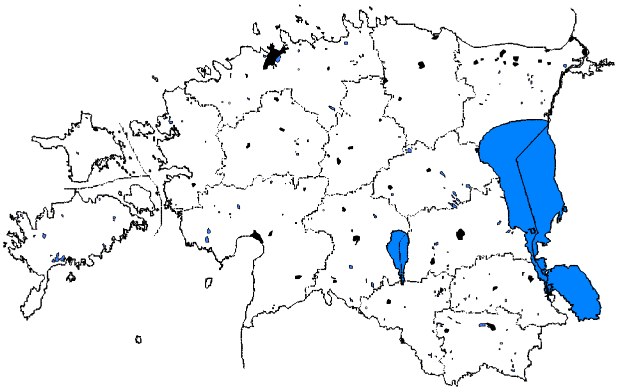
ESTONIA' S FIRST NATIONAL COMMUNICATION UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE



Ministry of Environment of the Republic of Estonia

Tallinn 1995

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FOREWORD

The independence of the Republic of Estonia was restored shortly before the United Nations Conference on Environment and Development in Rio de Janeiro took place. However, Estonia was among the signatories of the United Nations Framework Convention on Climate Change, demonstrating its concern about global environmental matters. Estonian Parliament ratified the Convention on 11 May 1994 and the Act on ratification of UNFCCC was declared by the President on 26 May 1994. The Convention entered into force for Estonia on 28 October 1994.

The first national communication represents the efforts of Estonia, as one of the Annex I Parties, to comply with the provisions laid down in Articles 4 and 12 of the Convention. Estonia has faced and is still facing the difficult transition from centrally planned to market economy together with basic changes in legislative, administrative, fiscal systems. Monitoring and statistics have also undergone notable modifications. This makes it difficult to present at this stage accurate GHG emission forecasts.

One can say that our communications to the Conferences of the Parties to the Convention will be developing together with the facilities necessary for the compilation of these reports. I would hereby like to thank the following ministries and institutions, which have contributed to the present communication:

Ministry of Agriculture,
Ministry of Economy, Department of Energy,
Ministry of Transport and Communication,
Ministry of Foreign Affairs,
Institute of Ecology,
Environment Information Center Ministry of Environment,
Ministry of Environment.

Vootele Hansen
Minister of Environment

INTRODUCTION

Basic information

Estonia is situated in north-western part of the flat East-Euoropean plain, remaining entirely within the drainage area of the Baltic Sea (Figure 1). The coastline length is 3,794 km. The country is located between 57.30 and 59.49 degrees of latitudes and 21.46 and 28.13 degrees of longitudes. The total area of Estonia is 45,215 km^2, of which 4,132 km^2 (9.2%) is made up of more than 1,500 islands and islets. 19,200 km^2 (42-43% of total land area) of the Estonian territory is made up of productive forest land. The Estonian forests belong to the zone of mixed and coniferous forests with relatively favourable growth conditions. Forests with conifers as dominant tree species make up 63% of the total area of the Estonian forests and 66% of the total forest yield; forests with deciduous trees as dominant species constitute 37% of the forested area and 34% of the forest yield. The peatland area is approximately 10,000 km^2, corresponding to 22% of the territory (partly coinciding with forest areas).

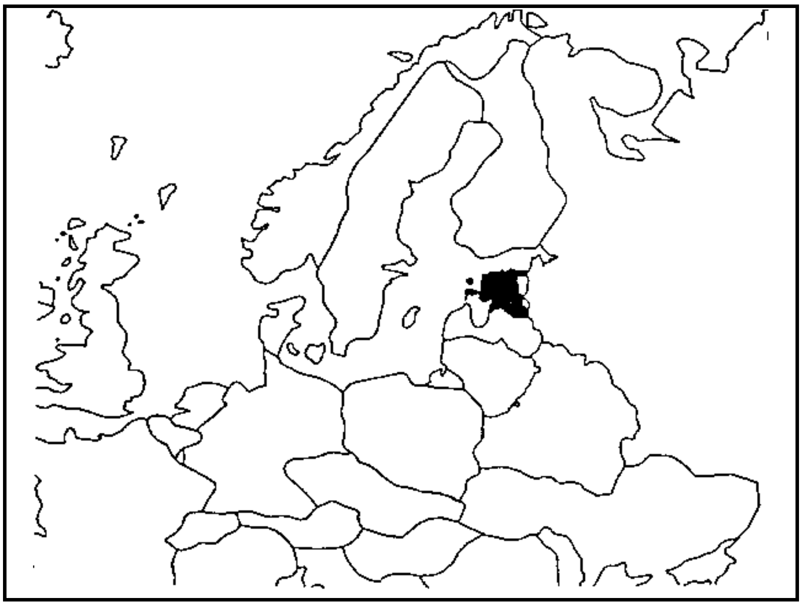


Figure 1. The situation of Estonia within the catchment area of the Baltic Sea

Estonia is characterised by a flat topography. The average elevation is 50 m, with the highest point being 318 m above sea level. The country can be divided into two regions;

Lower Estonia and Upper Estonia. Upper Estonia comprises the more elevated areas in the central and southern parts of country, which were not covered by the sea during the Holocene. The soils of Upper Estonia are more fertile and the rural population is denser than in Lower Estonia. Of the total population of the 1,574,955 persons (1990 census), 71.4 % live in urban areas. The population density is 35 persons/km^2. 51% of the population live in five largest cities (Tallinn 484,400, Tartu 115,400, Narva 82,300, Kohtla-Järve 76,800 and Pärnu 54,200).

Estonia belongs to Atlantic continental region of the temperate zone, which is characterized by rather warm summers and comparely mild winters. Since the annual amount of precipitations exeeds evaporation approximately twicely, the climate is excessively damp. The amount of solar radiation varies widely during the year. The length of summer day exceeds three times that of a winter day in northern Estonia. The height of the sun attains 55° at summers solstice and only 8° at winter solstice.

Although not very large in area, Estonia is relatively rich in natural resources, both mineral and biological, which have been and will be the basis of Estonian economy. The production and processing of mineral resources give a considerable share of the cross national product (Table 1.).

Table 1. Active deposits of Estonian mineral resources [Paalme, 1992].

Resource		
Oil shale	3,800	million tons
Phosphorite	260	million tons
Limestone, dolomite	300	million m^3
Sand, gravel	180	million m^3
Peat	560	million tons
Lake mud	120	million tons
Curative mud	4	million tons

Serious environmental problems are caused by the industrial use of these resources. One of the most important is connected with the excavation of oil shale, which is accompanied by a decline of ground water table, degradation of the quality of the fields and forests, as well as direct reduction of useful land due to the subsidence of soil and the deposition of waste. The area made useless by excavation and industrial activity is at least 450 km^2, which comprises about 1% of Estonian territory. The restoration of land for recreation or for the development of industry helps to reduce the negative side effects of the excavated areas. Waste materials of oil shale mining and processing cover thousands of hectares, there are waste heaps with relative heights exceeding 100m. Those terricones contain a number of compounds emitting or easily washed out with atmospheric precipitations.

The most important branch of industry in Estonia is energy. The total power yield of the Estonia and Baltic Thermal Power Plant is about 3,000 MW. About half of the energy produced in 1990 was exported to Russia and Latvia. Approximately 75% of pollutants (CO_2, SO_2, NO_x, fly-ash) is emitted by the Baltic and Estonian TPP, which rank among the ten biggest sources of air pollution in Europe.

The center of chemical industry is in the north-eastern part of Estonia, the biggest enterprises being the Kiviõli Oil Shale Chemical Plants and the Kohtla-Järve Oil Shale Processing Association. The chemical industry has been mainly developed on the basis of oil shale and other imported raw materials (natural gas, apatite) for the production of fuel oil, aromatic hydrocarbons, phenols, solvents, cosmetics and pesticides.

