of clouds has not changed in practice. There is a minor drop in the amount of low clouds. In spite of this, data analysis testify to the decrease in sunshine duration as well. The mean relative humidity has remained unchanged.

During recent years trends of rise of a water level can be observed in the Riga Gulf and the water area adjacent to the Latvian territory. Thus, from 1978 on the mean water level in the Riga Gulf has increased by 18 cm (station in Daugavgriva), whereas the mean level in the Baltic Sea by 14 cm (station in Liepaja). Quantile analysis of the water level and the Daugava throughput has demonstrated that the detected increase in the water level might be caused by anthropogenic factors.

6.3. Scientific research and international cooperation

Climate observation and databases assist scientists to better understand issues related to climate changes all over the world and Latvia as well.

Under circumstances of the former USSR scientific research with developed countries is coordinated by central state structures and the scientists from peripheral areas in practice stood no chances of organizing direct scientific cooperation projects with Western countries and getting involved in International Programmes of Scientific Cooperation.

To full extent this refers to involvement in a variety of Programmes of Global scope, based upon International Council of Scientific Unions, *Paris, France*, United Nations Environment Programme, World Meteorological Organizations, *Geneve, Switzerland* financially supported under the auspices of the above organizations, i.e., World Climate Research Programme (WCRP), International Geosphere and Biosphere Programme (IGBP), Human Dimensions of Global Change Programme (HDP) and other projects and programmes concerned with a study of ozone layer and its protection, tropospheric pollution or effect caused by greenhouse gas emissions.

However, it is appropriate to list a number of research projects supported by the Latvian Science Council and which are directly related to issues of global climate change.

Institute of Geodesy and Geoinformation of Latvian University is active in the field of Geographical Information Systems, Digital Cartography, Remote Sensing and Geodesic Data Acquisition Systems Based on Satellite Laser Range Meters. Institute of Nuclear Physics and Spectroscopy of Latvian University is engaged in a project "UV and VUV Spectroscopy and Photochemistry of Polluted Atmosphere". Biological Department of the University together with Institute of Biology of Latvian Academy of Sciences run research work within the following projects "Biogeoindicative System and Methods for Evaluation of Environment Quality", "Use of New Biomonitoring Methods in Evaluation of Biodiversity of Fresh Waters and Its Dynamics"; "Circulation of Organic Carbon and Biogenic Elements in Ecosystem of Riga Bay". Besides the

listed projects a number of technically oriented studies are to be mentioned, which are carried out at Institute of Physico-energy of Latvian Academy of Sciences and at RTU and are aimed at designing equipment for environmental monitoring, implementation of systems and methods economizing energy and heat, design of energy-intensive and ecologically friendly energy technology. The aforementioned research areas might be considered as an integral part of IGBP. Despite limited financial resources the State Hydrometeorlogical Agency being Latvian representative at the World Meteorological Organization (WMO), since 14 June, 1992 is involved not only in implementation of projects of WMO, but also seeks to meet requirements of international conventions or takes part in carrying out separate their parts, as well as participates in many international projects.

In pursuance of a subprogramme of the World Climate Research Programme (WCRP) - the World Climate Data and Monitoring Programme, the Hydrometeorlogical Agency in 1994 within a framework of Voluntary Co-operation Programme (VCP) received a CLICOM (Climate Computing) - a climatic data processing system from a donor-country - the U.K., which enables Latvia to install a software for processing climatological data and to create a national database meeting the world standards thus permitting to a fuller extent fulfil international commitments. Beginning with 1995 processing of climatic data is performed at an internationally accepted level.

Interests of Latvia are represented in such WMO programmes as:

Hydrology and Water Resources Programme in accordance with which efforts are undertaken in order to restructure a system of hydrological observations;

subprogramme of the Atmospheric Research and Environment Programme aimed at atmospheric observations (GAW) within a framework of which Latvia is represented with observation data from the station of a regional level since 1993;

a number of employees have taken part in various training courses within a framework of the Education and Training Programme, i.e.: seminars, short-term, long-term, retraining and post-diploma courses;

experts from Latvia have taken an active part in a preparatory work of the Second IPCC Assessment of Intergovernmental Panel on Climate Change (IPPC) to be completed by September, 1995. Besides, Latvia participates in developmental actions on Coastal Area Management, since having a sea border, it is economically interested in development of harmonized strategies for coastal area management, where the current climate changes are taken into account.

At present first steps are taken in conceiving a National Programme. Within a scope of HMA a draft of general review and climate programme of Latvia is being devised.

Apart from this Latvian HMA is engaged in co-operation with Scandinavian countries and the Council of Ministers of Nordic countries in the following projects: "Baltic Integral Monitoring" (BIM) and "Gulf of Riga".

Also, within a framework of Geneva 1979 Convention on Long-range Transboundary Air Pollution Latvia runs measurements in accordance with a Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Long-term Financing of the Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP).

Several projects, i.e. (BALTEX - Baltic Sea Experiment), a project aimed at improvement of telecommunications BALTMET (BALTMET-SMHI), a project concerned with hydrology and meteorology BALTMOD-IHMS (BALTMOD - transfer to Integrated Hydrological Modelling System) are represented in a capacity of scientific and technical projects based upon bilateral or multilateral arrangements between related institutions.

Latvia is involved in the work of European Network for Research in Global Change (ENRICH), co-ordinated by European organizations.

Participation of the Latvian side into the Human Dimensions of Global Environment Change Programme (HDP) at present is mainly confined to capacity building process, resulting in quite a rapid improvements in educational aspects (see Chapter 7).

Present estimates testify that, provided a state budget is the sole financial source, there is little likelihood that economic situation in Latvia in near future will permit to develop national programmes for climate change or commence systematic, practically orientated research. At the same time, the existing research infrastructure and qualification of personnel taken into consideration, scientific work might begin if international collaboration takes pace and international united fund allotted for the said scientific studies are made available to Latvia. The present scientific potential ensures participation in implementation of IGBP as well as HDP project. Participation of Universities in the above projects can not be overestimated, since these open growth opportunities for students who wish to devote themselves professionally to solving problems related to global climate change.

7. EDUCATION, TRAINING AND PUBLIC AWARENESS

Education is one of the ways to raise public awareness. Along with deterioration of an economic situation in Latvia, public interest in protection and rehabilitation of environment has decreased in general. Objectives of environmental education at a national level might be the following:

- promotion of public development (harmony of material and spiritual needs and interests);
- building of public responsibility in reference to environment;
- comprehensive education of public on environmental issues.

Education, training and public awareness concerning environmental problems are the key factors in tackling issues related to climate changes, these are included within WCRP programme. Latvia is neither directly involved in implementation of HDP, nor in any of the projects financed within a framework of this programme. However, during recent years by virtue of support by academic community and universities of Baltic Region, a significant headway is achieved in the field of academic education in relation to environmental issues and, consequently, with implementation of HDP programme.

At the same time there is an improvement in the quality of environmental programme at comprehensive school level; to some extent information is disseminated at municipal level as well.

It is well-marked progress, though insufficient and vulnerable, since it is not sustainable by solely national means. Achievement of a high interest level of general public requires significant ancillary resources, at the same time it is of utmost importance since development of private economy is considered and it is necessary to achieve sustainable growth from the very beginning.

Universities and academic circles

At the present moment it is possible to get Bachelor's Degree in nature sciences in environmental protection speciality. Apart from it Master's Degrees are conferred at LU in the following fields: environment science and management; Master of Art in Nature Sciences; interdisciplinary environment chemistry. The following Engineer and Master studies are offered by RTU: "Technologies and equipment in environmental protection", "Water supply, sewage and utilization of water resources". Issues of environmental education are emphasized for Master's Degree at Latvian Academy of Agriculture, whereas Daugavpils Pedagogical University offers Degree of Master of Art in Pedagogics - teachers for preliminary schools specializing in ecological issues.

All the listed study programmes have been conceived during last 1 - 3 years; several additional courses are considered at the present moment. As a result efforts undertaken by Universities and Academic circles give valuable preliminary contribution in speeding up building of public awareness, particularly concerning the young generation, on environmental issues and related changes in global climate.

Sustainable development principle forms the basis of the strategy of HDP programme. At present only the Programme of Master of Art Studies in Environment Science and Management at LU is devised within a framework of a "sustainable growth" concept; "Centre of Environment Science and Management Studies" (CESAMS) which implements the programme is seeking to undertake research activities to promote the development of "Local Agenda 21" programme aimed at ensuring sustainable municipal development.

A database network of Latvian academic institutions being installed at the present moment promises novel opportunities in near future, since all the said institutions will be in a position to get connected to international networks of climate change programmes and to use the received

information, both for training purposes and for research.

Society and mass media

Involvement of general public, as well as issue of public awareness is rather pessimistic at present, mainly due to its low information level, which is caused by a lack of specialized literature in Latvian, poor library facilities and, of course, by educational problems inherited from the previous system.