Estonian agriculture has specialized in livestock breeding of which cattle-breeding is most important. Loop production yields about one third of the gross agricultural product - as of 1 January 1990 the overwhelming majority of arable land belonged to collective and state farms. Sinc that the large farms began to break into private farms and now there are transitional period in full restructuring of agriculture.

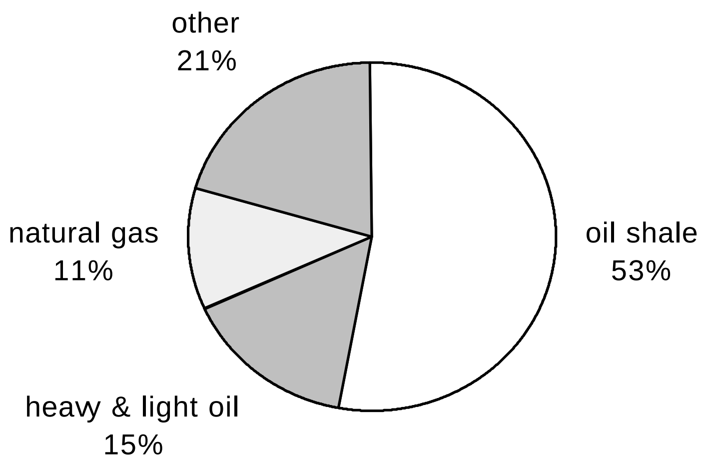
Energy and Industry

Estonia does not have any major source of fossil fuels search as oil, coal or natural gas, except deposits of oil shale and a substantial part of the fuel used thus must be imported. The Estonian's energy policy now is focused on reducing fuel imports and increase the efficiency of energy use.

Energy-related activities are the most significant contributor to Estonian greenhouse gas emissions. Emissions from fossil fuel combustion comprise the vast majority of these energy-related emissions with releases of CO_2 from fossil fuel combustion. Activities associated with the production, transmission, storage and distribution of fossil fuels also emit greenhouse gases. These are primary fugitive emissions from natural gas systems, oil shale oil production and oil shale mining. The main gas emitted through these activities is methane, while smaller quantities of NMVOCs, CO_2 and CO can also emitted. These gases represent a much smaller portion of total energy emissions than CO_2.

In 1990 Estonian energy system consumed in total 452000 TJ of fuel. Estonia satisfies most of its energy demand by using fossil fuels. In 1990 oil shale constituted 52,8 % of the energy balance (Figure 2.). The share of oil shale in the Estonian energy balance is high, because it is used as a fuel in four oil shale fired power plants. During oil shale combustion CO_2 is formed not only as a burning product of organic carbon, but also as a decomposition product of carbonate part. In years 1990 - 1993 electricity production has decreased considerably due to economical depression. It means decrease in oil shale consumption for electricity generation from 22,4 million tons in 1990 to 15 million tons in 1993. At the same time emission from transport is increased accordingly to the increasing number of transport vehicles. A lot of used old cars and lorries are imported from abroad. Therefore the total emissions from transport vehiclesshows continual increase tendency.

Figure 2. Fossil fuel forenergy production.



Basic trends in energy policy of the Republic of Estonia

Energy policy is proceeding from general economic policy of the state, intersts of consumers and energy companies ens environment requirements.

As objective is set forth to guarantee the needs of the state in fuel, heat and electric energy at minimum costs and expences, taking thereby in to consideration technical, economical and social conditions and environmental requirements.

Forestry

Usually the data of 1990, 1991 and 1992 years are used for estimation of carbon fluxes from the Estonian forestry. Current emissions of CO_2 from biomass left to decay are estimated over the previous decade (1980-1990). The tracking of soil carbon, as well as carbon in product pools, have also been included. Current releases of carbon from soils due to conversions are estimated over previous 25 years (1965-1990). Immediate release from the burning, delayed release from decay and long-term loss of soil carbon have been used as average datas over the period shown before and calculated per year.

The availability of data needed, their statistics and confidence in enterprises of the Estonian forestry have been satisfied. There is a consistent and arranged accounting in forestry. The data about fuelwood includes the figures of official fellings, not of private fellings in country side (percentage is insignificant). Therefore the datas about the wood used in the heating are a little suspicious.

In 1988 the Estonian forests consisted of premature and mature stands (17%), middle-aged stands (53%), and young stands (30%). In exploitable profitable spruce, pine and birch forests young stands are respectively 1-40, 1-40 and 1-20 years old, middle age 41-60, 41-80 and 21-50, premature and mature stands 61, 81 and 51 years old (Karoles *et al.*, 1994).

Despite the small area of the territory of Estonia, the forests growing here are rather diverse. The great variability brought about by natural conditions (parent material of soil, relief, climatical differences) is in its turn increased by the circumstance that the majority of the forests of Estonia have been affected by man’s activities in various degrees and ways (cutting, drainage, fires, etc.).

Agriculture

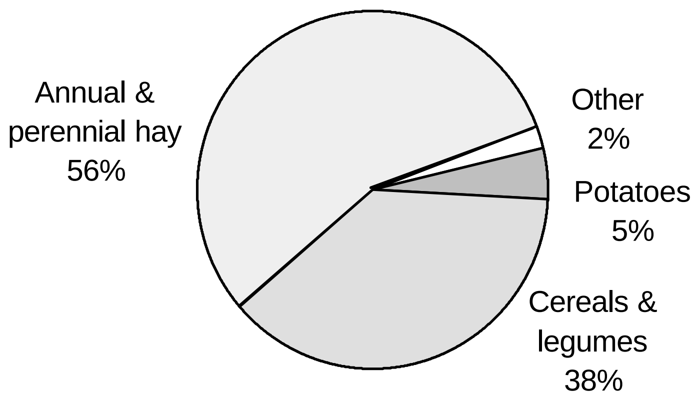
Territory of arable land in Estonia in 1991 was 1,130.000 hectares, the total sown area is 1,110,000 hectares.

Estonian agriculture has specialized in livestock breeding. Until the late 1980s, livestock breeding depended largely on the fodder imported from the other parts of the former USSR. In consequence, a large amount of milk and meat produced in Estonia was exported to the other parts of the Soviet Union. Our agriculture chiefly depended on functioning of collective farms and state farms at that time. Towards the end of the 1980s, the Soviet - time large farms began to break into smaller units, private farms and family farms were established or re-established.

In Estonia by January 1, 1991 there were 1,132,000 hectares of arable land i. e. 25% of the territory. At that time 312,000 hectares of natural grassland and 1,920,000 hectares of forest and woodland were in our country. (Tab. 2).

The total area of sown land was 1.11 million hectares in 1991. 55.9% of that were under annual and perennial hay; 37.5% - under cereals and 6.3% - under potatoes, fodder crops and vegetables. Industrial crops were grown on 3,011 hectares. (Fig. 3)

Figure 3. Use of sown area in Estonia



The total amount of mineral fertilizers used in collective farms and state farms was 195,200 tons, what included 69,800 tons of nitrogen fertilizers. Organic fertilizers were used on an average 7.0 tons per 1 hectare of sown land. To add the amount of fertilizers used in private farms approximately 125,200 tons of nitrogen was put into soil with fertilizers, from which 70% was nitrogen in form of mineral fertilizers.

The total yield of cereals and legumes formed 939.4 thousand tons, out of which the yield of barley covered 66.3%. By January 1, 1991 there were 757.7 thousand cattles, included 280.7 thousand cows in Estonia. At that time 959.9 thousand pigs, 139.0 thousand sheep and 8.6 thousand horses were there in the country.