To a large extent problems are aggravated by the fact that mass media, i.e., press, radio, television for the time being demonstrate poor command of issues related to environment and do not rate these as news highlights. An action the "Last Warning" which takes place in 11.02.95 in many cities all over the world, also in Riga and informed general public about impact of GHG on climate.

Non-governmental organization

Upon commencement of transition stage in Latvia, a number of non-governmental organizations are founded for protection and conservation of environment. Among others Latvian Green Party, Environment Protection Club, Ecological Centre of Latvian University, Latvian Nature Foundation, Children Environment School, Green Library etc., should be mentioned. A number of international NGO's have local representations in Latvia: Coalition for Clean Baltics (CCB); World Wildlife Foundation (WWF); Friends of Earth (FOE). Activities of the abovementioned organizations in one way or other promote building of public awareness and care for changes in global climate. Representatives of NGO's are involved in devising Latvian EPPP.

Comprehensive education system

In developing environment education secondary schools rely upon assistance of universities and activities of non-governmental organizations. Sociological polling testifies that schoolchildren rate environmental issues among priorities.

At the same time Children Environment School as a non-governmental organization to finance their projects enters competition for international funds. Daugavpils Pedagogical University runs special retraining seminars for teachers, whereas the organization Co-operation for Peace organize such seminars, both for teachers and pupils. A project "Air Pollution in Europe" is the one having the closest bearing to issues related to global climate change; 110 classes from a number of schools are involved, all activities are co-ordinated by the Ecological Centre of Latvian University.

International assistance

Possibilities of Latvia to support education on environmental issues from the state budget are constrained; the present level in environmental education is achieved by virtue of activities of informed part of general public, as well as owing to support of governmental and non-governmental organizations of Nordic countries and European Union. The support continues to grow, which can be regarded as a certain guaranty that knowledge, connected with issues of environment and global climate change, is going to be integrated into Latvian system of education.

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ABBREVIATIONS (TEKSTÂ LIETOTIE SAÎSINÂJUMI)

AREP	Atmospheric Research and Environment Programme
BALTEX	Baltic Sea Experiment
BALTMOD-IHMS	BALTMOD transfer to Integrated Hydrological Modelling System
BIM	Baltic Integrated Monitoring
CESAMS	Centre of Environment Science and Management Studies
CCB	Coalition for Clean Baltic(NGO)
CLICOM	Climate Computing
EMEP	Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Long-term Financing of the Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
ENRICH	European Network for Research in Global Change
EPPP	Environmental Protection Policy Plan
FCCC	Framework Convention on Climate Change
FEWE	Polish Foundation for Energy Efficiency
FOE	Friends of Earth
GAW	Global Atmospheric Watch
GDP	Gross domestic product
Geneva Convention	Convention on Long-range Transboundary Air Pollution
GHG	Greenhouse gases
GIS	Geographical Information Systems
HDP	Human Dimensions of Global Change Programme
HMA	Hydrometeorological Agency
IGBP	International Geosphere and Biosphere Programme
IM	Integral Monitoring
IPCC	Intergovernmental Panel on Climate Change
LSSR	Latvian Soviet Socialistic Republic
LU	University of Latvia
MEPaRD	Ministry of Environmental Protection and Regional Development
Master Plan	Programme of Energy Development
NGO	Nongovernmental organization
OECD	Organization of Economic Cooperation and Development

RTU	Riga Technical University
Sink	Any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas into the atmosphere
UNEP	United Nations Environment Programme
USSR	Union of Soviet Socialist Rebublics
VCP	Voluntary Co-operation Programme
WCRP	World Climate Research Programme
WMO	World Meteorological Organisation
WWF	World Wide Fund (NGO)

CHEMICAL SYMBOLS AND UNITS OF MEASUREMENT

Chemical symbols

C	carbon
CH4	methane
CO	carbon monooxide
CO2	carbon dioxide
N	nitrogen
N2O	nitrous oxide
NOx	nitrogen oxides
NMGOS	non-methane volatile organic compounds
O_3	ozone

Units of measurement

Gg	gigagram	(10^6 gram)
GJ	giga joule	(10^9 joule)
ha	hectar	(10^4 m^2)
kg	kilogram	(10^3 gram)
PJ	peta joule	(10^{15} joule)
Mtoe	megaton oil equivalent	

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Chapter 3, Appendix Table A.3.1. **Energy sector.** GHG emissions in Latvia in 1990 (Gg)

GHG source and sink categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1.All energy	22605.6	4.167	1.03	90.135	363.125	55.324
1.A. Fuel combustion	22605.6	2.368	1.03	90.135	363.125	55.315
1.A.1. Energy & transformation	8274.4	0.509	0.07	15.223	22.727	0.648
1.A.a Losses	34.5					
1.A.2. Industry	2680.4	0.059	0.014	3.362	0.939	0.099
1.A.3. Transport	5660.6	1.486	0.108	65.833	329.077	54.199
1.A.5. Residential	3140.3	0.184	0.029	2.711	4.414	0.179
1.A.6. Agriculture/forestry	1449.7	0.108	0.016	1.582	4.789	0.124
1.A.7. Other	1365.7	0.022	0.793	1.424	1.179	0.066
1.B. Fugitive fuel emissions		1.799				0.009

Chapter 3, Appendix Table A.3.2. **Energy sector.** CO_2 emissions from fuel combustion in 1990 (Gg)

	PJ	Emission factor $kgCO_2/GJ$	CO_2 Emissions (Gg)
1.A. Fuel combustion	344.77		22605.6
Fuel type			
Gasoline	42.30	68.61	2902.1
Diesel oil	55.26	73.33	4051.7
Residual fuel oil	63.35	76.60	4852.3
LPG	3.77	62.44	235.4
Other liquid fuel	26.60	72.60	1931.0
Coal	26.00	92.71	2410.4
Peat	4.20	103.86	436.2
Coke	0.42	106	44.5
Natural gas	102.87	55.82	5742.2
Wood	15.40	92.71	1427.7
Bunker	2.23	73.33	163.5
Jet fuel	2.37	70.80	167.8

Note: Emissions originating from combustion of wood, jet fuel during international flights and of bunker fuel are excluded from total CO_2 emissions and are not shown in Table A.3.1.

Chapter 3, Appendix Table A.3.3. **Energy sector.** Emission factors of fuels used for residential and agriculture, kg/GJ)

Types of fuel	CH_4	N_2O	NO_X	CO	NMVOC
Coal	0.0015	0.0014	0.113	0.0535	0.0048
Gas	0.0014	0.0001	0.067	0.017	0.0019
Oil	0.029	0.0006	0.161	0.015	0.0029
Peat & wood	0.002	0.002	0.2	1.5	0.025

Chapter 3, Appendix Table A.3.4. **CH_4 emissions in agriculture sector.** CH_4 emissions from enteric fermentation and animal waste in 1990 (Gg)

	Number of domestic animals	CH_4 emissions (Gg)		Emissions factors (kg/animals per annum)	
		A. Enteric fermentation	B. Animal waste	A. Enteric fermentation	B. Animal waste
4. Agriculture 4.A. Enteric fermentation 4.B. Animal waste Total	13362	97.964	13.310		
Type of domestic animals					
Cattle	1439	93.959	6.826		
Dairy	535	43.335	3.210	81.0	6
Other	904	50.624	3.616	56.0	4
Goats	5	0.025	0.001	5.0	0.12
Sheep	165	1.320	0.031	8.0	0.19
Pigs	1401	2.102	5.604	1.5	4
Horses	31	0.558	0.043	18.0	1.4
Poultry	10321		0.805		0.078

Chapter 3, Appendix Table A.3.5. **N_2O emissions from agriculture sector.** N_2O emissions from fertilizer in 1990 (Gg)

	Average consumption (Gg N year)	Average N_2O emissions (Gg)
4. Agriculture 4.C.Agricultural soils 4.C.1. Fertilizer Total	120.3	0.445
Type of fertilizer		
Ammonium nitrate	67.0	0.273
Urea	21.2	0.037
Ammonium sulfate	1.6	0.003
Aqua ammonia	3.2	0.082
Ammonium phosphate	19.2	0.036
Other complex	2.2	0.004
Other nitrogen	5.9	0.010

Chapter 3, Appendix Table A.3.6. **N_2O emissions in agriculture sector.** N_2O emissions from organic fertilizer in 1990 (Gg)

	Amount of fertilizers (Gg)	N_2O- N emissions (Gg)	N_2O emmision s(Gg)
4. Agriculture 4.C.Agricultural soils 4.C.2. Organic fertilizer Total	14400	0.576	0.905

Chapter 3, Appendix Table A.3.7. **Land use change and forestry.** CO_2 removals from forestry in 1990 (Gg)