This year 177.1 thousand tons of meat, 1092.8 thousand tons of milk and 559.7 million eggs were produced.

During the following years landstock of private farms due to farm reconstructions increased by 3.4 times.

At the same time the level of agricultural production in the whole country has decreased. It can be explained by economic factors. The cost of fertilizers, machinery, fuel has become higher, but the prices of agricultural products are relatively low. Therefore the profitability of agricultural production is low. The land legislation is not worked out as well. That is one of the most important obstacle in the development of agriculture.

Table 2. Landstock in Estonia.

Item	1991 1000 hectares	1992 1000 hectares	1993 1000 hectares
Total landstock	4522.6	4522.6	4522.6
arable land	1131.9	1131.9	1127.6
gardens	14.9	14.8	14.9
natural grassland	311.6	311.5	312.5
forest and woodland	1920.1	2015.6	2021.8
inland water	283.3	283.3	283.3
Agricultural producers	2538.3	2545.3	2549.1
arable land	1110.7	1111.0	1111.4
gardens	12.7	12.7	12.7
natural grassland	244.3	244.9	244.7
forest and woodland	712.4	814.7	817.9
inland water	55.1	55.3	55.4
Inc. in private farms	62.1	176.7	213.9
arable land	25.6	75.9	91.8
gardens	0.3	0.9	1.1
natural grassland	8.4	19.7	23.0
forest and woodland	18.5	56.9	70.5
inland water	1.1	3.2	3.8

INVENTORY OF THE GHG EMISSIONS AND REMOVALS BY SINKS

ENERGY AND INDUSTRY

Reference approach of carbon dioxide emissions

The amount of carbon in the fuel varies significantly by fuel type. The dry matter of Estonian oil-shale is considered to consist of three main parts: organic, sandy-clay and carbonate. During oil-shale combustion CO_2 is formed not only as a burning product of organic carbon, but also as a decomposition product of carbonate part. And therefore the total quantity of carbon dioxide increases up to 25 % in flue gases of oil shale. Carbon emission factors of fuels (CEF) used in Estonia are given in Table 3. These factors were used to for calculation of CO_2 emissions from energy sources.

Table 3. Carbon emission factors (CEF)

Fuel	CEF (tC/TJ)	Fuel	CEF (tC/TJ)
Primary fuels		**Primary fuels**	
LIQUID FOSSIL		SOLID FOSSIL	
Crude Oil	20.0	Anthracite	26.8
Natural Gas Liquids	17.2	Coking Coal	25.8
		Sub-Bituminous Coal	26.2
Secondary Fuels		Lignite	27.6
Gasoline	19.9	Peat	28.9
Jet Kerosene	19.5	Oil Shale *	29.1
Other Kerosene	19.6		
Gas/Diesel Oil	20.2	**Secondary Fuels/Products**	
Residual Fuel Oil	21.1	BKB & Patent Fuel	25.8
LPG	17.2	Coke	29.5
Ethane	16.8		
Bitumen	22.0		
Lubricants	20.0		
Petroleum Coke	27.5		
Refinery Feedstocks	20.0		
Other Oil	20.0		
GASEOUS FOSSIL		BIOMASS	
Natural Gas(Dry)	15.3	Solid Biomass	29.9

* Carbon emission factor of oil-shale is calculated at complete oxidation of organic carbon and at decomposition rate 0.90 of ash carbon part.

Table 4. CO_2 from energy sources. 1990 (Reference Approach)

Fuel Types	CO_2 Emissions Gg	
	Carbon Bases	Molecular Bases
Liquid Fossil Fuels	**2,651.9**	**9,717.7**
Natural Gas Liquids	26.1	95.6
Gasoline	460.5	1,688.6
Jet Kerosene	30.6	112.1
Other Kerosene	91.6	335.8
Diesel Oil	509.5	1,868.3
Heavy Fuel Oil	1,501.7	5,500.5
LPG	23.3	85.4
Other Oil	8.6	31.4
Solid Fossil Fuels	**6,707.8**	**24,597.7**
Oil-Shale	6,286.7	23,053.5
Coal	242.8	890.4
Peat	178.3	653.8
Gaseous Fossil (Natural gas)	**777.4**	**2,854.3**
Biomass (Wood)	**231.0**	**847.0**
TOTAL	**10,368.2**	**38,016.7**

Reference Approach of CO_2 emissions from energy sources are given in table 4. Estonia satisfies most of its energy demand by using fossil fuels. The major part of primary energy in Estonia is converted to electricity and heat or refined to the peat briquettes and oil shale oil. In energy sector the biggest part of CO_2 comes from oil shale. Total CO_2 emissions from fossil fuel consumption are 10,137.2 TMTCE (thousand metric tons of carbon eqvivalent).

Biomass fuel was used in form of fuelwood and wood waste. For 1990 CO_2 emissions from biomass consumption were 231.0 TMTCE. Fuelwood burned one year but regrown the next year only recycles carbon. As a result, carbon dioxide emissions from biomass have been estimated separately from fossil fuel-based emissions and are not included in national totals.

Carbon dioxide emissions from energy production

Approximately 68% of Estonian energy is produced through the combustion of oil shale. The remaining 22% comes from heavy fuel oil, natural gas or other energy sources such as coal, light fuel oil, LPG.

Oil shale across all sectors of the economy was responsible for about 76% of total Estonian energy related CO_2 emissions with heavy oil for 14%, natural gas 6%, and others 4%.

The energy conversion sector accounts 77% of Estonian emissions from fossil fuel consumption, making it the largest source of CO_2 emissions.

Sectional emissions of carbon dioxide were: industrial - 33%, transportation - 30%, residential - 19% and commercial - 18%.

Carbon dioxide emissions from industry

In the industrial sector the transformation of raw materials from one stage to another releases such greenhouse gases carbon dioxide. The production processes that emit CO_2 include cement production, lime production, limestone consumption. Total CO_2 emissions from these sources were approximately 171.1 MTMCE in 1990, accounting for 1.7 % of total emissions of carbon dioxide. Cement and lime production are main industrial processes of carbon dioxide emissions. Table 5 summaries Estonian emissions of carbon dioxide from all fossil fuel consumption and from industrial processes.

The combined electric power and heating stations being built in the cities shall either in municipal ownership, mixed joint stock companies or totally owned by foreign owners.

Table 5. Sources of CO_2 emissions: 1990.

Source	CO_2 Emissions (Gg)	
	Carbon Bases	Molecular Bases
Fossil fuel consumption	**10,137**	**37,170**
Energy conversion	7,759	28,450
Residential	450	1,650
Commercial	429	1,574
Industrial	776	2,845
Transport	723	2,651
Industrial processes	**171**	**627**
Cement production	127	468
Lime production	40	145
Limestone and oil shale ash consumption	4	14
TOTAL*	**10308**	**37797**

***** The totals provided here do not reflect emissions from bunker fuels used in international transport activities.

Methane emissions from fossil fuel production, transmission, storage and distribution

Emissions of greenhouse gases released as a result of energy production, transmission, storage, and distribution activities. These emissions are primary methane. This sector presents estimates of emissions from following source categories:

- Oil shale mining and handling, including emissions from underground mines, surface mines, and postmining activities;
- Oil shale oil production, venting, transmission, and storage;
- Natural gas systems, including transmission, and distribution.

Emissions from oil shale mining

In 1990 approximately one half of oil shale was mined from underground mines and the second half from surface mines. Total amount of methane emissions from oil shale mining and postmining is 179.4 Gg (± 20 %)

Methane emissions (Gg of CH_4) from oil shale mining and handling, from oil and gas activities are given in Table 6.

Table 6. Methane emissions from mining, oil and gas activities: 1990

Source Category	CH_4 Emissions Gg	CH_4 Emissions Gg
	Carbon Bases	Molecular Bases
Oil shale mining and handling:	**134.6**	**179.4**
Underground mines	126.3	168.4
Open pits	8.3	11.0
Oil and gas activities:	**29.0**	**38.7**
Oil	1.1	1.5
Gas	27.9	37.2
Wastes:	**170.3**	**227.1**
Landfills	160.4	213.9
Wastewaters	9.9	13.2
TOTAL	**333.9**	**445.2**

Emissions from oil shale oil production, oil transmission and storage

In 1990 in Estonia was produced approximately 15 PJ oil shale oil, was imported 134 PJ and exported 3.8 PJ fossil liquid fuels.

Methane emissions from oil production and processing were estimated by determining representative emissions from major activities.

These include:

- fugitive emissions and ventings in processing factories;
- oil storage facility emissions
- emissions from transmission and loading operations.

The emission data are given in Table 6.

Emissions from natural gas transmission and distribution

In 1990 was imported approximately 51 PJ of natural gas. Emissions are caused by system leaks, distributions, routine maintenance releases and leakages at consumers. For 1990 methane emissions from these activities were 37.2 Gg (see Table 6).

Emissions from waste

Landfills

Organic landfill materials such as yard waste, household garbage, food waste, and paper can decompose and produce methane. Methane production typically begins one or two years after waste placement in landfill and may last long time (over 50 years). Methane may be recovered for use as on energy source. Estonia has not detailed statistics on landfills waste. Waste landfills was estimated on bases of total population of Estonia. In 1990 methane emission from Estonian landfills were 213.9 Gg (Table 6).

Wastewater

Methane is produced when organic material in treated and untreated wastewater degrades anaerobically, i.e., without the presence of oxygen.

Methane emissions from municipal wastewater has calculated on bases of total population of Estonia. At this time, data are not sufficient to estimate methane emissions from industrial wastewater steams in Estonia. Preliminary methane emissions from industrial wastewater are calculated on bases of manufacture of machinery and products, chemicals, pulp and paper products, building materials and light industry.

In 1990 methane emissions from municipal and industrial wastewater are 13.2 Gg (see Table 6).

Other greenhouse gases

Other greenhouse gases (SO_2, CO, NO_x) from stationary sources are given in Table 7 on bases of dates from Estonian Institute of Metrology and Hydrology.

The emission estimates here were calculated using the IPCC *Draft Guidelines for National Greenhouse Gas Inventories Vol. 1-3* (IPCC/OECD, 1994).

Table 7. Other GHG (CO, NO_x, SO_2) emissions from stationary sources: 1991

Source	Emissions Gg		
	CO	NO_x	SO_2
Baltic Thermal Power Plant	-	6	90
Estonian Thermal Power Plant	4	6	59
Estonian Cement	0.7	1	6
Oil-Shale Chemistry Association	0.5	0.2	5
Iru Thermal Power Plant	-	0.6	11
Kohtla-Järve Thermal Power Plant	-	0.1	3.5
Kiviõli Plant of Oil-Shale Chemistry	0.1	-	1.5
Sillamäe Plant of Oil-Shale Chemistry	1.2	0.5	2
Tallinn Heating System	0.5	-	-
TOTAL	57	21	232

Other greenhouse gas emissions from mobile combustion

Mobile sources emit the greenhouse gases: methane, carbon monoxide, nitrogen oxides, and nonmethane volatile organic components. Emissions of these gases are produced by the incomplete combustion of the fossil fuels to power vehicles. Fossil fueled motor vehicles comprise the single largest source of CO emissions in Estonia. Road transport accounts for the majority of mobile source emissions.

CO emissions from mobile combustion are a function of the efficiency of combustion. CO emissions are highest when air-fuel mixtures have less oxygen than required for complete combustion. This occurs especially in idle, low speed and cold start conditions.

Emissions from mobile sources are estimated by major transport activity (passenger cars, buses, lorries, special vehicles, motorcycles, tractors, small excavators, diesel locomotives, air transport), where several major fuel types, including gasoline, diesel fuel, jet kerosene, natural gas liquids, other kerosene and LPG are considered. Road transport accounts for the majority of mobile source fuel consumption, and the majority of mobile source emissions. Table 8 summarises emissions from mobile sources.

The number of transport vehicles is increasing very quickly in Estonia. Among them a lot of used old cars and lorries are imported from abroad. Therefore emissions from mobile sources show continual increase tendency.

Table 8. Other GHG emissions from mobile combustion (1990).

Source	Emissions Estimates Gg			
	CO	NO_x	CH_4	NMVOC
Highway Vehicles	242	46	3	32
Other Mobile Sources	37	7	0.4	5
TOTAL	279	53	3.4	37

FORESTRY

Methods

There are large uncertainties in all current methods for estimating fluxes of CO_2 and other greenhouse gases from forestry and land use changes. Direct measurements of changes in carbon stocks are extremely difficult since one must confront the difficulty of determing small differences in large numbers as well as the heterogenity of terrestial systems. The simplified method for inventory of greenhouse gases fluxes from land use and forestry is recommended by IPCC Guidelines for National GHG Inventory Programme (Greenhouse Gas Inventory Workbook, Vol. 2). A more practical first order approach was to make simple assumptions about carbon stock changes and CO_2 flux .

The IPCC Guidelines contain default methodologies and some datas for the estimation of greenhouse gas emissions and removals. The methodology applied in present inventory does not differ from that recommended in the IPCC Guidelines. Average annual statistics on land use change and management activities are used. The assumptions and default datas (recommended by IPCC Guidelines) have been used when national assumption were not available.

Finally the fundamental bases for the methodology GHG-s inventory rests upon two linked themes:

1. the flux of CO_2 to or from the atmosphere are assumed to be equal to changes in carbon stocks in existing biomass and soils, and

2. changes in carbon stocks can be estimated by first establishing rates of change in land use and then applying simple assumptions about the biological response to a given land use.

Objectives

Objectives of the presented work was to evaluate the possible emissions or removals of greenhouse gases from or to Estonian forests as a result of human activity and policy of forestry.

Forests, which cover almost half of Estonian land , are an important terrestrial sink for carbon dioxide (CO_2). Because approximately half the dry mass of wood is carbon, as trees add mass to their stems, branches and roots, more carbon is accumulated and stored in the trees than is released to the atmosphere through respiration and decay. Soils and vegetative cover in forest also provide a potential sink for carbon emissions. When humans use and alter the functions of forest ecosystem through land use change and forest management activities, the natural balance of CO_2 and other GHG-s emissions and uptake may be disbalanced and their atmospheric concentrations adjust.

During the past half-century the area of forest stands has more than doubled (in 1935 - 20.2 %; in 1993 - 47.7 %) and will be increasing for the nearest future in Estonia. As a results of biological process (*e.g.* growth, mortality) and humans activities (*e.g.* harvesting, thinning, etc.) the carbon bilance in forest ecosystem have been changed, already if compared the situation in the past and will be change due to alterations in Estonian forestry in future.

The Estonian forest carbon flux presented in inventory estimates for 1990 ($\pm$ 2 years) and is based on a total accounting of biomass carbon stored in aboveground biomass of trees, soil carbon, as well as carbon in product pools.

The annual carbon flux from Estonian forest is estimated to have been a net sequestration of carbon from the atmosphere to the biosphere. The total removal of carbon to forest was accounted to be 3094.57 Gg, including 2476.63 Gg removal by trees and 617.94 Gg by soils.