Species	Mean age of species, years	Species covered area, 10^6 ha	Annual stem wood increment, m^3/ha, year	Annual whole-tree biomass increment, m^3/ha, year	Species wood density 1000kg/ m^3	Annual dry whole-tree biomass increment 1000kg/ha, year	Total dry whole-tree biomass increment in Latvia 10^6 1000kg/year	Total annual carbon sequestration Gg/year	Total atmospheric CO_2 sequestration Gg/year
1.Pine	55	1.048	5.0	8.0	0.48	3.84	4.024	2012	7 378
2.Spruce	39	0.554	7.6	12.16	0.41	4.99	2.762	1381	5 064
3.Birch	39	0.786	4.4	7.04	0.54	3.8	2.988	1494	5 478
4.Aspen	44	0.067	7.9	12.64	0.34	4.30	0.288	144	528
5.White alder	26	0.144	6.6	10.56	0.37	3.91	0.563	281	1 032
6.Black alder	42	0.063	3.9	6.24	0.37	2.31	0.145	73	267
7.Oak, ash	48	0.028	6.3	10.08	0.66	6.65	0.186	93	342
8.Shrub land		0.15		2.0	0.472	0.94	0.14	7	260
9.Small stands,parks, allies		0.02	5.5	8.8	0.472	4.15	0.08	4	150
10.New reforestration		0.09		2.0	0.472	0.94	0.08	4	150
Actual decrease in sequetration									(-20)
Total seques-tration									**20 580**
Calculated emissions from cut			(- 4.54) m. m^3	(- 7.2622)	0.472		(-3.428)	(- 1 7139)	(- 6 280)
Calculated net removals									**14 300**

Chapter 3, Appendix Table A.3.8. **CH_4 emissions from waste.** CH_4 emissions from municipal solid waste in 1990 (Gg)

	Total MSW (Gg)	MSW landfilled (Gg)	Emission factor ($kgCH_4$/kg of waste)	CH_4 emission (Gg)
6. Waste 6.A.Landfills Total	584.84	497.11	0.0875	43.50

ANNEX 4

Chapter 4, Appendix Table A.4.1. International agreements and activities Latvia accedes to

No	Title	Concise annotation
1	United Nations Framework Convention on Climate Change (FCCC) (1992)	reduction in GHG emission levels
2	Intergovernmental Panel on Climate Change (IPCC)	is engaged in scientific study of climatic change and its influence, devises an internationally co-ordinated activity programme
3	United Nations Environmental Programme\World Meteorological Organization (UNEP\WMO)	observation of atmospheric pollution
4	1979 Convention on Long-range Transboundary Air Pollution	international monitoring of air pollution; reduction of air pollution
5	Global Climate Observation System (GCOS)	exchange of information among member countries
6	EUROTAC	studies tropospheric movement and transformation of pollutants above Europe
7	Integral monitoring	international monitoring of environmental pollution
8	Global Atmospheric Watch (GAW)	co-ordinates monitoring programmes on ozone, atmospheric background pollution etc.
9	Helsinki Convention on Protection of Environment of the Baltic Sea (1974, 1992)	engaged in protection of environment of the Baltic Sea (1974); protection and improvement of environment of the Baltic Sea basin (1992)
10	London Convention on Preventive Protection against Pollution by Ships	marine environment protection against pollution by ships; regulation of ship design
11	Strasbourg Resolutions on Forest Protection (1990)	monitoring of forest ecosystems, protection of forest genetic resources, creating a database on forest fires, programme of physiological assessment of forest tree species, study of an ecosystem
12	Helsinki resolutions on forest protection (1993)	unexhausting management of the European forest, conservation of biological diversity, methodological assistance to developing countries, preparing forest ecosystem for eventual climate change
13	1986 Convention on Urgent Notification about Nuclear Accidents	determines the exchange of an information flow between International Agency of Nuclear Energy and Member Countries
14	1986 Convention on Assistance during nuclear accidents or radiation emergency	prescribes the order assistance is rendered among Member Countries during Nuclear Accident or Radiation Emergency
15	1992 Helsinki Convention on Transboundary Effects of Industrial Accidents	outlays necessary arrangements to prevent accidents and lessen consequences, as well as ensures exchange of information and sets order of rendering assistance

16	Agreement between Baltic countries "On parallel activities of Estonian, Latvian and Lithuanian Energy Systems"	Dispatch Centre "Baltija" is created to co-ordinate activities of Estonian, Latvian and Lithuanian Energy Systems
17	1989 Basel Convention on "the Control over theTransboundary Movements and of Hazardous waste and their Disposal",	determines toxic waste transportation procedures
18	Energy Charter	sets guidelines for energy efficiency programmes
19	Free Trade Agreement between EC and Latvia	regulates free flow of goods in accordance with international quotas