Commercial harvest and management of various kinds make up a large majority of total forests biomass losses. Depending on the level of that, the annual rate of removals and emissions may be changed. Carbon annual emission rates from Estonian forest are estimated to have 926.27 Gg. The harvested timber and fuelwood effectively results in immediate carbon emission to about 769.64 Gg. Additional carbon flux from forest have been estimated the on-site burning of branches, barks and other wood wastes 9.51 Gg. By forest conversion some of the biomass remains on the ground (stumps) where it decays slowly and 9.22 Gg carbon is released to the atmosphere due to the decay. Rather high amount of carbon is released to the atmosphere from the forest soil (Table 9).

The bases calculations focus primarily forest conversation processes and abandonment of managed lands. In the calculation processes of CO_2 removals or emissions of forests have been taking into account alterations of areas and aboveground biomass changes due to management of forest. So, annual removal of CO_2 to Estonian forests was during the inventory year 11346.75 Gg. This figure includes 7438.27 Gg CO_2 due to accumulation by total growth increment of managed forests and 3908.48 Gg CO_2 due to accumulation by abandonment of managed lands over previous 20 years (Table 9).

In the processes of forest management a portion of wood may be removed from the conversion site and used as fuelwood or for products. This results 2791.03 Gg of CO_2 emission annually to the atmosphere. A portion may be burned on site or converted to slash and decayed to carbon dioxide step by step. The annual rate of soil CO_2 emission from forest conversions was estimated 508.75 Gg CO_2 (Table 9). Total CO_2 emission from forest ecosystem is 3396.32 Gg CO_2.

Taking into account emissions and removals of CO_2 in forest ecosystem the net CO_2 uptake by forest ecosystem in Estonia estimates 7950.43 Gg per year (Figure 5).

Table 9. Removals/emissions of carbon and CO_2 in forestry and land use change (1990).

Source		C (Gg)		CO_2 (Gg)	
		Removal	Emission	Removal	Emission
Forest management	Biomass growth increment	2028.6		7438.3	
	Harvest		769.6		2822.0
Forest conversion	On-site burning		9.5		34.9
	Decay		9.2		33.8
	Soil		138.8		508.7
Abandoned managed lands	Aboveground	448.0		1642.7	
	Soil	617.9		2265.8	
TOTAL		3094.5	927.1	11346.8	3399.4

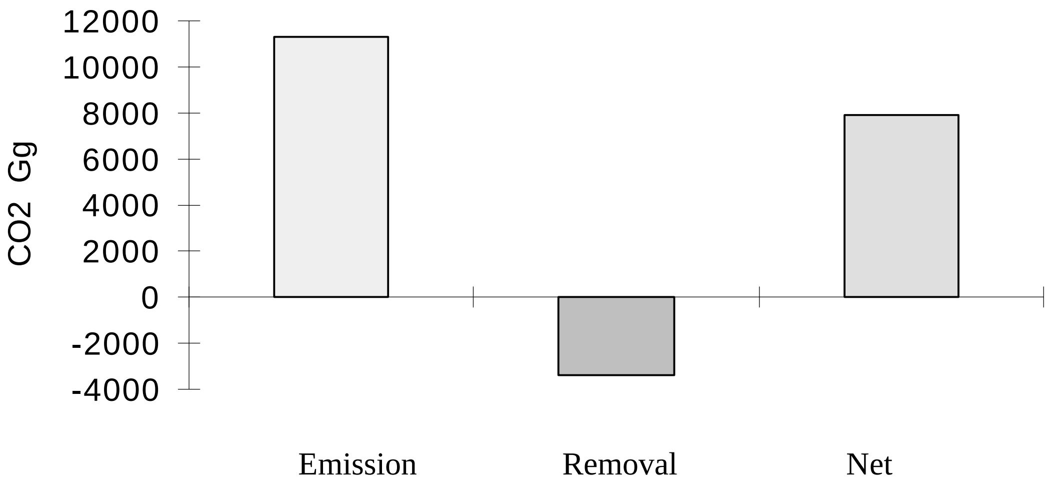


Figure 4. CO_2 emission and removal.

Forest management activities may also result in fluxes of other greenhouse and radiatively important gases balance in the atmosphere. Open burning associated with forest clearing or other land use change may be a cause to disbalance of non-CO_2 trace gases normal situation in atmosphere. In the figure 4 is shown that emission of CH_4, CO, N_2O and NO_x, emissions can take place in case of open burning associated with forest conversion. Gross emissions of non-CO_2 trace gases due to biomass burning may occur over immediate or delayed time frames.

However, the effects of forestry activities on fluxes of these gases are not finally understood and highly uncertain, the data calculated by using the methods recommended in IPCC Guidelines (1994) are presented for Estonia in table 10.

Although the level of emission from Estonian forest is not considerable, the data will be needed and interesting for comparison the changes in bilance of GHG-s inventory in future.

Table 10. The results of non-CO_2 GHG emissions in Estonian forests (Gg).

CH_4	CO	N_2O	NO_x
0.1521	1.3307	0.0010	0.0378

WETLANDS

Although the peatlands cover about 1 million ha or ca 22% of Estonian territory the peat accumulation as the main functional peculiarity characterizing the virgin state of the peatland is proceeding on much more limited areas. During the last decades our peatlands have been influenced importantly by amelioration activities mostly for agricultural and forestry purposes. Role of peat industry is considered to be somewhat lower.

The inventory aimed to assess the ecological state and values of peatlands is not did in Estonia up to date. Therefore we can't postulate how much of our peatlands and/or wetlands are in virgin state, what part is indirectly affected by the drainage or damaged otherwise than amelioration for agricultural, forestry or peat industry purposes.

The way to get some more realistic picture about the state of Estonian peatlands is to do the expert assessment.

According to official data there is drained for agricultural aims about 120 000 ha, for forestry purposes some 180 000 ha and for industry needs ca 38 000 ha of peatlands. The total value of about 340 000 ha of drained peatlands does not correspond to the actual area of drained or affected by amelioration peatlands for reasons described in following:

3. The data gives information about the area of amelioration systems established, but does not describe the territories bordering the systems which are affected by the activities. Also, there is not accounted with the outflow ditches and other compartments made outside the systems and widening the affected area in its way.
4. It is not accounted with bordering or surrounding ditches made around almost all peatlands during the decades, especially in fifties and sixties.
5. During the Soviet period many state and collective farms did different kind of amelioration activities outside any official plans. Result to that the most part of peatlands on thin peat layer were drained with the help of only few ditches cut through peatland and reaching the mineral ground below peat deposit.
6. Result of straightening of rivers and streams peatlands locating close to waterflows were drained but not accounted as drained areas.
7. In peat industry the areas bordering peat-fields and affected drastically by peat-cutting are also not taken into account.
8. It is not considered with the influence of oil shale industry on the state of peatlands distributing above the oil shale mines or damaged result to emission of calcium-rich dust from the oil shale industry.

The results of the expert assessment are given in the tables 11 and 12 for 1970 and 1990 respectively.

Most drastically are affected fens, swamps and floodplains of which about only 10% are still in virgin state. Less important is drainage influence to bogs. The anthropogenic effect on the state of lakes and marshes has consequenced in the falling down of the water level only in very exceptional cases.

Our data indicate that the peat accumulation in different peatland types is not varying largely and is between 1.5 and 1.9 t ha^{-1} y^{-1} [Ilomets, 1994]. Here the accounts are based on the mean value of 1.7 t ha^{-1} y^{-1}. In lakes the accumulation on organic sediments (gyttja) is differing importantly from 1 to 100 mg cm^{-2} y^{-1}, e.a. the mean value is taken as 10 mg cm^{-2} y^{-1} or 1 t ha^{-1} y^{-1} . If consider with 54% carbon content in the dry matter both in peat and lake gyttia then the mean accumulation of CO_2-C in the virgin peatlands is about 0.9 t ha^{-1} y^{-1} and in lakes ca 5.4 kg ha^{-1} y^{-1}.