Chapter 4, Appendix Table A.4.2. Principal laws, resolutions or regulations adopted or drafted after the base year, which might influence GHG emissions

No.	Name	Concise annotation
General issues of environment protection		
1.	Law "On environment protection (1991)	Fundamental law on environment protection comprises principal rules and guidelines concerning the rights of the resident for appropriate quality of environment for living, availability of information about environmental conditions, the way many environmental issues are tackled, distribution of authority in environment protection as well as other issues.
2.	Law "On State Ecological Expertise" (1990)	Regulates procedures of performing state ecological expertise, its goals, objects and other principal rules
3.	Regulatory Act "On State inspection of environment protection of the Republic of Latvia" (1990)	Determines the status of a state inspector and a scope of competence, as well as regulates order of applying for licences permitting utilization of natural resources.
4.	Law "On Committee of Environment Protection of the Republic of Latvia" (1990).	Forms legal basis concerning rights and executive means of a number of environmental protection institutions
Sectorial issues and natural resources		
5.	Law "On natural resource tax" (1990).	By adopting this law, for the first time in Latvian history a special tax is imposed on pollution of environment and involvement of natural resources in economic turnover. Natural resources tax was one of the most influential economic instruments in environment protection, however, in virtue of rapid changes it fails to perform the fiscal function, due to devaluation of rates. A new law on natural resources tax is drafted in 1994, which shall enter into force in 1995.
6.	Resolution "On natural resources and pollution" (1990).	Objective - to reduce pollution and squandering of natural resources, raise funds for environment protection.
7.	Law "On hazardous waste" (1993).	Regulates order to be used in handling hazardous waste.

No.	Name	Concise annotation
8.	Law "On order of suspension of enterprises, institutions and organizations" (1991).	Prescribes the order to be used for suspension of activities of enterprises with regard to legislation infringements.
9.	Resolution "Dangerous types of environment pollution and maximum acceptable concentrations in water and sewage (1991).	Determines dangerous levels of water pollution, sets maximum acceptable concentration in overground water basins and sewage outflow sites for 36 substances.
10.	Law "On particularly preservable natural territories" (1993).	Specifies particularly preservable natural territories, outlays order of formation and protection etc.
11.	Law "On use and organization of land exploitation (1991) with amendments and supplements (1993)	Defines order of use and organization of land exploitation.
12.	Law "On management and utilization of forests" (1994)	Ensures protection of forest as an ecosystem, as well as renewal of forest resources, regulates principal rules of forest management.
13.	Law "On rational utilization and protection of land resources" (1994)	Prescribes rates of natural resource tax and fines for overproduction of resources.
14.	Regulations "On use of state forests"	Determines order of protection and use ecological values of state forests.
15.	Regulations "On forest typing and appropriation of particularly preservable forest sectors" (1994)	Specifies, that notwithstanding the form of property, forest management includes enhancement of ecological properties of the forest, protection against pests and diseases, provision of fire service and guarding against unauthorized utilization.
16.	Regulations "On road traffic" (1994)	Regulates traffic safety
17.	"State technical check-up rules for mechanical vehicles and trailers" (1994)	Regulates traffic safety
18.	Rules "On trucking" (1994).	Regulates traffic safety
19.	USSR State standards "Measuring techniques and standards of carbon oxide and hydrocarbon contents in exhaustion gases of vehicles with petrol engines" (1988)	Regulates acceptable pollution levels.
Administrative Code:		

No.	Name	Concise annotation
20.	Article 55. Infringement of protection regulations with respect to subsoil resources" (1992)	Regulates unauthorized production and overproduction of mineral wealth
21.	Article 58. Environment pollution and littering	On pollution of environment with sewage, chemical substances, industrial or communal waste.
22.	Article 76. On infringement of rules concerning transportation, storage or use of pesticides, growth stimulants, mineral fertilizers and other materials. (1994)	Punitive sanctions for infringement of rules of transportation, storage and use of pesticides, growth stimulants, mineral fertilizers or other materials.
Criminal Code:		
23.	Article 155\1 with amendments. Start-up of an enterprise without waste treatment facilities or with malfunctioning waste treatment facilities (1993)	Criminal liability for environmentally adverse actions.
24.	Article 225 with amendments. Pollution of water, soil and atmospheric air (1994).	Criminal liability for environmentally adverse actions
Draft Laws:		

No.	Name	Concise annotation
1.	"On natural resource tax" (replacement for Law of 1990).	This draft law contains several amendments, if compared to the previous, which can be divided into three groups: 1 - indexation of tax rates not bringing about aggravation of economic crisis. Rates will increase 3 to 5 times with respect to ones used previously. 2 - Introduction of new taxation objects. Within the context of climate changes it is worth mentioning fees, envisaged for consumption of hazardous goods and products. All energy resources (fuels, combustible materials) affecting ozone layer are included. Revenue shall be allocated to the Foundation of environment protection of Latvia and utilized as financial support for alternative energy projects, other programmes, as well as individual projects in a mixed way - by crediting and providing subsidies. 3 - Adoption of new regulating principles: tax credit principle shall be applied to companies, which implement environment protection measures; use of environment protection licences. This mechanism will be applied both, to specify and implement reduction of maximally acceptable pollution levels (national or regional quotas) in accordance with national strategy and also to restrict import or production of obnoxious materials (substances depleting an ozone layer, for instance). It is planned to organize licence market by using structures of the Environment Protection Foundation; further on it will be developed in the direction of free market of securities. The new NRT draft law is conceived as a package of tools, assuming in the same time, that its efficiency in mitigating environment pollution (including pollution types causing climatic changes) will be low. It is expected that the contribution of this tax to GDP will not exceed 0.5% in 1995, however in energy sector it might be as high as 4%.
2.	On energy sector	Comprehensive law on regulation of economic activities in energy sector.
3.	On subsoil resources	Interim order of utilization of subsoil resources.
4.	On conservation of species and biotopes	Prescribes utilization order of wild plants and animals, ensures protection of particularly protectable species and biotopes
5.	On chemical substances	Determines order to be used for stock-taking, performing safety precautions upon handling chemical substances; regulates import, production, storing, transportation etc.
6.	On protection of air	Comprehensive law on air protection in Latvia.
7.	On safety strips	Comprehensive law on safety strips of all types.
8.	On private farmsteads	Sets farm management principles, prescribes maximum land area to be owned by one owner.
9.	On regulation of entrepreneurial activities in energy sector	Regulates entrepreneurial activities in energy sector.

ANNEX 5

Chapter 5, Appendix Table A. 5.1. Scenario 1. GHG emissions in Latvia in 2000 (Gg)

GHG source and sink categories	CO2	CH4	N2O	NOx	CO	NMVOC
Total emissions and sinks	16179	110.75	1.35	48.83	264.37	36.62
1.All energy	16115	3.31	0.74	48.83	264.37	33.44
1.A. Fuel combustion	16115	2.12	0.74	48.83	264.37	33.44
1.A.1. Energy & transformations activities	7510	0.62	0.08	13.98	36.59	0.86
1.A.a Losses - transport & distribution	17					
1.A.2. Industry	1254	0.02	0.01	1.41	0.32	0.04
1.A.3. Transport	3962	1.16	0.05	27.59	205.64	32.07
1.A.5. Residential	1741	0.21	0.03	3.17	14.69	0.3
1.A.6. Agriculture/forestry	557	0.09	0.02	1.18	6.58	0.13
1.A.7. Other	1074	0.02	0.55	1.5	0.55	0.04
1.B. Fugitive fuel emission		1.19				
2. Industrial processes	64					
2.E.1. Cement production	64					
3. Solvent and other product use						3.18
3.A. Degreasing and dry cleaning						0.07
3.B. Chemical products manufacture /processing						0.21
3.C. Other						2.9
4. Agriculture		55.38	0.61			
4.A. Enteric fermentation		49.38				
4.B. Animal waste		6				
4.C. Agricultural soils			0.61			
5. Land use change and forestry	(-8940)					
5.C. Managed forests	(-8940)					
6. Waste		52. 06				
6.A. Landfills		52.06				

Chapter 5, Appendix Table A.5.2. Scenario 2. GHG emissions in Latvia in 2000 (Gg)