Result to drainage of virgin peatlands the accumulation of organic matter has ceased and due to intensive decay processes the mineralization of the matter has started. For several decades the breakdown of peat deposit and peat losses processes on fenlands ameliorated for agricultural purposes is monitored in Estonia. It is shown that the mineralization of organic matter is about 15 to 20 tons per hectare per year during the first decade after the establishment of amelioration system [Tomberg, 1992]. Later it will be stabilisized and depending on the character of exploitation (crop field, grassland, pasture) may be between 5 and 15 tons per hectare per year. Possible mean level may be about 8 tons per hectare per year if consider with relative importance of different exploitation ways in Estonia. As it is shown in several studies the rate of mineralization of the peat on the bogs and swamps is quite probably on the same level as on fenlands.

Table 11. Area of virgin and affected by drainage wetlands: 1970

Wetland type	Virgin state, km^2	Affected by drainage, km^2 *	Total, km^2
Bogs	3000	800	3800
Fens	1892	2000	3892
Swamps	1125	500	1625
Marshes	50	-	50
Floodplains	350	530	880
Lakes	2070	-	2070
TOTAL	8487	3830	12,317

* drained areas plus areas influenced by drainage where peat accumulation is ceased

Table 12. Area of virgin and affected by drainage wetlands: 1990

Wetland type	Virgin state, km^2	Affected by drainage, km^2 *	Total, km^2
Bogs	2500	1300	3800
Fens	500	3392	3892
Swamps	110	1515	1625
Marshes	50	-	50
Floodplains	60	820	880
Lakes	2070	-	2070
TOTAL	5290	7027	12,317

* drained areas plus influenced by drainage areas where peat accumulation is ceased

Table 13. Carbon bases CO_2 and CH_4 accumulation and emission on Estonian wetlands: 1970.

Type of wetland	CO_2 -C accumulation, Gg	CO_2 -C emission, Gg	CH_4 emission on virgin wetlands, Gg	CH_4 emission on wetlands affected by drainage, Gg
Bogs *	270	344	0.4	0.9
Fens *	170	860	6.7	0.3
Swamps *	101	215	0.2	0.05
Marshes *	5	unknown	2.4	unknown
Floodplains*	32	48	2.9	0.08
Lakes **	1	unknown	24.4	unknown
TOTAL	549	1 467	36.8	0.52

* CO_2-C accumulation on virgin peatlands is approximately 0.9 t ha^{-1}, CO_2-C emission is calculated when the annual peat mineralization on drained peatlands is 4.3 t ha^{-1}

** annual C accumulation in Estonian lakes is taken equal to 324 kg ha^{-1}

Table 14. Carbon based CO_2 and CH_4 accumulation and emission on wetlands: 1990.

Type of wetland	CO_2 -C accumu-lation, Gg	CO_2 -C emission, Gg	CH_4-C emission on virgin wetlands, Gg	CH_4-C emiss-ion on affected wetlands, Gg
Bogs*	225	559	0.3	0.1
Fens*	45	1459	1.8	0.5
Swamps*	10	651	0.2	0.2
Marshes*	5	unknown	2.4	unknown
Floodplains*	5	353	0.5	0.1
Lakes**	67	unknown	24.2	unknown
TOTAL	357	3022	29.4	0.9

* CO_2 accumulation on virgin peatlands is approximately 0.9 t/ha, CO_2 emission is calculated when the annual peat erosion from drained peatlands is 4.3 t/ha.

** annual C accumulation in Estonian lakes is taken equal to 0.54 t/ha.

AGRICULTURE

Methods

IPCC methodology was strictly followed for the inventory [IPCC Guidelines, 1994; EPA, 1994]. We have got the reliable statistics about the use of fertilizers only for state farms, but not for the private ones. Per livestock unit 12 tons of manure was taken into account. As to commercial fertilizers we have presumed a private farm has used the fertilizers the same amount as that in a state farm, i. e. 79.3 kg N/ha [Statistical Yearbook, 1993].

Nitrous oxide emissions from commercial and organic fertilizers used in 1991 were estimated using the draft IPCC methodology.

$$N_2O \text{ Emissions} = \Sigma\,(F_{mn} + F_{on} + F_{bnf}) \times C \times 44 / 28$$

$$C_{low} = 0.0005$$

$$C_{median} = 0.0036$$

$$C_{high} = 0.0390$$

where:

F_{mn} = amount of mineral fertilizer applied (10^3 t N / yr)

F_{on} = amount of organic fertilizer applied (10^3 t N / yr)

Fb_{nf} = amount of biological N fixation applied (10^3 t N / yr)

CH_4 and N_2O emissions from agriculture

Main GHG sources in agriculture of Estonia are animal husbandry and use of fertilizers. According to IPCC methodology more attention is paid to CH_4 and N_2O emissions. Emissions from burning straw and other plant residues are not calculated in the present inventory as the statistical data is not available. In our conditions the burning of plant residues is not very essential from GHG emission point of view.

Table 15. CH_4 emissions from enteric fermentation.

Animal type	Enteric fermentation emission factors kg CH_4/head/yr	1991 Population head	CH_4 Emissions Gg/yr	1992 Population head	CH_4 Emissions Gg/yr	1993 Population head	CH_4 Emissions Gg/yr	Average CH_4 Emission Gg/yr	%
Cows	81	280700	22.7	264300	21.4	253400	20.5	21.6	45.0
Cattle	56	477000	26.7	444000	24.9	361200	20.3	23.9	50.0
Sheep	8	139000	1.1	141900	1.1	123100	1.0	1.1	2.3
Horses	18	8600	0.2	7800	0.1	6600	0.1	0.1	0.3
Swine	1.5	959900	1.5	798600	1.2	541100	0.8	1.2	2.4
Total CH_4 emissions			52.2		48.7		42.7	47.9	100

Table 16. CH_4 emissions from livestock manure management.

Animal type	Manure Management Emission Factors kg CH_4 / head/yr	1991 population head	CH_4 emission s Gg/yr	1992 population head	CH_4 emissions Gg/yr	1993 population head	CH_4 emission s Gg/yr	Average CH_4 emissions Gg/yr	%
Cows	6	280700	1.7	264300	1.6	253400	1.5	1.40	23.4
Cattle	4	477000	1.9	444000	1.8	361200	1.4	1.70	25.1
Sheep	0.19	139000	0.0	141900	0.0	123100	0.0	0.03	0.4
Horses	1.4	8600	0.0	7800	0.0	6600	0.0	0.01	0.2
Swine	4	959900	3.9	798600	3.2	541100	2.2	3.07	45.0
Poultry	0.078	6536400	0.5	5538300	0.4	3418100	0.3	0.40	5.9
Total CH_4 Emissions			8.0		7.0		5.4	6.81	100

Table 17. Total CH_4 Emissions from enteric fermentation and livestock manure management

Animal type	1991	1992	1993	Average	%
	CH_4 Emissions Gg/yr				
Cows	24.4	23.0	22.0	23.1	42.3
Cattle	28.6	26.6	21.7	25.6	46.9
Sheep	1.1	1.2	1.0	1.1	2.0
Goats	0.0	0.0	0.0	0.0	0.0
Horses	0.2	0.2	0.1	0.2	0.4
Swine	5.3	4.4	3.0	4.2	7.7
Poultry	0.5	0.4	0.3	0.4	0.7
Total CH_4 Emissions	60.1	55.8	48.1	54.6	100