GHG source and sink categories	CO2	CH4	N2O	NOx	CO	NMVOC
Total emissions and sinks	16956	114,15	1.43	52.48	278.23	39.19
1.All energy	16885	3.44	0.76	52.48	278.23	35.69
1.A. Fuel combustion	16885	2.21	0.76	52.48	278.23	35.69
1.A.1. Energy & transformations activities	7775	0.63	0.09	14.43	36.65	0.87
1.A.a Losses - transport & distribution	17					
1.A.2. Industry	1395	0.02	0.01	1.57	0.36	0.05
1.A.3. Transport	4274	1.23	0.06	30.58	219.3	34.3
1.A.5. Residential	1757	0.21	0.03	3.18	14.69	0.3
1.A.6. Agriculture/forestry	588	0.1	0.02	1.21	6.68	0.13
1.A.7. Other	1079	0.02	0.55	1.51	0.55	0.04
1.B. Fugitive fuel emission		1.23				
2. Industrial processes	71					
2.E.1. Cement production	71					
3. Solvent and other product use						3.5
3.A. Degreasing and dry cleaning						0.08
3.B. Chemical products manufacture / processing						0.22

3.C. Other						3.2
4. Agriculture		58.65	0.67			
4.A. Enteric fermentation		52.23				
4.B. Animal waste		6.42				
4.C. Agricultural soils			0.67			
5. Land use change and forestry	(-8940)					
5.C. Managed forests	(-8940)					
6. Waste		52.06				
6.A. Landfills		52.06				

Chapter 5, Appendix Table A.5.3. Scenario 3. GHG emissions in Latvia in 2000 (Gg)

GHG source and sink categories	CO2	CH4	N2O	NOx	CO	NMVOC
Total emissions and sinks	18021	114.37	1.62	56.55	293.69	42
1.All energy	17935	3.66	0.81	56.55	293.69	38.08
1.A. Fuel combustion	17935	2.34	0.81	56.55	293.69	38.08
1.A.1. Energy & transformations activities	8040	0.64	0.09	14.89	36.71	0.88
1.A.a Losses - transport & distribution	19					
1.A.2. Industry	1696	0.03	0.01	1.91	0.44	0.06
1.A.3. Transport	4588	1.33	0.07	33.55	233.35	36.64
1.A.5. Residential	1757	0.21	0.03	3.18	14.69	0.3
1.A.6. Agriculture/forestry	696	0.11	0.02	1.43	7.91	0.15
1.A.7. Other	1139	0.02	0.59	1.59	0.59	0.05
1.B. Fugitive fuel emission		1.32				
2. Industrial processes	86					
2.E.1. Cement production	86					
3. Solvent and other product use						3.92
3.A. Degreasing and dry cleaning						0.08
3.B. Chemical products manufacture / processing						0.24
3.C. Other						3.6
4. Agriculture		58.65	0.81			
4.A. Enteric fermentation		52.23				
4.B. Animal waste		6.42				
4.C. Agricultural soils			0.81			
5. Land use change and forestry	(-8940)					
5.C. Managed forests	(-8940)					
6. Waste		52.06				
6.A. Landfills		52.06				

Chapter 5, Appendix Table A.5.4. **Energy sector.** Projection of CO_2 emissions from combustion of different types of fuel in 2000 (Gg)

	scenario 1		scenario 2		scenario 3	
	PJ	CO_2	PJ	CO_2	PJ	CO_2
1.A.Fuel combustion	231.10	16115.3	242.43	16885.4	257,62	17934.5
Fuel types						
Gasoline	37.40	2565.0	39.91	2738.1	42.96	2947.4
Disel oil	31.95	2342.9	34.91	2560.0	39.28	2880.4
Heavy fuel oil	48.78	3736.2	51.12	3915.2	54.11	4144.5
LPG liquefied gas	2.84	177.3	2.85	177.9	2.89	180.4
Other liquid fuel	10.00	726.0	10.00	726.0	10.00	726.0
Coal	21.02	1948.7	21.13	1958.7	21.69	2010.8
Peat	4.02	421.7	4.02	421.7	4.03	422.7
Coke	0.12	12.7	0.13	13.8	0.16	17.1
Natural gas	74.97	4184.8	78.36	4374.o	82.50	4605.2
Wood	33.42	3130.1	33.48	3157	34.29	3211.6
Bunker fuel	10.85	808.6	11.88	885.5	12.63	941.7

Note: Emissions from combustion of wood and bunker oil are excluded from total CO_2 emissions.

Chapter 5, Appendix Table A.5.5. **Land management and forestry** (CO_2 sink). Projection of CO_2 removals from forestry in 2000 (Gg)

5. Land management and forestry 5.C. Forestry	
CO_2 sequestration (Gg)	20600
Actual decrease in sequestration	(- 40)
Total CO_2 sequestration (Gg)	20560
Calculated CO_2 emissions from cut (Gg),	(- 11620)
- Fuelwood burned	3157
- Exported	4648
- Other	3815
Calculated net removals (Gg)	8940