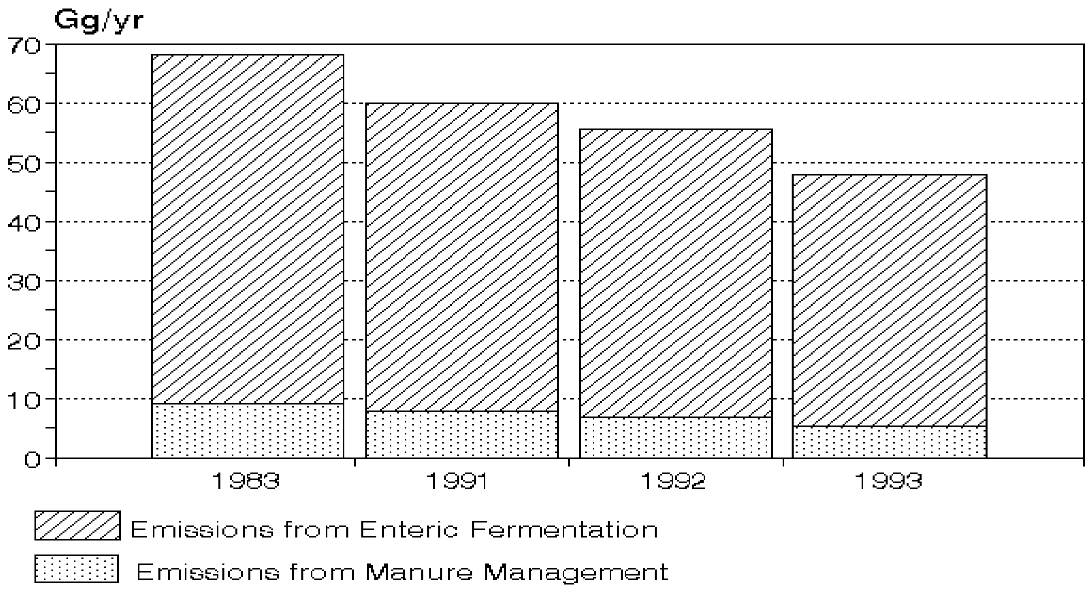


Figure 3.METHANE EMISSION FROM ENTERIC FERMENTATION AND LIVESTOCK MANURE MANAGEMENT

The total amount of methane emission from livestock in 1991 was 60.1 Gg, out of which the most part was enteric fermentation factors. CH_4 emissions from manure management formed 13%. (Tab. 15, 16, 17. Fig. 6) From the total CH_4 emission 88% comes from cattle, 8.8% - from swine. As the population of livestock had decreased during the next two years (1992, 1993) the methane emissions had decreased by 20% as well. During the last 10 years the methane emission has decreased by 1.4 times. In 1983 methane emission from enteric fermentation and livestock manure management formed 68.2 Gg, but in 1993 it was only 48.1 Gg.

In 1991 the amount of nitrogen from the mineral fertilizers used was 88368 tons. That forms 79.3 kg nitrogen per hectare. The manure applied to the soil consisted 36818 tons of nitrogen. If we take into account the total amount applied to the soil, the total N_2O - N emission for different levels was the following:

1 low level (C_{low} = 0.0005) - 98.4 t N_2O - N

2 median level (C_{median} - 0.0036) - 707.2 t N_2O - N

3 high level (C_{high} - 0.039) - 7672.1 t N_2O - N

That would make accordingly 88, 635 and 6885 g N_2O - N per hectare of arable land. If we consider the other sources of nitrogen which by the scientists of Research Institute of Agriculture[Kanger, 1994], it would from 31 kg N/ha , N_2O - N emission would reach the level of 113, 810 and 8782 g , N_2O - N/ha. Hence the total N_2O - N emission, depending on the emission coefficient, would be accordingly 126.0, 905.2 and 9820.3 tons N_2O - N per year. During the last years compared with the years 1985 - 1987 [Kanger, 1994] the amount of mineral fertilizers has decreased 2-5 times and manure use more than 2 times accordingly. So the total nitrous oxide emission has decreased 2.5 times as well.

CONCLUSIONS

Preliminary results for GHG budget in Estonia in 1990 are given in Table 18:

Table 18. Preliminary results for GHG budget in Estonia 1990.

Source	Emissions, removals (Gg)				
	CO_2	CH_4	CO	NO_x	N_2O
Industry, energy, transport	39841	451	293	152,5	5,20
Agriculture	150	60	NE	NE	0,95
Forestry, land use change	-7950	0.2	1.3	0.04	0.001
Wetlands	9772	40	NE	NE	NE
TOTAL	39622	551	294	152,5	6,11

NE - not estimated

In industry the emission of GHG decreased from 1990 to 1994 about 1/3. In energy the emissions will decrease when oil shale using TPPs will be modernized and efficiency of the boilers and flue gas cleaning equipment will increase (Moetus, 1993, State Energy Dep., 1992, Statistical Office 1993; Taehtinen, 1992).

The emissions from transport are stabilizing and tendency for purchasing newer cars is occurring. The taxes to old cars are higher and average salary is continuously increasing. It will led to increase of GHG emissions from transport.

CO_2 budget in case of trees in boreal zone is always positive, it means that more carbon is accumulated than emitted during the respiration and decay. Forest management and industrial use of forest might led to the essential changes in the GHG budget.

In agriculture the emissions are stabilized, the use of fertilizers is considerably decreased when compared to 1990.

In wetlands the amelioration activities have been reduced, but new problems arise in connection with land privatisation. Some projects have been started to solve these problems and design laws and taxes to protect wetlands.

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POLICIES AND MEASURES

STRATEGIC TASKS

TRANSFER TO ECONOMICALLY GROUNDED ENERGYSAVING AND LESS ENERGY-CONSUMING PRODUCTION IN THE COUNTRY AS A WHOLE.

Objective: decreasing consumption and losses of fuel & energy.
Immediate tasks are set forth in the Energysaving program of the Republic of Estonia.

DECREASING THE SHARE OF IMPORTED FUELS IN THE FUEL BALANCE

Objective: to increase the importance of domestic fuels
It is projected to increase the share of domestic fuels in the fuel balance four times to 1997 compared with 1993 and to guarantee that as a fuel for heat production is used at least 12% of wood and peat .

WORKING OUT A STATE INVESTMENT, PRICING-AND TAXATION POLICY

Objective: regulation & aiding operation and development of the state energy system.

WORKING OUT ENERGY-RELATED LEGISLATION

Objective: To define the rights and obligations of the state, energy companies and consumers.

CREATION OF THE SYSTEM OF ELECTROTECHNICAL STANDARDIZATION AND WORKING OUT NORM DOCUMENTS.

Objective: guaranteeing the security and convenience of electrotechnical products sold in Estonia and possible market for domestically manufactured products.

REDUCING ENVIRONMENTAL DAMAGES.

Objective: Avoiding increasing damages to the environment and keeping to internationally accepted environmental standards.

PREPARATION OF SPECIALISTS, EDUCATION AND TRAINING.

Objective: to secure Estonian energy system with a skilled personnel.

PROVIDING FOR THE SECURITY OF FUEL AND ENERGY PRODUCTION, TRANSPORTATION AND UTILIZATION.

Objective: to improve the safety at work, and making using of the facilities simpler.

THE BASIC RESEARCH IN ENERGETIC

Objective: to develop areas of research in which Estonia has a certain potential, to export the results of scientific studies and to develop cooperation with leading scientific research institutions and high schools in the world.

IMPLEMENTATION OF APPLIED RESEARCH AND EXCHANGE OF INFORMATION

Objective: optimizing the energy system and its parts and providing optimized development.

DEVELOPING ALTERNATIVE ENERGY RESOURCES

Objective: to mitigate the energy balance on islands and separate farmsteads and improve enterpreneurship.

PROJECTS OF MODERNIZING ELECTRICAL POWER STATIONS

Objective: reasonable prolongation of the working age of power stations.

INTERNATIONAL COOPERATION IN PROCURING FUEL AND ENERGY PRODUCTION

Objective: broadening the fuel and energy market, reducing production costs and joint investments.

DIVERSIFYING THE FORMS OF OWNERSHIP AND ENTERPRENEURSHIP

Objective: creating owner, finding rational corporate forms, facilitate privatization, improving investments.

TACTICS

IMPLEMENTATION OF THE NATIONAL ENERGYSAVING PROGRAMME

1.1. Creating possibilities for getting credits

1.2. Creating direct economic stimulus for energysaving

1.3. The state investments for putting in to order heating systems

1.4. Introducing a system of decreasing subsidies for producer

1.5. Providing consumers with concrete recommendations for energysaving and instructions for saving in households.

1.6. Application of international experience

1.7. Making conscious energysaving propaganda

DECREASING IMPORTED FUELS IN THE FUEL BALANCE

2.1. To finish tests of the peat boiler
2.2. Consumer-oriented recommendations for remaking boiler equipment
2.3. Finishing the working out of contemporary oil-shale incineration technology
2.4. To make up the fuel balances for the Counties providing for a larger share of local fuels.
2.5. To review the existing experience of producing peat regarding technology and machinery
2.6. Preserving the current level of oil-shale production
2.7. Priority development of the companies involved in remaking and maintaining boilers
2.8. Providing credits for domestic industry.

WORKING OUT THE STATE INVESTMENT-,PRICING-AND TAXATION POLICY

3.1. Determining the minimum size investments in to state- owned companies providing the technical level of facilities and technology should not further worsen . Minimum investments for electric power stations and mining shall be determined.
3.2. Creating tax facility for companies working on local fuels.
3.3. Analysing the importance of costs for energy component in different products, comparing it with the same in developed countries.
3.4. Authority for establishing the price should be brought as close to the consumer as possible.
3.5. Joint conferences of manufacturers and consumers shall be turned in to regular events
3.6. Producers shall have to present the forecast of the rate for electricity for a next 5-year period.
3.7. For enlargement of electric energy market the producers are recommended to advertise possibilities and advantages of electric heating.

WORKING OUT ENERGY-RELATED LEGISLATION

4.1. The list of necessary legal acts shall be clarified and harmonized.

4.2. A working system should be created providing for drafting the laws and their approval by the State Assembly

4.3. Cooperation between the Baltic States in drafting the legislation

4.4. To finish the draft laws on electricity and energy and bring them to the State Assembly

STANDARDIZATION OF ELECTROTECHNICAL PRODUCTION

5.1. Establishing standardization of electrotechnical production

5.2. List of the immediately needed standards shall be specified together with possibilities of their procurement from international bodies of standardization

5 3. List of immediately needed instructions, regulations shall be specified and their drafting organized

5.4. Review of former all-union norm documents and adapting them to Estonian conditions.

REDUCING ENVIRONMENT DAMAGES

6.1. Accepting international environmental norm documents and joining to international environmental agreements.

6.2. Damages to the environment in the region of Ida-Virumaa oil-shale power generating plants shall be mapped and analysed.

6.3. Proceeding from influence to the environment a "Chamber" or "Whole" excavating technology shall be chosen.

6.4. Making prospect plans for recultivating and protecting of subsoil water in areas of worked out quarries.

PREPARATION OF SPECIALISTS, EDUCATION AND TRAINING

7.1. Establishing professional associations.

7.2. Working out and enacting order of getting engineering profession.

7.3. Additional training of engineers shall be concentrated at Tallinn Technical University and professional societies.

7.4. Creating a particular system of competitions and special premiums for propagating this profession.

7.5. Creating a data base of young professionals with outlook

7.6. Regular training of the managers reserve.

7.7. Preparing training programmes together with companies and high schools of the neighbouring countries.

7.8. Exchange of experts and students between Estonia and developed countries.

PROVIDING FOR THE SECURITY OF FUEL AND ENERGY PRODUCTION, TRANSPORTATION AND UTILIZATION

8.1. Preparing the electrical energy safety rules

8.2. Preparing the rules for labour safety

8.3. Carring out expertise of imported electricity consuming goods before selling them on Estonian market.

8.4. Establishing expertise of electric goods, made in Estonia.

8.5. Enacting by law an obligatory checking of electrical installations in the buildings, where many people are gathering

8.6. Establishing the electrical control centre.

8.7. Providing safety training while concluding labour contracts.

CARRYING OUT SCIENTIFIC RESEARCH AND EXCHANGE OF INFORMATION

9.1. Most perspective subjects of scientific research shall be decided and cooperation developed with worlds' leading universities and research institutions.

9.2. Existing scientific potential and research shall be systematized.

9.3. Special purpose energy programmes shall be drawn up.

9.4. Drawing up a special purpose programme for consulting company of the Baltic states on systems of electroenergetics.

9.5. Drawing up scientific research programmes for the companies.

DEVELOPING ALTERNATIVE ENERGY RESOURCES

10.1. Evaluation of the potential wind- and hydroenergy of rivers.

10.2. Supporting enterpreneurship in rehabilitation of old hydraulic power stations, getting the loan facilities.

10.3. Implementation of the pilot project on the island of Ruhnu where the wind-driven generator and Diesel engine driven generator will operate in tandem.

10.4. Feasibility study of the garbage incineration plant and alternative bio gas generation plant

ON A BASIS OF A PILOT PROJECT IN TALLINN.

We consider as alternative energetics the hydro energy, wind energy and bio gas.

Cultivating the willow shoots and following mechanical harvesting is still not perspective.

Alternative energy companies are based on either private capital or on direct foreign aid based pilot projects.

PROJECTS OF MODERNIZING ELECTRICAL POWER STATIONS

11.1. A realistic final working terms schedules of the power blocks of the electric power stations shall be drawn up.

11.2. Building and testing a test boiler.

11.3. In consideration of the reduced output the possible conservation of the facilities of the power station

11.4. Optimum distribution of loads on transmission lines regarding reduced loads.

11.5. Market studies of electric power in the neighbouring countries.

11.6. Programme of activities for the Balti and Eesti electric power stations.

INTERNATIONAL COOPERATION IN PROCURING FUEL AND ENERGY PRODUCTION

12.1. Drawing up a joint Master Plan of energetics for Baltic states.

12.2. The extent of Estonian participation in renovation of Lithuanian oil refinery and building of oil terminal.

12.3. Extent of Estonian participation in putting in to order of the Latvian gas capacity.

12.4. The extent of participation of Latvia and Lithuania in formation of Estonian Power stations.

12.5. Looking for possibilities of selling Lithuanian top energy.

12.6. Joint activities with the Russian Federation regarding possible sales of electric power to

Finland via Viipuri.

12.7. Harmonized activity in building Latvian and Lithuanian oil terminals at the ports.

12.8. Joint interest of the Baltic States in constructing some complex electric power transmission lines around the Baltics (Baltic circle) and in gas pipeline.

12.9. Establishing international energy committee.

12.10. Joining international organizations.

12.11. Joint training programmes for specialists of the Baltic states.

12.12. Baltic States dispatcher control centre becoming economically independent entity.

12.13. Joint application of the Baltic states regarding joining "Nordel" as observer member.

DIVERSIFYING THE FORMS OF OWNERSHIP AND ENTERPRENEURSHIP

13.1. Analysis of operations of the currently state-owned enterprises.

13.2. Concrete development programme for every company up to year 2000.

13.3. Through administrative councils the share of the state in the management of the companies shall be determined.

13.4. Economical pre-requisites of springing up local energy companies. Production and transportation of the electric power will remain state owned.

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